Enablers and restrictors of mobile banking app use: A fuzzy set qualitative comparative analysis (fsQCA)☆

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A B S T R A C T

Banking customers no longer require desktop computers to manage their accounts, because phones and tablets are currently always within reach. However, several factors may restrict the adoption of mobile banking apps. This study presents unpublished findings on mobile banking app use and identifies the potential barriers that currently restrict its wider adoption. Employing a fuzzy set qualitative comparative analysis (fsQCA), this study examines how perceived risk, perceived ease of use, perceived usefulness, compatibility, age, and income all affect mobile banking app use, and non-use, using empirical data from a sample of banking customers. The analysis of necessary conditions shows that mobile banking app use is associated with low perceived risk, high compatibility, high perceived ease of use, and high perceived usefulness. The findings also reveal that a combination of low compatibility, low perceived usefulness, low perceived ease of use, and a high perceived risk is a sufficient condition for mobile banking app non-use.

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1. Introduction

Customers no longer require desktop computers to manage their bank accounts, because their phones and tablets are always within their reach, which allows banking anytime, and anywhere. The potential of mobile banking warrants further research into its adoption and use. The increasing prevalence of mobile phones and tablets has expanded the demand for mobile banking services. The use of such devices to conduct banking transactions is less widespread than anticipated (Shaikh & Karjaluoto, 2015). Furthermore, adding customer value is at the heart of every business, which generates a need to understand which elements of mobile banking add value from the customer's perspective.

This study proposes a holistic approach to understand mobile banking app (MBA) use, which explores each case systematically, and views cases in terms of combinations of values, comparing their different combinations holistically (Ragin, 1997). MBA use depends on six commonly-identified enablers of mobile banking adoption (perceived risk, perceived ease of use, perceived usefulness, compatibility, age and income) (cf. Shaikh & Karjaluoto, 2015); however, MBA use likely depends on the relevant configurations of these factors.

Fuzzy set qualitative comparative analysis (fsQCA) is appropriate for this study, because this method focuses on the way that causal conditions combine with one another (Fiss, Sharapov, & Cronqvist, 2013; Ragin, 2000). That is to say that this method identifies how the antecedents of mobile banking usage combine to produce alternative configurations to achieve a similar outcome, namely, use (*use*) or non-use (*~use*) and which antecedents are necessary, or sufficient, to achieve this outcome. Ragin (2006) ascertains that a condition is necessary if this condition always holds when the outcome occurs. In contrast, a condition is sufficient if the outcome always occurs when the condition holds, even if outcomes occur under different conditions.

By examining the effect of the antecedents on MBA use, this study departs from prior research in three ways. First, by using qualitative comparative analysis, this study seeks configurations of what causes mobile banking use, rather than treating each antecedent separately. Second, unlike most studies, this study treats actual customer use of mobile banking as an outcome variable, and not the intention to use mobile banking. Third, this study explores apps that are installed in smartphones and tablets. These are now the new mediums of mobile banking.

2. Mobile banking app use

Mobile banking is a banking product or service to conduct financial and non-financial transactions using a mobile device such as a mobile

phone or tablet. Shaikh and Karjaluoto (2015) identify as many as 84 antecedents of mobile banking. Four commonly identified factors of mobile banking are used in this study, namely: perceived risk, perceived ease of use, perceived usefulness, and compatibility. This analysis also includes income and age, on account of their inconclusive effects on mobile banking adoption.

2.1. Perceived risk

Perceived risk (*prisk*) refers to certain types of financial product performance and the social, psychological, physical, and time risks when consumers make transactions online (Wu & Wang, 2005). One major risk of mobile banking is fraud and the increased threat to security that is associated with mobility (Corradi, Montanari, & Stefanelli, 2001). Previous research (e.g., Laforet & Li, 2005; Liu & Chen, 2009; Mallat & Rossi, 2009; Yang, 2009; Zhang, Zhu, & Liu, 2012) emphasizes the negative role of perceived risk on mobile commerce adoption. Therefore, when the risk of using mobile banking is higher, the willingness to use this technology is reduced. Accordingly, the following proposition is formulated:

Proposition 1. *Low perceived risk is a necessary condition to predict MBA use.*

2.2. Perceived ease of use

Mobile banking services benefit from user-friendly interfaces, which increase the likelihood of a positive attitude towards mobile banking. Perceived ease of use (*peou*) refers to the degree to which a person believes that using a particular system is effortless (Davis, Bagozzi, & Warshaw, 1989). Perceived ease of use has a significant effect on the adoption of and intention to use mobile banking (Davis et al., 1989; Wu & Wang, 2005). Many scholars consider perceived ease of use to be a significant precursor to the perceived credibility of internet banking (Wang, Wang, Lin, & Tang, 2003). Recent studies show that perceived ease of use has a significant effect on users' attitudes and thus influences the intention to adopt mobile banking (Chitungo & Munongo, 2013; Shaikh & Karjaluoto, 2015). This study therefore develops the following proposition:

