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An Integrating Framework through the Extension of the UTAUT2 Model for Online Banking: A Context from a Two-Staged Approach with PLS-SEM and Fuzzy Z-AHP

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This study aims to develop a conceptual model for online banking by identifying key factors influencing its acceptance and use. In light of the complexities of online banking and the challenges posed by the COVID-19 pandemic, the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model was extended with three additional constructs: customer service, perceived security, and fear of COVID-19. The proposed framework combines the UTAUT2 model with a hybrid methodology that integrates PLS-SEM and Fuzzy Z-AHP. The study first tested the model's hypotheses using PLS-SEM, and the results were used to construct a decision matrix for Fuzzy Z-AHP analysis. Data were collected from 346 online banking customers in Albania, revealing that habit is the most influential factor in online banking adoption. This research makes significant contributions across theoretical, managerial, and methodological domains. Theoretically, it enriches the UTAUT2 model by incorporating new constructs, enhancing its applicability. From a managerial perspective, the findings highlight critical factors shaping customer decisions, offering actionable insights for practitioners. Methodologically, the study introduces a sequential multi-method research approach by integrating PLS-SEM and Fuzzy Z-AHP.

Keywords: *Online Banking; PLS-SEM; Fuzzy Z-AHP; UTAUT2; Constructs.*

Introduction

In the last decade, an increasing trend of online payments compared to cash payments has been noticed in many economically developed countries (Caddy *et al.*, 2020). In the online payment field, online banking has played an important and central part (Lee, 2009). Online banking is a banking channel that let customers to do a wide range of financial and non-financial activities (Aboobucker & Bao, 2018). Customers, instead of generating transactions in the traditional way (face to face), cooperate interactively with the bank with the help of electronic devices and internet web applications. Banks and their customers have different benefits from online banking such as speed of processing transactions and personalised services (Abdulfattah, 2012).

With online banking, several transactions can be carried out electronically, namely, paying bills, transferring funds, checking the balance of the account, etc. In addition, online banking has affected online payments in such areas as online shopping, online auction, and internet stock trading. Covid-19 has had an impact on people's behaviour. One of the consequences is that people have acquired new habits. The society became limited in social interactions, and one of the results is the non-use of ATMs due to the fear of the spread of the virus (Minguez *et al.*, 2020). Online payments became the solution.

During the pandemic, electronic cashless transactions in the form of online payments increased significantly in various platforms such as online banking and cloud-based electronic money applications (Musyaffi *et al.*, 2021). In order to explain the factors that influence the use of online banking, some theories were developed that made predictions in the adoption and use of a new technology. A review and combination of eight models of technology usage—including the Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), hybrid model TAM–TPB, Motivational Model (MM), Theory of Planned Behaviour (TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive

Theory (SCT)—led to the development of the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). The UTAUT model includes the constructs of performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), behavioural intention (BI), and use behaviour (UB). The UTAUT model was expanded with some new factors and was named UTAUT2. In the UTAUT2 model, 3 new constructs were added, namely, hedonic motivation (HM), price value (PV) and habit (HT) (Venkatesh et al., 2012).

The study aims to understand the acceptance of online banking in Albania in a broader and integrative way. It means that the expansion of the UTAUT2 model has been carried out by combining the factors of customer service (CS), perceived security (PS) and the fear of the Covid-19 (FFC). Firstly, the partial least square-structural equation modelling (PLS-SEM) is used to estimate which of the constructs of UTAUT2 model affects better the behavioural intention to use online banking. All the results obtained from the PLS-SEM model are used to construct the decision matrix for the Fuzzy Z-AHP method. This approach eliminates the need for the decision-maker to perform pairwise comparisons manually for the structured decision problem, streamlining the decision-making process. Thomas Saaty (Saaty, 1989) introduced AHP to solve complex decision-making problems as part of multi-criteria decision making (MCDM), but to agree with the uncertainty, AHP is extended with fuzzy logic as Fuzzy Z-AHP according to Zadeh (Lotfi A. Zadeh, 2011) fuzzy sets. Therefore, this study proposes this integrated framework of the two approaches - PLS-SEM and Fuzzy Z-AHP - to evaluate which of the constructs of UTAUT2 extended model impacts the behavioural intention of using the online banking platform. To the best of our knowledge, no previous study has dealt with such a comprehensive model which shows the predictors of acceptance and use of online banking in Albania. Moreover, due to Covid-19, the integration of the fear factor from the Covid-19 was not taken into consideration in the studies related to Albania.

The purposes of this study are as follows: i) to present a new approach through an extended UTAUT2 model to explore the factors that explain the use and acceptance of online banking in Albania. More specifically, the integration of three new factors, which are respectively FFC, PS, CS. ii) to highlight a two-staged approach with the combination of the PLS- SEM results to orient better the construction of the decision matrix for initializing the Fuzzy Z-AHP method. The integrated framework of the study is shown in Figure 1.

Literature Review

Given the widespread use of online banking today, studying the factors influencing the acceptance of this platform is of significant interest. The UTAUT2 theory provides a comprehensive explanation for the adoption and use of new technologies, particularly in terms of behavioural intention. PLS-SEM modelling facilitates the development of complex models without requiring strict distributional assumptions. Additionally, decision-makers employ various advanced mathematical methods to construct the decision matrix, which serves as the foundation for initializing the Fuzzy Z-AHP method.

