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Examining the Factors Affecting Customers' Adoption of Mobile Banking with Structural Equation Model

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Abstract: Mobile banking is an application used on a smartphone or tablet that allows you to perform your banking transactions by connecting to the internet from your mobile device without having to go to the branch. Mobile banking usage showed a rapid increase in the last 10 years in Turkey as well as all over the world. However, the fact that some bank customers do not prefer mobile banking for different reasons increases the importance of investigating the factors that affect customers' adoption of mobile banking. It is important that banks adopt the latest information technology system to better understand changing customer needs. The Technology Acceptance Model (TAM) is an information systems theory is used to measure the response of consumers to technological change. The main objective in this research is to analyze the relationships among the factors that determine the attitude of bank customers using mobile banking application via the TAM theory. This research data was collected from surveys applied to public, private and participation bank customers in Konya province. The collected data set was tested by the Structural Equation Model method.

Müşterilerin Mobil Bankacılığa Uyumunu Etkileyen Faktörlerin Yapısal Eşitlik Modeli ile İncelenmesi

Anahtar Kelimeler
Yapısal Eşitlik Modeli,
Teknoloji Kabul Modeli,
Mobil Bankacılık

Öz: Mobil bankacılık, şubeye gitmek zorunda kalmadan bir akıllı telefon veya tablet ile mobil cihazınızdan internete bağlanarak bankacılık işlemlerinizi gerçekleştirmenizi sağlayan bir uygulamadır. Mobil bankacılık kullanımı son 10 yılda Türkiye'de ve tüm Dünyada hızlı bir artış göstermektedir. Bununla birlikte, bazı banka müşterilerinin mobil bankacılığı henüz tercih etmemesi, müşterilerin mobil bankacılığı benimsemesini etkileyen faktörlerin araştırılmasının önemini artırmaktadır. Değişen müşteri ihtiyaçlarını daha iyi anlamak için bankaların en son bilgi teknolojisi sistemini benimsemesi önemlidir. Teknoloji Kabul Modeli (TAM), tüketicilerin teknolojik değişime tepkisini ölçmek için kullanılan bir bilgi sistemleri teorisidir. Bu araştırmanın temel amacı, mobil bankacılık uygulamasını kullanan banka müşterilerinin tutumlarını TAM teorisi ile belirlemektir. Bu araştırma verileri Konya ilindeki kamu, özel ve katılım bankası müşterilerine uygulanan anketlerden toplanmıştır. Elde edilen veriler Yapısal Eşitlik Modeli yöntemi ile test edilmiştir.

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1. Introduction

In the past twenty years, mobile commerce (m-commerce) has emerged as a conclusion of the convergence of the wireless technology, internet and mobile devices. The concept of m-commerce for information technology (IT) is a new paradigm. The m-commerce implementation provided greater mobility and flexibility in areas such as quality control, investment and health as an extension of m-commerce. As a result, the m-commerce has become a very important component of today's business world. This new implementation, changes the way finance institutions provide and design services to individuals. It also modifies how people interact with other social components like retail banks. Mobile banking (MB) method is an innovator application used to access banking transactions, with this method customers can perform banking services at any time and at anywhere and to connect banking service quickly and easily via mobile devices [1,2].

Unlike mobile applications, computer and web applications, mobile devices are developed according to their specifications and technical skills [3]. As with other technologies and applications, the adoption of the MB application is also regarding the quality of the application [4]. For this reason, it is significant to specify the relationships between the factors related to the quality of the applications in order to adopt mobile banking applications and to obtain the benefits expected from these applications. Although there are some studies on the factors affecting the use of MB applications in the literature, the number of studies on determining the importance of these factors is quite low [5].

In order to perform the necessary researches in evaluating the efficiency of a MB application, the Technology Acceptance Model (TAM) theory is used. TAM is one of the models highly used method in the literature to identify the factors that have the greatest impact on the acceptance of an information system used [6]. TAM is a method first proposed by Davis (1986) in order to explain the acceptance of the technology on users. TAM was developed by Davis (1989) to explain the effects of user perceptions of system factors that are thought to be effective on users' acceptance of information systems [6-8].