Proposition 2. *Perceived ease of use is a necessary condition to predict MBA use.*

2.3. Perceived usefulness

Davis (1989) defines perceived usefulness (*pu*) as the degree to which a person believes that using a particular technology enhances his or her job performance. Customers adopt mobile banking systems because they consider them to be useful (Akturan & Tezcan, 2012; Amin, Hamid, Tanakinjal, & Lada, 2006). Customers can conduct financial transactions through mobile cell phone and tablets without having to travel to an actual bank. Perceived usefulness is thus associated with external efficiency and effectiveness (Tan & Teo, 2000) and has a direct impact on behavioral and usage intention (Agarwal & Karahanna, 2000; Venkatesh & Davis, 2000; Wu & Wang, 2005). This study concurs with prior research and predicts a similar usefulness effect on MBA use. Accordingly, this study develops the following proposition:

Proposition 3. *Perceived usefulness is a necessary condition to predict MBA use.*

2.4. Compatibility

Compatibility (*comp*) is defined as being the degree to which an innovation fits with the existing values, previous experiences, and current needs of a potential adopter (Rogers, 1995). Compatibility is one of the most commonly researched factors that is associated with mobile banking adoption (Wu & Wang, 2005). Studies (e.g., Chen, Lou, & Luo, 2002; Hanafizadeh, Behboudi, Koshksaray, & Tabar, 2014; Wu & Wang, 2005) show that high levels of compatibility with customers' lifestyles and preferences are associated with higher levels of technology adoption. Considering these findings, this study proposes the following:

Proposition 4. *Compatibility is a necessary condition to predict MBA use.*

2.5. Age

The literature requires additional research concerning the effect of age on mobile banking adoption. Some studies (e.g., Howcroft, Hamilton, & Hewer, 2002; Joshua & Koshy, 2011; Karjaluoto, Mattila, & Pento, 2002; Okazaki, 2006; Polatoglu & Ekin, 2001) indicate that younger customers, who are typically under 30 years old, prefer internet banking more than older customers (Puschel, Mazzon, & Hernandez, 2010). Other studies (e.g., Cruz, Neto, Munoz-Gallego, & Laukkanen, 2010) claim that older people perceive mobile banking as more difficult to use than younger people. In contrast, several studies suggest that middle-aged customers are the main users of mobile banking services. For example, Laukkanen and Pasanen (2008) conclude that the odds of middle-aged customers using mobile banking services is 1.9 times greater than the odds of 18–24 year-old customers using mobile banking services. Similarly, Laforet and Li (2005) conclude that a Chinese mobile banking user is aged up to 44 years. Other studies (e.g., Laukkanen & Cruz, 2012) conclude that age does not seem to have a significant effect on mobile banking adoption. Based on these inconclusive findings, the following proposition is posited:

Proposition 5. *Age is a necessary condition to predict MBA use.*

2.6. Income

The literature on online banking indicates that its users usually earn higher incomes. Al-Ashban and Burney (2001) argue that income level plays an important role in the adoption and use of telebanking services. Howcroft et al. (2002) suggest that high-income consumers express stronger preferences for non-branch methods. The studies by Lockett and Littler (1997), Polatoglu and Ekin (2001), and Karjaluoto et al. (2002) also suggest that customers with higher income levels favor internet banking more than older customers. However, Laukkanen and Cruz (2012) do not find a significant effect of income on mobile banking adoption. Considering these findings, the following proposition is suggested:

Proposition 6. *Income is a necessary condition to predict MBA use.*

2.7. Multiple routes to MBA use

Ragin (2000) argues that the same outcome can be achieved through different configurations of causal factors. While configurations of those factors that explain MBA use can potentially be numerous, equifinal configurations that effectively explain the phenomenon usually reduce to a few pattern of factors. FsQCA accounts for "equifinality", allowing for causal paths to lead to the same outcome (MBA use, or non-use). Drawing on the above arguments, the following proposition is suggested:

Proposition 7. *Disparate configurations of enablers (restrictors) of mobile banking apps (perceived risk, perceived ease of use, perceived usefulness, compatibility, age and income) are equifinal in leading to mobile banking app use (non-use).*

3. Data, measures, and method

3.1. Data

The target population of this study is banking customers who are aged 18 years and older, and who live in Portugal. The Portuguese market is appropriate for the purposes of this study. In the last quarter of 2014, mobile services in Portugal had a penetration rate of 160.5 per 100 inhabitants. That is, on average, each Portuguese citizen possesses more than one mobile phone (ANACOM, 2015). In addition, 57% of Portugal's population uses a smartphone, which is greater than Japan (54%), similar to the United States (57%), and close to the United Kingdom (71%) (Consumer Barometer with Google, 2015). Furthermore, the majority of internet banking studies were undertaken in Asia (Hanafizadeh, Keating, & Khedmatgozar, 2014).