Several previous studies have used the results of PLS-SEM as the main input to perform the Fuzzy Z-AHP (Qendraj *et al.*, 2021; Xhafaj, Qendraj, Xhafaj& Gjikaj, 2021). The Fuzzy Z-AHP belongs to a class of soft computing methods (MCDM), where complex decisions have been made as optimal as possible.

Gbongli Komlan (2017) have used a two-staged SEM-AHP technique to predict and prioritize mobile financial services perspective adoption via multi-dimensional consumers’ trust and perceived risk factors concurrently. Yi-Hui Chiang (2013) proposed a combined path modelling of Analytic Hierarchy (AHP) and PLS-SEM to advance the understanding of the processes involved in blog site evaluation. Suresh Kumar Jakhar proposed an integrated approach that combines the Fuzzy Analytic Hierarchy Process (FAHP) with Partial Least Squares Structural Equation Modelling (PLS-SEM) to address real-world supply chain networks (Jakhar & Barua, 2014).

Several studies have explored online banking using the PLS-SEM method. For instance, Alhassany and Faisal (2018) investigated how the adoption of internet banking is determined by factors such as technological features, personal characteristics, social environments, and perceived risks. Additionally, Rocío Carranza et al. (2021) applied the Technology Acceptance Model (TAM) to examine the factors influencing bank customers' adoption of e-banking to enhance their banking experience.

The conceptual framework of the study is explained on the basis of the expansion of the UTAUT2 model including the constructs: (CS), (PS) and (FFC).

Performance expectancy refers to an individual's belief that using online banking is beneficial for completing banking tasks (Venkatesh *et al.,* 2012; Martins *et al.*, 2014). Previous studies (Khan et al., 2017; Rahi et al., 2019) have demonstrated that performance expectancy has a significant positive influence on behavioural intention to use online banking. Similarly, research by Martins et al. (2014) and Oliveira et al. (2016) in the context of online banking confirmed a strong relationship between performance expectancy and behavioural intention. Based on this review of the literature, the following hypothesis is proposed:

H_1: *Performance expectancy has positive impact to behaviour intention to use online banking.*

Effort expectancy refers to the perceived ease of use of online banking (Venkatesh *et al.,* 2012; Xhafaj, Qendraj, Xhafaj, & Halidini, 2021). Previous studies (Martins et al., 2014; Chaouali et al., 2016) have highlighted that ease of use is a crucial factor influencing behavioural intention to use online banking. Similar findings were reported by Rahi et al. (2019) and Riffai et al. (2012). Based on these arguments, the following hypothesis is proposed:

H_2: *Effort expectancy has positive impact to behaviour intention to use online banking.*

Facilitating conditions refer to an individual's belief that the technological infrastructure supports the use of internet banking (Venkatesh *et al.,* 2003). Previous research has shown that facilitating conditions positively influence behavioral intention to use online banking (Venkatesh & Davis, 2000; Albugami & Bellaaj, 2014; Yeow *et al.*, 2008; Alalwan & Williams, 2014). Based on these findings, the following hypothesis is proposed:

***H₃:** Facilitating condition has positive impact to behaviour intention to use online banking.*

Habit refers to the automatic behaviours individuals exhibit when using online banking. These behaviours often arise from the experiences they have developed and the knowledge they have acquired over time (Venkatesh et al., 2012). In the context of online banking, habit is identified as a key factor influencing behavioural intention to use online banking (Merhi *et al.*, 2019; Farzin *et al.*, 2021).

***H₄:** Habit has positive impact to behaviour intention to use online banking.*

Customer service is defined as a useful service that guides and solves technical problems when using online banking (Blut *et al.*, 2015). In the context of online banking researchers show that customer service had a positive and significant influence on behaviour intention to use online banking (ho & Lin, 2010; Swaid & Wigand, 2007; Rahi, 2017; Cristobal *et al.*, 2007)). The above theoretical grounds lead us to formulate the following hypothesis:

***H₅:** Customer service has positive impact to behaviour intention to use online banking.*

Perceived security is concepted as the degree of confidence that individuals have that data transactions are protected by the online banking system (Merhi et al., 2019). Perceived security was found to be a crucial determinant of behaviour intention to adopt online banking (Sánchez-Torres et al., 2018; Anouze & Alamro, 2020). Based on the above line of reasoning, the following hypothesis is proposed:

***H₆:** Perceived security has positive impact to behaviour intention to use online banking.*

Fear from covid-19 is defined as social concern regarding the possibility of infection through paper money, coins, ATM (Huterska *et al.*, 2021). This situation has its impact on bank customers, especially regarding the acceptance and use of online banking dictated by banks to continue normally all financial transactions. The following hypothesis is proposed to analyse the impact of fear from covid-19.

***H₇:** Fear from covid-19 has positive impact to use behaviour online banking.*

An individual's intention to approve the use of a new technology to accomplish various tasks is referred to have his or her BI (Ain et al., 2016). Empirical evidences confirm that the influence of BI to use online banking behaviour are confirmed in the studies of Nguyen et al. (2020); Farzin et al. (2021). Based on the above line of reasoning, the following hypothesis is proposed:

***H₈:** Behavioural Intention (BI) has positive impact to use behaviour online banking.*

Methodology

This research aims to analyse the UTAUT2 model via an integrated framework which is developed in two phases: in the first phase it was applied PLS-SEM to guide with its output the start of the fuzzy Z-AHP method by constructing the decision matrix of the model, the second phase applies the complete fuzzy Z-AHP to rank the constructs based on the importance that each of them has toward the BI construct. In other words the findings of the Z-AHP method determine which of the constructs impact better the use of online banking. The figure 1 shows the integrated framework of the study.