Considering the literature, there are many studies conducted using the technology acceptance method in recent years. Abdullah and Ward (2016), using quantitative Meta-Analysis, e-learning adaptation according to the TAM identify the most frequently used external factors [9]. Lin and Kim (2016), model derived a model of TAM made as a result of the testing work, privacy and concerns about intrusive that predetermined variables perceived to perceived usefulness, but has found they could not detect the ease of use of sponsored advertising [10]. Chen et al. (2017), examined a number of social-psychological behavioral intention to adopt a predictive model based on TAM and Adoption of Smart and Sustainable Energy Technology Models [11]. Dumpit and Fernandez (2017) adopted the TAM, but contained subjective norm, perceived volatility, speed and security of internet are included as an additional structure [12]. Taherdoost (2018), developed the E-Service Technology Acceptance Model (ETAM) to evaluate the acceptance of e-service technology by the user [13]. Verma and Sinha (2018) aimed to identify important factors in a rustic situation based on TAM, which influenced acceptance of a mobile-based AES [14]. Kalyoncuoğlu (2018), examined the factors that affect the acceptance of the use of virtual cards for the reliability of payment transactions in consumers' online purchases with the TAM [15]. To and Tang (2019), investigated the premise of students' aim to attendance evaluation of computer-based courses and consequently suggested an improved TAM [16]. Binyamin and Smith (2019) investigated the factors affecting the use of LMS in higher education students by expanding the TAM method. As a result of this study, 8 external variables were adapted to this method [17].

The main objective of this study is to analyze the relationships among the factors specifying the attitude of bank customers that use the MB by using the TAM method.

1.1 Mobil Banking

The banking sector is one of the main sectors that frequently use innovative applications based on Information Technologies (IT). Banks are implementing a variety of IT innovations in order to turn the opportunities offered by developing technologies into advantages and to survive and excel in the highly competitive environment in the sector. Internet banking, an IT product, has facilitated people manage their money thanks to innovations made in the early 1980s. Banks began to offer people the tools to facilitate their financial transactions. Internet banking began to become popular in 2001. Due to the production of smart phones in the early 2000s, the concept of mobile banking, another IT product, emerged.

Due to the advancement on mobile technologies, there have been major technological revolutions in many sectors. The banks operating in Turkey, seriously work to adapt to developments related to mobile banking. By means of the increasing number of smartphone users in recent years, the number of customers using mobile banking passed the number of customers using internet banking.

Digital, Internet and Mobile Banking Statistics which publish by the Banks Association of Turkey are given in Figure 1 [18].

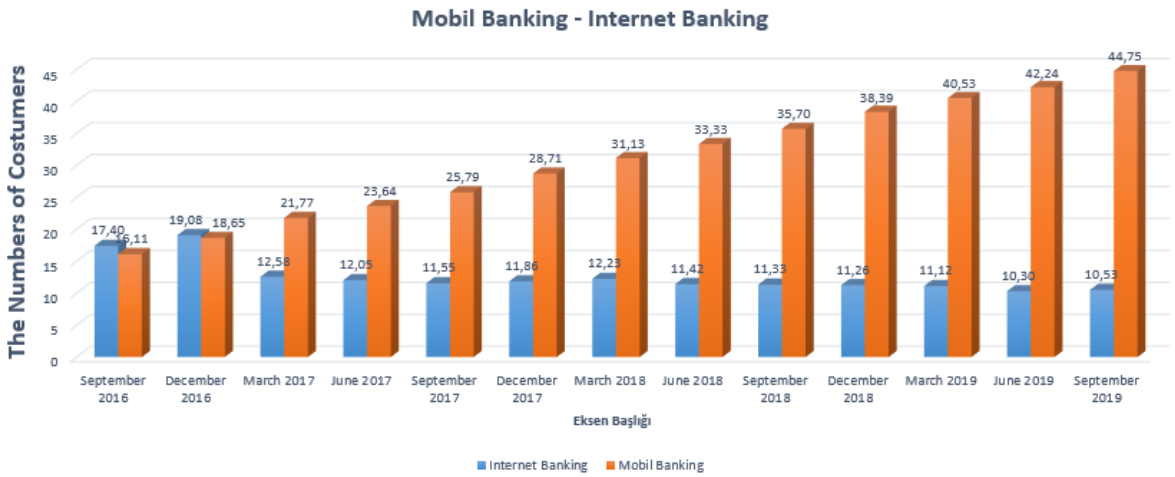

Figure 1. Number of individual customers (million) actively using mobile banking and Internet banking systems in Turkey.