An online survey was conducted in 2012 and produced a convenience and snowball sample of 439 valid responses. The survey was sent by e-mail to students studying in executive courses at a Portuguese university, and the survey was also shared through social media networks. Of the 439 respondents, 405 use home banking, 285 use mobile banking, and 126 use MBAs. In total, 55% of the sample is female, 45% of the participants are aged under 35 years (younger group), and 55% are aged 35 years or older (older group). Finally, the annual income of the respondents is 15% with less than €10,000, 43% with between €10,000 and €25,000, 24% with between €25,000 and €40,000, and the remaining 18% with more than €40,000.

3.2. Measures

The first section of the questionnaire recorded the subjects' demographic information, including age, and income. The second section asked the subjects to indicate their degree of agreement with each item. The items related to the four antecedents were extracted and adapted from Wu and Wang (2005). Before the final revisions, the items that were translated to Portuguese were again translated back into English, and the back-translation showed a strong equivalence. The questionnaire was pre-tested through face-to-face interviews with 10 banking customers, and changes were made until the desired phenomena were captured. Some items were eliminated and other items were modified to reduce ambiguity or a duplication of meaning. The final survey consisted of 17 items that measured four factors, namely, perceived risk, perceived ease of use, perceived usefulness and compatibility. Before the calibration of the variables, an index (score) was calculated for each factor by averaging the corresponding items.

The data were collected by using a five-point Likert-type scale, where 1 indicates "strongly disagree" and 5 indicates "strongly agree". Perceived risk (*prisk*) is captured on a six-item Likert-type scale (e.g., "I think MBAs are not secure because they use the internet" and "I think MBAs increase the risk of fraud"). To measure perceived ease of use (*peou*), this study uses three items (e.g., "I think using MBAs is easy" and "I think learning MBAs is easy"). Perceived usefulness (*pu*) uses four items (e.g., "using MBAs allows for carrying out financial transactions anywhere, anytime" and "I think using MBAs facilitates my daily life"). Finally, four items measure compatibility (*comp*) (e.g., "using MBAs fits my personal style" and "using MBAs fits well because I use the internet"). The internal consistency is high. All factors exceed the recommended minimum Cronbach's alpha coefficient ($\alpha = 0.70$) (Nunnally, 1978): *prisk* ($\alpha = 0.90$), *peou* ($\alpha = 0.90$), *pu* ($\alpha = 0.83$), and *comp* ($\alpha = 0.90$).

To address the issue of common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) that threatens the validity of the results, this study uses Harman's single factor test. The Bartlett test of sphericity is significant ($\chi^2 = 4956.4$, $p < .000$), showing that sample data is suitable for the analysis. The four factors with an eigenvalue of more than 1.0 account for 73% of variance. The first factor accounts for 45% of the variance, that is to say that the items do not merge into one factor. This study distinguishes four factors. The mono-method bias is not a serious problem.

3.3. Method

This study uses a specific type of qualitative comparative analysis, namely, fsQCA. The necessary conditions analysis emphasizes the cases that influence the outcome, which are then used to test the propositions. The analysis uses an algorithm to simplify the combinations and minimize the solutions. To explore the possibility that causal recipes of two or more variables influence MBA use, each variable is calibrated by using the fsQCA 2.5 software program (www.fsqca.com).

The outcome is a dichotomous variable that distinguishes between the customers who use MBAs (*use*), and the customers who do not (*~use*). The conditions are: perceived risk (*prisk*), perceived ease of use (*peou*), perceived usefulness (*pu*), compatibility (*comp*), age (*age*), and income (*inc*). The original scales of perceived risk, perceived ease of use, perceived usefulness, and compatibility are all calibrated into a fuzzy set scale, which is recommended by Woodside (2013). The original value that covers 5% of the data values is set as the point of full non-membership, the original value that covers 50% of the values is set as the cross-over point, and the original value that covers 95% of the values is set as the point of full non-membership. Table 1 provides the statistics and original values of these three points for *prisk*, *peou*, *pu*, and *comp*.

Age is a dichotomous condition that establishes whether a banking customer is older than 35 years (which codes a banking customer as 1, fully in this set), or is younger than 35 years (which codes a banking customer as 0, outside the set). As proposed by Feurer, Baumbach, and Woodside (2016), income is a fuzzy set condition which depends on a banking customer's annual income (under €10,000 = 0, between €10,000 and €25,000 = 0.25, between €25,000 and €40,000 = 0.75, and over €40,000 = 1).