The target population of this study included customers of different banks. It's used the Google Form, a web based, and in total 346 questionnaires were completed. A questionnaire was distributed through the email address, Facebook, LinkedIn, and through WhatsApp groups. The questionnaire consists of two parts, where the first includes questions about gender, education and age, and the second part contains questions about the perception of individuals regarding the acceptance and use of online banking. The constructs of the model were measured using a 5-likert scale. The items for measuring the constructs are adapted from (Venkatesh *et al.*, 2003; Venkatesh *et al.*, 2012; Vatanasombut *et al.*, 2008; ho & Lin, 2010).

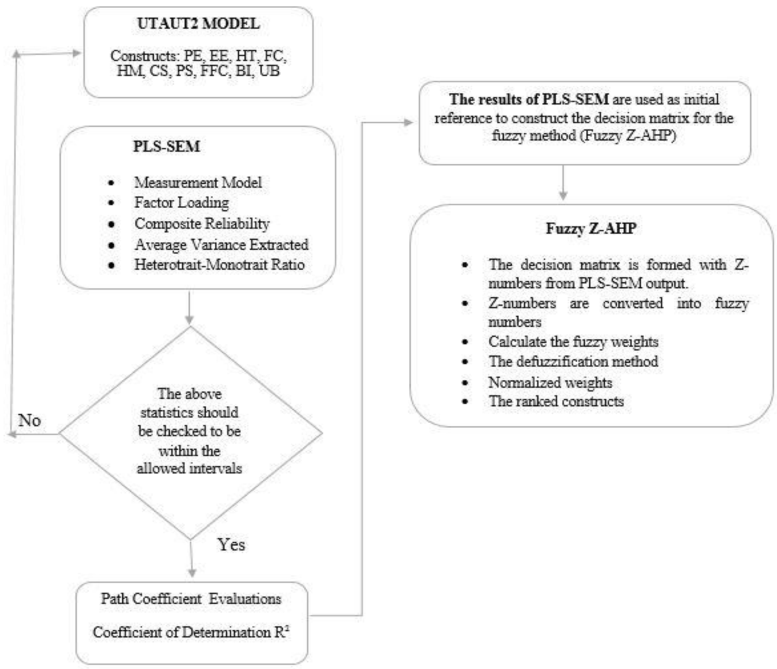

Figure 1. The Integrated Framework

PLS-SEM

PLS-SEM is a critical statistical technique in the behavioural sciences (Bollen, 1989). It is widely adopted by researchers because it allows the development of composite models with numerous constructs and items (Xhafaj, Qendraj, Xhafaj, & Gjikaj, 2021). The evaluation of a model using the PLS-SEM approach involves two main stages. The first stage assesses the measurement models, while the second evaluates the structural model (Joseph F. Hair et al., 2019). This study is grounded in the concept of behavioural intentions to use online banking. In similar research, latent variables are operationalized using reflective measurement models (Benitez *et al.*, 2020). The evaluation of reflective constructs encompasses several steps: assessing item reliability, construct reliability, and both convergent and discriminant validity (Rasoolimanesh & Ali, 2018). Item reliability is considered satisfactory when outer loading values exceed 0.7 (Sarstedt *et al.*, 2014). Construct reliability is achieved if Cronbach's alpha, and composite reliability (CR), values are all greater than 0.7 (J. F. Hair *et al.*, 2017). Convergent validity is determined using the average variance extracted (AVE), which should have a lower limit of 0.5 to indicate that the construct explains at least 50% of the variance of its items (Qendraj *et al.*, 2022). Discriminant validity is established when the heterotrait-monotrait (HTMT) ratio of correlations is below 0.9 (Henseler *et al.*, 2015).

Structural Equation

After the measurement model has been evaluated and all its indicators are within the acceptable intervals, the structural equation model will be evaluated. The latter shows how the latent variables are related to the dependent constructs. It includes the analysis of the size and the significance path coefficients. For the significance testing, a resampling method such as bootstrapping should be applied because PLS-SEM does not assume that the data have a normal distribution. To evaluate the structural equation, the coefficient of determination (R- Square) R^2 is used (J. F. Hair *et al.*, 2017).

Fuzzy Z-AHP

Regarding the decision-making problems, the main goal is to obtain a decision as optimal as possible. The fuzzy Z-numbers are used to make an optimal decision, useful and reliable. (L. A. Zadeh, 1965). The concept of fuzzy Z-numbers was introduced by Zadeh, as a base for dealing with uncertainty and partial reliability. The Z-number is denoted as an uncertain variable $Z = (A, B)$ and is converted into a fuzzy number based on the expectation of a fuzzy set (Kang *et al.*, 2012). A is a fuzzy subset of a random variable X of the uncertain variable Z, B is a fuzzy subset that shows the probability or the reliability of A, and B is also named as the degree of truth of A. Assume that $X = \{x_1, x_2, \dots, x_n\}$, and A a fuzzy set in X, $\mu_A: X \to [0,1]$ the membership function of the trapezoidal fuzzy number $x_i = \left(a_1{}^{(i)}, a_2{}^{(i)}, a_3{}^{(i)}, a_4{}^{(i)}\right)$ is shown by equation (1). The linguistic restriction fuzzy number of the set A is evaluated with the trapezoidal fuzzy numbers as shown in table 1, while B has a membership function $\mu_B: X \to [0,1]$ with triangular fuzzy numbers (See table 2). The elements of B are defined as $x_i = \left(b_1{}^{(i)}, b_2{}^{(i)}, b_3{}^{(i)}\right)$.