According to Figure 1, it is observed that the number of individual banking customers using mobile banking increased rapidly and the number of internet banking users decreased. This rapid increase in mobile banking usage may be with the increasing number of smartphone users and the fact that mobile banking applications become more practical.

In this research, the TAM method was used to explain and model how customers accepted mobile banking application.

1.2 Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) is a method used in explaining on adaptation of different management information systems. This model is an information technology system that is widely used in revealing the reasons why users accept new applications. There are two main objectives in this model.

- to estimate the acceptability of a tool.
- to describe the necessary modifications in the system to enable the user to accept the new application.

The concept of TAM was proposed by Davis (1986) to explain computer use. TAM was improved by Davis (1989) to determines the effects of user perceptions of system factors that are thought to be effective on users' acceptance of information systems [7,8].

TAM examines the following dimensions using the Likert scale survey:

Perceived Usefulness (PU) : Davis (1989) was described this factor as "the degree to which a person believes that using a particular system would enhance his or her job performance".(5 Item) [8].

Perceived Ease Of Use (PEOU) : Davis (1989) was defined this factor as "the degree to which a person believes that using a particular system would be free from effort". (5 Item) [8].

Attitude Towards Use (ATU): It is a positive or negative evaluation of the use of new technology by users (4 Item) [8].

Behavioral Intention to Use (BIU): It is a measurement that individual's behavior using new technology (3 Item) [8].

Actual System Use (ASU): Real use refers to the time the user spends using the technology (3 Item) [8].

There are many studies in the literature based on mobile technologies such as mobile devices, smartphones, mobile shopping, mobile communication, mobile marketing and mobile commerce (see [19]-[27]). Nowadays, with the growing interest in the use of mobile banking application, customers' attitudes and intentions should be measured by bank information processing center. In this paper, the analysis was performed to determine customer behavior using the original TAM proposed by Davis (1989).

2. Material and Method

2.1. Structural Equation Model

Structural Equation Model is a comprehensive statistical analysis method consisting of three basic components. These are (1) path analysis, (2) structural model and measurement model, (3) general estimation processes as historical development. This method used to test models that have a combination of causal and mutual relationships among latent and observed variables. SEM used in many fields of science provides a comprehensive method for testing and measuring meaningful theories. SEM implement a hypothesis testing approach to multivariate analysis of structural theory on a subject [28].

SEM consists of two components;

1. Measurement Model: illustrates the relationship between latent variables and observed variables.
2. Structural Model: illustrates the relationships between the latent constructs or endogenous variables.

SEM provides to determine direct and indirect effects between variables [29-31].

In this study, the SEM method was used to obtain the causal relationships between the factors in the TAM model and to evaluate the statistical significance of the relationships between these factors.

2.1.1 Evaluation of Model Fit for SEM

In the literature, there are many goodness of fit test to evaluate in SEM. The test statistics frequently used in the literature are chi-square statistic $\left(\chi^2\right)$, Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Statistic (GFI), Adjusted Goodness of Fit Statistic (AGFI), Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI) and Comparative Fit Index (CFI). Goodness of fit values and their fit reference ranges are shown in Table 1 [32].

Table 1. Goodness of Fit Indexes for SEM

Goodness of Fit index	Value (Excellent Fit)	Value (Acceptable Fit)
χ^2/df	$0 \le \chi^2/df \le 2$	$2 < \chi^2/df \le 3$
$RMSEA$	$0 \le RMSEA \le 0.05$	$0.05 < RMSEA \le 0.08$
$SRMR$	$0 \le SRMR \le 0.05$	$0.05 < SRMR \le 0.10$
CFI	$0.97 \le CFI \le 1$	$0.95 \le CFI < 0.97$
GFI	$0.95 \le GFI \le 1$	$0.90 \le GFI < 0.95$
$AGFI$	$0.90 \le AGFI \le 1$	$0.85 \le AGFI < 0.90$
NFI	$0.95 \le NFI \le 1$	$0.90 \le NFI < 0.95$

2.2 Sample

The research population consists of public, private and participation bank customers in Konya. Since the full list of the customers of this bank is not available, bank customers were randomly selected in randomly selected time periods by the banks during a month and a questionnaire was applied to 687 volunteers who will answer the questionnaire.