$$\mu_A(x_i) = \begin{cases} 0 & -\infty \le x_i \le a_1{}^{(i)} \\ \frac{x - a_1{}^{(i)}}{a_2{}^{(i)} - a_1{}^{(i)}} & a_1{}^{(i)} \le x_i \le a_2{}^{(i)} \\ 1 & a_2{}^{(i)} \le x_i \le a_3{}^{(i)} \\ \frac{a_4{}^{(i)} - x_i}{a_4{}^{(i)} - a_3{}^{(i)}} & a_3{}^{(i)} \le x_i \le a_4{}^{(i)} \\ 0 & a_4{}^{(i)} < u_i \le +\infty \end{cases},$$

$$A = \{x_i, \mu_A(x_i) | \mu_A(x_i) \epsilon [0,1], x_i \in X\} \tag{1}$$

$$\mathrm{B(X)}: \mathrm{X\ is\ A} \to \mathrm{Poss(X = x)} = \mu_A(x_i) \quad \text{and}$$
$$\mathrm{B} = \{x_i, \mu_B(x_i) | \mu_B(x_i) \epsilon [0,1], x_i \in X\}$$

$$\mu_B(x_i) = \begin{cases} 0 & -\infty < x_i \le b_1{}^{(i)} \\ \frac{x_i - b_1{}^{(i)}}{b_2{}^{(i)} - b_1{}^{(i)}} & b_1{}^{(i)} \le x_i \le b_2{}^{(i)} \\ \frac{b_3{}^{(i)} - x_i}{b_3{}^{(i)} - b_2{}^{(i)}} & b_2{}^{(i)} \le x_i \le b_3{}^{(i)} \\ 0 & b_3{}^{(i)} < x_i \le +\infty \end{cases} \tag{2}$$

Table 1

Saaty Scale

Saaty importance scale		Trapezoidal fuzzy numbers
1	Equal	(1,1,1,1)
3	Moderate	(2,2.5,3.5,4)
5	Strong	(4,4.5,5.5,6)
7	Very strong	(6,6.5,7.5,8)
9	Extremely strong	(8,8.5,9,9)
2	Intermediate values	(1,1.5,2.5,3)
4	Intermediate values	(3,3.5,4.5,5)
6	Intermediate values	(5,5.5,6.5,7)
8	Intermediate values	(7,7.5,8.5,9)

The Z-number $Z = (A, B) = (x_1, x_2), x_1 \in A, x_2 \in B$ is converted into a regular fuzzy number according formulas (3), (4), (5) (Azadeh et al., 2013):

The reliability (x_2) is converted into a crisp number with the equation $\alpha = \frac{\int x_i \mu_B(x_i) du}{\int \mu_B(x_i) du}$ (3)

The first component (u_1) is calculated by adding the weight of the reliability to the part of the restriction, so the weighted Z-number as Z^α:

$$Z^\alpha = \{x_i, \mu_{A^\alpha}(x_i) | \mu_{A^\alpha}(x_i) = \alpha\mu_A(x_i), x_i \in [0,1]\} \quad (4)$$

The weighted restriction is converted into a regular fuzzy number as:

$$Z' = \left\{x_i, \mu_{Z'}(x_i) \middle| \mu_{Z'}(x_i) = \mu_A\left(\frac{x_i}{\sqrt{\alpha}}\right), \mu(x_i) \in [0,1]\right\} \quad (5)$$

The numbers Z^α and Z' are equal related to the fuzzy expectation (Azadeh *et al.*, 2013):

$$E_{A^\alpha}(x) = \alpha E_A(x)$$
$$E_{Z'}(x) = \alpha E_A(x)$$

After converting the Z-number into a regular fuzzy number Z' is formed the decision matrix with fuzzy numbers, which initialize the fuzzy Z-AHP method.

$$\tilde{A} = \begin{pmatrix} 1 & \cdots & \widetilde{\alpha_{1n}} \\ \vdots & \ddots & \vdots \\ \widetilde{\alpha_{n1}} & \cdots & 1 \end{pmatrix} \text{ where } \alpha_{ij} = \frac{1}{\alpha_{ji}} \quad (6)$$

The decision matrix has to be consistent according Saaty index of consistency IC, that must be less than 0.1 (Saaty, 2008). For each of the constructs is calculated the fuzzy geometric mean value $\tilde{r}_i$:

$$\tilde{r}_i = \left(\prod_{i=1}^{n} \widetilde{\alpha_{ij}}\right)^{1/n} \quad (7)$$

Table 2

Reliability Scale Triangular Fuzzy Numbers

Reliability scale	Triangular Z-fuzzy numbers reliability scale
Equally reliable	(1,1,1)
Moderately reliable	(0.2, 0.3, 0.4)
Strongly reliable	(0.4, 0.5, 0.6)
Very strongly reliable	(0.6, 0.7, 0.8)
Extremely strong reliable	(0.8, 0.9, 1)
Intermediate reliability values	(0.1, 0.2, 0.3)
Intermediate reliability values	(0.3, 0.4, 0.5)
Intermediate reliability values	(0.5, 0.6, 0.7)
Intermediate reliability values	(0.7, 0.8, 0.9)

After $\tilde{r}_i$, are evaluated the fuzzy weights $\widetilde{\omega}_i$

$$\widetilde{\omega}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \ldots \oplus \tilde{r}_n)^{-1} \quad (8)$$

The defuzzification of the weights $\widetilde{\omega}_i = \left(\omega_i^{(1)}, \omega_i^{(2)}, \omega_i^{(3)}, \omega_i^{(4)}\right)$ is denoted with u_i using the method (Allahviranloo *et al.*, 2011; Qendraj *et al.*, 2021).

$$u_i = \frac{\omega_i^{(1)} + 2\omega_i^{(2)} + 2\omega_i^{(3)} + \omega_i^{(3)}}{6} \quad (9)$$

The last step is to normalise the weights u_i.

$$N_i = \frac{u_i}{\sum u_i} \quad (10)$$

Finally, the values of the normalised weights can be ranked from the highest value to the lowest value, thus dictating the rank from the most important to the last important.

Results

Table 3 shows the demographic data regarding the respondents. In the study, 40.3% of respondents are men, while 59.7% are women. Regarding to the age, it is noted that mostly the users of online banking belong to the age group younger than 30 years and that they represent 65.8% of all respondents. According to education, the highest percentage is occupied by respondents who have a bachelor's degree, which corresponds to 52.5%.

Table 4 presents the statistics for the measurement model, including loadings, composite reliability (CR), Cronbach's alpha (α), and average variance extracted (AVE). The table indicates that all loading values exceed 0.7, confirming the reliability of the items. Additionally, the values for Cronbach's alpha and composite reliability (CR) are also above 0.7,

meeting the established criterion for construct reliability.

Table 3

Demographic Data of the Respondent

Item	Value	Percentage
Gender	Male	40.3
	Female	59.7
Age	Younger than 30 years old	65.8
	31-40	14.8
	41-50	15.9
	Over 50 years old	3.5
Education	Middle school	0.9
	High school	13.9
	Bachelor	52.5
	Master	32.8

The average variance extracted (AVE) for all constructs is in the range of 0.665 to 0.823, so they are higher than the limit of 0.5 proposed for AVE, thus confirming satisfactory convergent validity. Table 5 shows the values of the heterotrait-monotrait (HTMT) ratio of correlations. Discriminant validity was checked using the HTMT criterion. As shown in table 5 all the values are smaller than the set limit of 0.9, confirming adequate results in terms of discriminant validity.

Table 4

Statistics of the Measurement Model

Constructs and Items	Loadings	CR	α	AVE
Behavioural Intention (BI)		0.918	0.866	0.788
BI1	0.889			
BI2	0.903			
BI3	0.872			
Customer Service (CS)		0.894	0.841	0.678
CS1	0.763			
CS2	0.808			
CS3	0.855			
CS4	0.863			
Effort Expectancy (EE)		0.914	0.873	0.726
E1	0.857			
E2	0.881			
E3	0.868			
E4	0.799			
Facilating Conditions (FC)		0.856	0.747	0.665
F1	0.83			
F2	0.847			
F3	0.766			
Hedonic Motivation (HM)		0.932	0.891	0.82
HM1	0.895			
HM2	0.91			
HM3	0.913			
Habit (HT)		0.905	0.86	0.705
HT1	0.876			
HT2	0.875			
HT3	0761			
HT4	0.841			
Performance Expectancy (PE)		0.9	0.853	0.693
P1	0.822			
P2	0.849			
P3	0.828			
P4	0.831			
Pandemic Coronavirus (PC)		0.93	0.887	0.815
PC1	0.902			
PC2	0.909			
PC3	0.888			
Perceived Security (SE)		0.933	0.893	0.823
SE1	0.889			
SE2	0.908			
SE3	0.924			
Usage Behaviour (UB)		0.92	0.87	0.794
UB1	0.876			
UB2	0.881			
UB3	0.975			

Table 5

Heterotrait Monotrait (HTMT)

	BI	CS	EE	FC	HM	HT	PE	FFC	PS	UB
BI										
CS	0.874									
EE	0.82	0.83								
FC	0.743	0.741	0.79							
HM	0.793	0.872	0.728	0.703						
HT	0.879	0.791	0.689	0.632	0.823					
PE	0.762	0.735	0.84	0.695	0.629	0.695				
FFC	0.591	0.61	0.531	0.572	0.644	0.678	0.531			
PS	0.811	0.876	0.75	0.672	0.767	0.788	0.651	0.655		
UB	0.876	0.803	0.764	0.761	0.762	0.818	0.576	0.736	0.747	

Structural Equation Model

Figure 2 shows the path coefficient for the structural equation model. The tested hypotheses are presented in Table 6, showing that the relationship between CS (β=0.195, p<0.1), EE (β=0.163, p<0.1), HT (β=0.35, p<0.1), PE (β=0.088, p<0.1), PS (β=0.098, p<0.1) are positively significant related to BI of online banking. Furthermore, it was found that BI (β=0.685, p<0.05) and FFC (β=0.155, p<0.1) have a positive significant effect with use behaviour of online banking.