2.3 Research Model and Hypotheses

The research model used in the study is the classical TAM model given in Figure 1. Using this model, the causal relationships between Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Towards Use (ATU), Behavioral intention to use (BIU) and Actual System Use (ASU) were tried to be explained. TAM model used in the research is given in Figure 2.

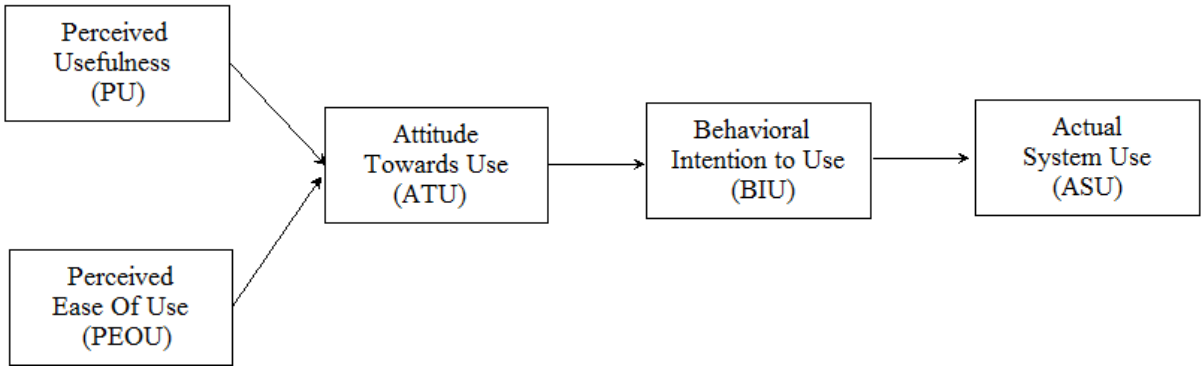

Figure 2. The original TAM (Davis, 1989)

The items in the measurement tool were compiled considering study of Davis et al.(1989). In the response of the measurement tool, the degree to which the According to "Strongly agree", "Agree", "Neither Agree nor Disagree", "Disagree", "Strongly Disagree".

According to Davis' findings, PEOU is positively associated with the use of a system. It has been determined in many studies that there is a positive relationship between PEOU and intention to use. According to the results of experimental and applied researches about TAM, PU is positively associated with the use of an information system and its user attitudes [6]. Based on this information, the research hypotheses are given below, respectively.

H_1: Perceived Usefulness has a positive effect on Attitude Towards Use
H_2: Perceived Ease of Use has a positive effect on Attitude Towards Use
H_3: Attitude Towards Use has a positive effect on Behavioral Intention to Use
H_4: Behavioral Intention to Use has a positive effect on Actual System Use

3. Results

3.1 Descriptive Statistics

Bank customers' descriptive statistics (Bank category, Gender, Jobs, Age) are summarized in Table 2.

Table 2. Fruquency tables for Bank Customers

Customers' Banks				**Customers' Gender**		
Banks	Frequency	Percent		Gender	Frequency	Percent
Public	295	42.9		Woman	295	42.9
Private	244	35.5		Man	392	57.1
Participation	148	21.5				
Customers' Jobs				**Customers' Age**		
Jobs	Frequency	Percent		Age	Frequency	Percent
Public	168	24.5		Under 26	286	41.6
Private sector	245	35.7		26-35	190	27.7
Self Employed	56	8.2		36-45	116	16.9
Retired	50	7.3		46-55	45	6.6
Student	144	21		Over 55	50	7.3
Other	24	3.5				

As can be seen from Table 2, 57.1% of the customers are male and 42.9% are female. 42.9% of the customers are public banks, 35.5% are private banks and 21.5% were participation bank customers. The private sector with 35.7% and public institutions with 24.5% are the most frequently employed sectors. The highest age group rank of the participants is under 26 with 41.6% and then 26-35 age group with 27.7%.

3.2 Structural Equation Model Results

The SEM results obtained from the analysis performed with AMOS 22 software are presented in Table 3-4 and Figure 3. Considering the decision criterion χ^2/df which is used for the evaluation of χ^2 value calculated for SEM, it was decided that the model variance-covariance matrix was compatible with the population variance-covariance matrix. Jöreskog and Sörbom (1993) used the χ^2/df ratio instead of the χ^2 value to evaluate the fit of the model [6,33]. This ratio value is obtained as 2.98 and it was statistically decided that the compatibility of the data with the model is acceptable.