Table 6

Path Coefficients

Hypotheses	Path Coefficients	P-value
BI→UB	0.685	0.000
CS→ BI	0.195	0.000
EE→ BI	0.163	0.001
PE→ BI	0.088	0.055
PS→ BI	0.098	0.067
HM→ BI	0.037	0.522
HT→ BI	0.35	0.000
FC→ BI	0.072	0.137
FFC→ UB	0.155	0.002

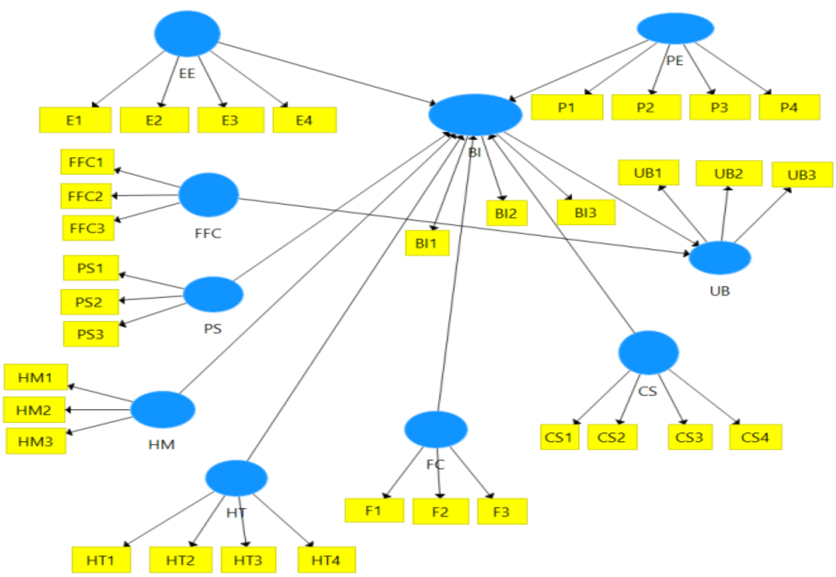

Figure 2. Structural Equation Model

Table 7 indicates that the variance in behavioural intentions about using online banking is 0.728 (R2 = 0.728), that is explained by CS, EE, HT, PE, PS. Similarly, R2 value for use behaviour is 0.604, meaning that 60.4% of the variance in the use behaviour construct is accounted for by behavioural intention and fear of Covid-19. These findings suggest that the proposed model has strong explanatory power for customer behavioural intentions and use behaviour in the context of online banking (Cohen, 1988).

Table 7

Square

Constructs	R-Square	R-Square Adjusted
BI	0.728	0.722
UB	0.604	0.602

Fuzzy Z-AHP

Fuzzy Z-AHP cannot be used only because it isn't suitable for testing hypotheses and generating path coefficients. . The significant variables from PLS-SEM analysis have been used as the input variables for the AHP analysis. The integration of two methods ensures methodological contributions from the statistical standpoint. PLS-SEM results are essential to construct the decision matrix, the fuzzy Z-AHP initiator. The primary table that guides the construction of the decision matrix is the path coefficient table (see table 6).

Table 8

The Decision Matrix with Z-Numbers

BI	PE	EE	PS	HT	CS
PE	(1, 1, 1, 1)→ A (1, 1, 1)→ B	(0.2,0.3,0.7,0.8)→ A (0.4, 0.5, 0.6)→ B	(0.05,0.085,0.185,0.2)→ A (0.1, 0.2, 0.3)→ B	(0.05,0.085,0.185,0.2)→ A (0.1, 0.2, 0.3)→ B	(0.1,0.15,0.35,0.4)→ A (0.5, 0.6, 0.7)→ B
EE	(1,1.5,2.5,3)→ A (0.8, 0.9, 1)→ B	(1, 1, 1, 1)→ A (1, 1, 1)→ B	(0.1,0.15,0.35,0.4)→ A (0.5, 0.6, 0.7)→ B	(0.1,0.15,0.35,0.4)→ A (0.5, 0.6, 0.7)→ B	(0.2,0.3,0.7,0.8)→ A (0.4, 0.5, 0.6)→ B
CS	(7,7.5,8.5,9)→ A (0.1, 0.2, 0.3)→ B	(3,3.5,4.5,5)→ A (0.5, 0.6, 0.7)→ B	(1, 1, 1, 1)→ A (1, 1, 1)→ B	(1,1.5,2.5,3)→ A (0.8, 0.9, 1)→ B	(3,3.5,4.5,5)→ A (0.5, 0.6, 0.7)→ B
HT	(7,7.5,8.5,9)→ A (0.1, 0.2, 0.3)→ B	(3,3.5,4.5,5)→ A (0.5, 0.6, 0.7)→ B	(1,1.5,2.5,3)→ A (0.8, 0.9, 1)→ B	(1, 1, 1,1)→ A (1, 1, 1)→ B	(5,5.5,6.5,7)→ A (0.3, 0.4, 0.5))→ B
PS	(3,3.5,4.5,5)→ A (0.5, 0.6, 0.7)→ B	(1,1.5,2.5,3)→ A (0.8, 0.9, 1)→ B	(0.1,0.15,0.35,0.4)→ A (0.5, 0.6, 0.7)→ B	(0.01,0.155,0.175,0.3)→ A (0.4, 0.5, 0.6))→ B	(1, 1, 1,1)→ A (1, 1, 1)→ B

Table 9

Z-Number and the Weight of the Reliability

BI	PE	EE	PS	HT	CS
PE	(1, 1, 1, 1; 1)	(0.2,0.3,0.7,0.8; 0.5)	(0.05,0.085,0.185,0.2; 0.2)	(0.05,0.085,0.185,0.2; 0.2)	(0.1,0.15,0.35,0.4; 0.6)
EE	(1,1.5,2.5,3;0.9)	(1, 1, 1, 1; 1)	(0.1,0.15,0.35,0.4; 0.6)	(0.1,0.15,0.35,0.4; 0.6)	(0.2,0.3,0.7,0.8; 0.5)
CS	(7,7.5,8.5,9; 0.2)	(3,3.5,4.5,5; 0.6)	(1, 1, 1, 1; 1)	(1,1.5,2.5,3;0.9)	(3,3.5,4.5,5; 0.6)
HT	(7,7.5,8.5,9; 0.2)	(3,3.5,4.5,5; 0.6)	(1,1.5,2.5,3;0.9)	(1, 1, 1, 1; 1)	(5,5.5,6.5,7; 0.4)
PS	(3,3.5,4.5,5; 0.6)	(1,1.5,2.5,3;0.9)	(0.1,0.15,0.35,0.4; 0.6)	(0.01,0.155,0.175,0.3; 0.5)	(1, 1, 1, 1; 1)

Converting Z-numbers into regular fuzzy numbers is applied in the equation (5). Table 10 shows the results of the conversion.

Table 10

Tab Regular Z-Fuzzy Number (Z)

BI	PE	EE	PS	HT	CS
PE	(1, 1, 1, 1; 1)	(0.28, 0.42, 1, 1.14,)	(0.11,0.19,0.41,0.44)	(0.11,0.19,0.41,0.44)	(0.13,0.19,0.45,0.52)
EE	(1.05,1.58,2.63,3.16)	(1, 1, 1, 1; 1)	(0.13,0.19,0.45,0.52)	(0.13,0.19,0.45,0.52)	(0.28, 0.42, 1, 1.14,)
CS	(15.9,17, 19.3, 20.5)	(3.89,4.5,5.8,6.5)	(1, 1, 1, 1; 1)	(1.05,1.58,2.63,3.16)	(3.89,4.5,5.8,6.5)
HT	(15.9,17,19.3, 20.5)	(3.89,4.5,5.8,6.5)	(1.05,1.58,2.63,3.16)	(1, 1, 1, 1; 1)	(7.9,8.7,10.3,11.1)
PS	(3.89,4.5,5.8,6.5)	(1.05,1.58, 2.63,3.16)	(0.13,0.19,0.45,0.52	(0.014,0.22,0.25,0.43)	(1, 1, 1, 1; 1)

The R square value (see table 7) serves as a normalisation of the data from the two previous tables. The decision matrix with Z-numbers is formed as a pair of (A, B) where the first component is formed with trapezoidal fuzzy numbers and the second component with triangular fuzzy numbers. (See table 8).

Solving the integral $\alpha = \frac{\int x_i \mu_B(x_i) du}{\int \mu_B(x_i) du}$ the result is, $\alpha = \frac{b_1^{(i)} + b_2^{(i)} + b_3^{(i)}}{3}$. In table 9 to each Z- number is added the value of α (See equation (4)). The normalised weights are arranged from highest to lowest, establishing the ranking from most to least important (table 11).

Table 11

Fuzzy Z-AHP with TpFN numbers

	$\tilde{r}_i$	$\tilde{\omega}_i$	u_i	N_i	Rank
PE	(0.14, 0.23, 0.52, 0.58)	(0.007, 0.014, 0.043, 0.058)	0.04	0.036	5
EE	(0.26, 0.39, 0.85, 0.99)	(0.014, 0.023, 0.07, 0.099)	0.06	0.054	4
CS	(3.98, 4.82, 6.42, 7.23)	(0.21, 0.29, 0.53, 0.723)	0.43	0.387	2
HT	(4.75, 5.69, 7.42, 8.26)	(0.24, 0.34, 0.61, 0.826)	0.5	0.45	1
PS	(0.29, 0.86, 1.14, 1.45)	(0.015, 0.052, 0.094, 0.145)	0.08	0.072	3

Discussion

The research revealed that habit is the most critical factor influencing behavioural intention to use online banking, aligning with the findings of Lewis et al. (2013) and Wang et al. (2015). Similarly, Guo and Barnes (2011), in their study on purchasing dynamics in virtual environments, identified habit as the primary driver of purchase decisions.

HM wasn't an influential construct the same line with Oliveira et al (2016), and Merhi et al (2019). This study revealed that EE significantly influence the intention to adopt online-banking and the finding aligns with that of Morosan and De Franco (2016), Xhafaj et al (2024). Consequently, when a customer finds the new technology easy to use, the probability of acceptance increases significantly. Perceived security, customer service had a significant impact on behaviour intention to use online banking, our findings are consistent with previous studies (Shah et al (2014), Cristobal et al. (2007). Consequently, security remains a big concern and barrier to online banking adoption.

Conclusions

This study identified the factors influencing behavioural intentions and usage behaviour towards online banking during the social distancing conditions imposed by COVID-19. A novel two-stage approach was adopted, combining PLS-SEM and Fuzzy Z-AHP, to achieve a more comprehensive understanding. This integrated analysis offers significant methodological contributions from a statistical perspective.

The PLS-SEM results indicated that behavioural intentions were influenced by customer service, effort expectancy, performance expectancy, social influence, and habit. Habit results as the most influential factor. The future use of online banking by customers is expected to become a natural habit.

Behavioural intentions, along with the effects of the COVID-19 pandemic, significantly influence usage behaviour toward online banking. The integration of new factors into the UTAUT2 model adds a valuable theoretical dimension to understanding individuals' behaviour regarding online banking. By incorporating constructs such as CS, FFC, and PS, researchers can better analyse behavioural intentions and usage behavior in this context.

This study serves as a bases for future research on behavioural intentions related to online banking. The inclusion of the FFC construct contributes to theoretical advancements, as few studies have explored its role in use behaviour toward online banking.