The goodness of fit values obtained from the analysis performed with AMOS are summarized in Table 3. Take into consideration the descriptive suitability measures *SRMR =0.039* and *RMSEA=0.054* which are based on the difference between the estimated covariance matrix and the sample covariance matrix of the model are evaluated, it is seen that the model provides a good fit. Other goodness of fit indices was calculated as *CFI=0,964; GFI=0.937*; *AGFI=0.918* and *NFI=0.951*. When the goodness of fit criteria are examined, it can be said that the model is within acceptable limits.

Table 3. Fit Index For Proposed SEM

Goodness of Fit index	***Model***
χ^2/df	2.983
RMSEA	0.054
SRMR	0.039
CFI	0.964
GFI	0.937
AGFI	0.918
NFI	0.951

Structural Model results and Cronbach's Alpha (α) values are shown in Table 4. Cronbach's Alpha valuewhich is a reliability measure of the factors, is “close to reliable" if it is between 0.50 and 0.60, and "very reliable" if it is between 0.60 and 0.80. As can be seen from Table 4 the Cronbach α coefficient of all factors is above 0.7, it can be said that all factors are very reliable.

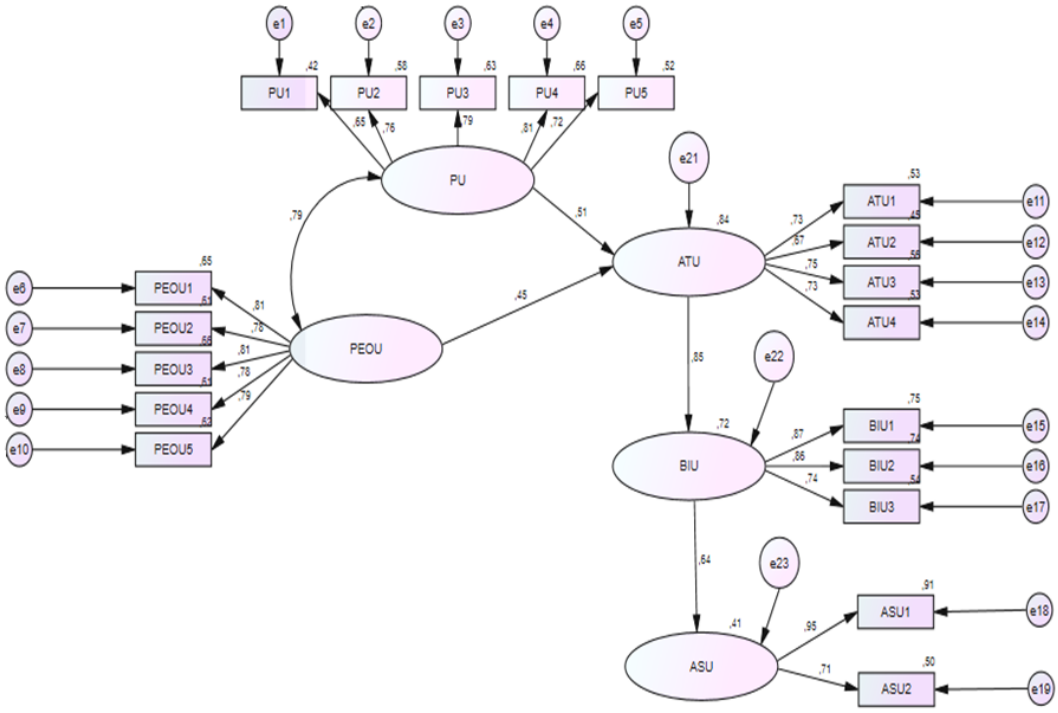

Figure 3. Structural Equation Model for Research Model TAM

Table 4. Structural Model Results for Research Model TAM

Items	*Estimate*	*t value*	*Cronbach's Alpha (α)*	R^2
PU			*0.898*	
PU1	0.649			0.421
PU2	0.759	20.352		0.576
PU3	0.795	17.303		0.632
PU4	0.812	17.57		0.659
PU5	0.723	16.095		0.523
PEOU			0.867	
PEOU1	0.806			0.650
PEOU2	0.779	22.43		0.607
PEOU3	0.812	23.655		0.659
PEOU4	0.781	22.344		0.610
ATU			0.809	
ATU1	0.729			0.531
ATU2	0.668	16.915		0.446
ATU3	0.747	18.974		0.558
ATU4	0.729	18.499		0.531
BIU			0.862	
BIU1	0.868			0.753
BIU2	0.863	28.278		0.745
BIU3	0.737	22.333		0.543
ASU			0.716	
ASU1	0.952			0.906
ASU2	0.710	15.308		0.504