One the primary objectives of the study was to integrate PLS-SEM results as a foundational source for constructing the decision matrix for the Fuzzy Z-AHP method. The constructs of the UTAUT2 model were ranked according to their importance in influencing behavioural intentions toward online banking. Fuzzy Z-AHP identified habit as the most important construct, followed by customer service, and finally perceived expectation. These findings align with PLS-SEM results, which also confirmed habit as the most impactful factor.

The study's findings provide valuable insights for bank managers, offering them essential knowledge about the factors influencing behavioural intentions toward online banking. However, the study is limited by its geographic scope, as it was conducted only in the city of Tirana, making the results non-generalizable to the entire country of Albania. Future research will aim to address this limitation by expanding the study to a broader geographical context and incorporating additional constructs.

Theoretical Implications

This study is the first in its nature that integrates UTAUT2 model with perceived security, customer service and fear from pandemic coronavirus. Incorporation of UTAUT2 model with perceived security, customer service and fear from pandemic coronavirus plays a key role to the UTAUT2 paradigm. Integrated UTAUT2 model showed substantial predictive power which confirmed the validity of the research model. Therefore, the present study goes a step further and investigates the role of fear from pandemic coronavirus on customer use behaviour in online banking.

Practical Implications

Habit is an important variable of the model. Customers are mostly influenced by their repetitive habits using online banking. Thus, managers should monitor the opinions that customers post in their social circles to anticipate the behavioural habits of customers related to using online banking. Our findings suggest that customer service and perceived security are important variables of the model. The guarantee of security, customer service should be of paramount importance in future strategies targeting online banking adoption and promoting continuous technology use.

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Annexes

Questionnaire/Items	***Source***
Performance Expectancy (PE)	
1. I I think that using online banking is useful in everyday life (PE1)	(Venkatesh *et al.*, 2003)
2. I think that using online banking helps me to do my daily tasks faster (PE2)	
3. I think using online banking increases my productivity (PE3)	
4. I think that using online banking helps me accomplish financial tasks faster (PE4)	
Effort Expectancy (EE)	
1. Interaction with online banking is clear and understandable (EE1)	(Venkatesh *et al.*, 2003)
2. I find online banking easy to learn (EE2)	
3. I am easily trained in the use of online banking (EE3)	
4. I find online banking easy to use in daily financial operations (EE4)	
Social Influence (SI)	
1. My close friends think I should use online banking services. (SI1)	(Venkatesh *et al.*, 2003)
2. Other people, whose opinions I value, think I should use	
online banking services (SI2)	
3. My close friends think that using online banking services is important for	
financial transactions (SI3)	
Facilitating Conditions (FC)	
1. I have all the tools to use online banking	
(internet, smartphones, computer, etc.) (FC1)	(Venkatesh *et al.*, 2012)
2. I think I have the necessary knowledge to use online banking (FC2)	
3. By using online banking, I think I can get help from others if I'm in trouble	
myself (FC3)	
Hedonic Motivation (HM)	
1. I think using online banking is fun (HM1)	(Venkatesh *et al.*, 2012)
2. I think using online banking is nice (HM2)	
3. I think that using online banking is very fun (HM3)	
Habit (HT)	
1. I think using online banking has become a habit for me. (HT1)	(Venkatesh *et al.*, 2012)
2. I think using online banking has become natural for me (HT2)	
3. The use of online banking creates a kind of addiction to it (HT3)	
4. I think I definitely need to use online banking (HT4)	
Fear from Pandemic Coronavirus (FPC)	
1. Due to the fear of the pandemic, I use online banking because I am interested	
in making payments without touching the ATM (FFC1)	
2. Due to the fear of the pandemic I use online banking because contactless	
payments between people protect me. (FFC2)	
3. I use online banking because the pandemic causes me to fear using cash. (FFC3)	
Perceived Security (PS)	
1. I feel safe when I use the online banking website (PS1)	(Vatanasombut *et al.*, 2008)
2. I trust that the online banking website protects my information (PS2)	
3. I trust that data transactions are protected by the online banking website (PC3)	
Customer service (CS)	
1. Online banking website guides me to solve technical problems (CS1)	(Ho & Lin, 2010)
2. The online banking website loads quickly (CS2)	
3 Online banking website executes transactions quickly (CS3)	
4. Online banking website executes transactions efficiently (CS4)	
Behavioural Intention (BI)	
1. I intend to use online banking in the future (BI1)	
2. I plan to use online banking continuously (BI2)	(Venkatesh *et al.*, 2003)
3. It is worth recommending online banking to my friends (BI3)	
Use Behaviour (UB)	
1. I use online banking (UB1)	
2. I use online banking to transfer money (UB2)	
3. I use online banking for financial transactions (UB3)	(Venkatesh *et al.*, 2012)

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Authors' Biographies

Evgjeni Xhafaj has received her associate professor title in the field of Statistics. She has been a lecturer and a researcher at the Department of Mathematics, Faculty of Mathematics and Physics Engineering, Polytechnic University of Tirana for 15 years. Her fields of interest include multivariate statistics, operations research, R, Python, etc.

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In Memoriam. This article is dedicated to the memory of Associate Professor Daniela Halidini, whose foundational contributions and academic vision laid the groundwork for this research.

Robert Kosova has received his associate professor title in the field of Operation Research; his Ph.D. thesis was the application of statistical methods to estimate oilfield reserves in Albania. He used to work at the Oil and Gas Institute of Albania, where he had and continues to have active collaboration with his fellow oil geologists. His fields of interest include applied statistics, mathematical modeling in engineering, especially in the petroleum industry, etc.

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