According to Figure 3, a positive statistically significant relationship is found between PU independent latent variable and ATU dependent latent variable (0.51). This value indicates that a one-point increase in PU will lead to a 0.51 point increase in ATU, and vice versa, a decrease in PU will result in a decrease in ATU. The path coefficient value between PEOU independent latent variable and ATU dependent latent variable is 0.45. It is determined that there is a statistically significant and positive middle level relationship between these two latent variables. As a result of causal relationships between PU and PEOU exogenous latent variables and ATU endogenous latent variable, it was found that external variables explained 0.837 % of ATU.

Only the ATU latent variable has a direct effect on the BIU dependent latent variable. Relationship between these two latent variables is 0.85. ATU latent variable explained 72.3% of the BIU latent variable.

Finally, a positive middle level relationship was found between BIU and ASU latent dependent variables (0.64). The coefficient of determination for these two latent variables is 0.412.

The Structural Equation Model and R^2 for the proposed Structural Equations are given in the Table 5. In the light of the findings, all research hypotheses were confirmed statistically.

Table 5. The Structural Equations and R^2 for Proposed Structural Equation Model

Structural Equations	R^2
$ATU = 0.515 \times PU + 0.451 \times PEOU$	0.837
$BIU = 0.851 \times ATU$	0.723
$ASU = 0.642 \times BIU$	0.412

4. Discussion and Conclusion

In this research, it is aimed to show the effects of Perceived Usefulness, Perceived Ease of Use, Attitude Towards Use, Behavioral Intention to Use and Actual System Use factors on the model which determine the behavior of users related to mobile banking application covered by classical TAM model. In addition in this study, mobile banking TAM model has been tried to be created in Konya.

The first hypothesis tested in the research, "*H_1: Perceived Usefulness has a positive effect on Attitude Towards Use*". This hypothesis was accepted by SEM analyze results $(PU \rightarrow ATU : \gamma = 0.515,\ t\ value = 8.730,\ p < 0.05)$. The Perceived Usefulness value of bank customers has a positive effect on their Attitude Towards Use value.

The second hypothesis tested in the research, "*H_2: Perceived Ease Of Use has a positive effect on Attitude Towards Use*". This hypothesis was accepted by SEM analyze results $(PEOU \rightarrow ATU : \gamma = 0.451,\ t\ value = 8.338,\ p < 0.05)$. The Perceived Ease of Use value of bank customers has a positive effect on their Attitude Towards Use value.

The third hypothesis tested in the research, "*H_3: Attitude Towards Use has a positive effect on Behavioral Intention to Use*". This hypothesis was accepted by SEM analyze results $(ATU \rightarrow BIU : \gamma = 0.851,\ t\ value = 18.983,\ p < 0.05)$. The Attitude Towards Use value of bank customers has a positive effect on their Behavioral Intention to Use value.

The fourth hypothesis tested in the research, "*H_4: Behavioral Intention to Use has a positive effect on Actual System Use.*". This hypothesis was accepted by SEM analyze results $(BIU \rightarrow ASU : \gamma = 0.642,\ t\ value = 17.304,\ p < 0.05)$. The Behavioral Intention to Use value of bank customers has a positive effect on their Actual System Use value.

Consequently, all four research hypotheses tested for the study were accepted. The results of the study are similar to the TAM models previously performed. In the light of the hypotheses results, we can be said that the adaptation of bank customers in Konya to mobile banking application technology is high. For this reason, we can be said that customers think that mobile banking technology will provide benefits (increase in performance) in their own lives. The increase in mobile banking application users in Turkey (Figure 1) is parallel with the results of our study.

The research was carried out on customers in public, private and participation banks operating in Konya with restraints by time, cost and accessibility. For this reason, researchers interested in this subject can study with larger samples and in various provinces.

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