4. Findings

Configurations leading to MBA use might be different from those leading to MBA non-use, as configurations in fsQCA are asymmetrical (Woodside, 2013). Schneider and Wagemann (2010), and Woodside (2014) argue that the outcome and the negation of the outcome should always be dealt with in two separate analyses. Therefore, the first explains which conditions lead to the outcome MBA use (*use*). The second analysis investigates the alternative model of MBA use (*~use*). QCA tests the following models:

$$use = f(prisk, peou, pu, comp, age, inc)$$
$$\sim use = f(prisk, peou, pu, comp, age, inc).$$

The first step of the analysis seeks the conditions that are necessary for the outcome. It examines whether a single condition is always

Table 1
Summary data for perceived risk, perceived ease of use, perceived usefulness, and compatibility.

Statistics		Prisk	Peou	Pu	Comp
N	Valid	439	439	439	439
	Missing	0	0	0	0
Mean		2.80	4.08	4.05	4.02
Std. error of mean		0.04	0.03	0.03	0.04
Median		2.80	4.00	4.00	4.00
Std. deviation		0.77	0.70	0.71	0.88
Minimum		1.00	2.00	1.00	1.00
Maximum		5.00	5.00	5.00	5.00
Calibration value at					
95%		4.00	5.00	5.00	5.00
50%		2.83	4.00	4.00	4.00
5%		1.50	3.00	3.00	2.25

present, or absent, when the outcome is present (or absent). Ragin (2000) proposes 0.80 for causal factors that are "almost always" necessary or sufficient, and 0.65 for causal conditions that are "usually" necessary or sufficient. With regard to MBA use, the consistency scores range between 0.20 and 0.80. Non-use of MBA consistency scores of 0.43 to 0.57 was observed (see Table 2). Superscript indicate those conditions that meet, or exceed, the 0.65 consistency benchmark. The left side of Table 2 shows that, as proposed, lower perceived risk, higher compatibility, perceived ease of use, and perceived usefulness appear to be important enabling conditions of MBA use. Age and income do not seem to be strong enablers for MBA use. The right side of Table 2 shows that none of the conditions exceeds the usually necessary threshold, that is, they are not necessary for causing MBA non-use.

The second step of the analysis involves construction of the truth table, reducing it to meaningful configurations, and producing a reduced set of logic statements describing the underlying causal patterns. The consistency threshold for the truth table is only achieved for MBA non-use. Table 3 shows the fsQCA analysis of MBA use and MBA non-use. The solution table indicates that Models 1a and 1b for MBA use do not achieve the minimum recommended consistency threshold of 0.65 (Ragin, 2000) to draw conclusions. Models 2a to 2e show a different pattern of solutions found for MBA non-use. All configurations comply with the consistency threshold. As Table 3 shows, the solution consistency is 0.87, and the model explains 41% of the cases of MBA non-use.

Five configurations explain the higher percentage of cases, where C1 = consistency and C2 = raw coverage:

$$\sim comp* \sim pu* \sim peou * prisk \ (2a, C1 = .87, C2 = .32).$$

A combination of low compatibility with customer lifestyle, low perceived usefulness, perceived difficulty of use, and a high perceived risk is a sufficient condition for MBA non-use.

$$\sim comp* \sim pu* \sim peou* \sim inc* \sim age \ (2b, C1 = .86, C2 = .14).$$

A sufficient condition for MBA non-use is low compatibility, low perceived usefulness, low perceived ease of use, low income, and being under 35 years old.

$$\sim pu* \sim peou * prisk* \sim inc* \sim age \ (2c, C1 = .86, C2 = .13).$$

A configuration of low perceived usefulness, low perceived ease of use, high perceived risk, low income, and being under 35 years old is a sufficient condition for not using MBA.

$$\sim comp* \sim peou * prisk* \sim inc* \sim age \ (2d, C1 = .87, C2 = .14).$$

Table 2
Overview of the necessary conditions.

Condition	Mobile banking app			
	Use (use)		Non-use (~use)	
	Consistency	Coverage	Consistency	Coverage
Prisk	0.33	0.19	0.55	0.81
~Prisk	0.67[a]	0.38	0.45	0.62
Comp	0.80[a]	0.41	0.47	0.59
~Comp	0.20	0.13	0.53	0.87
Peou	0.77[a]	0.41	0.44	0.59
~Peou	0.23	0.14	0.56	0.86
Pu	0.67[a]	0.36	0.48	0.64
~Pu	0.33	0.20	0.52	0.80
Age	0.59	0.31	0.54	0.69
~Age	0.41	0.26	0.46	0.74
Inc	0.57	0.35	0.43	0.65
~Inc	0.43	0.23	0.57	0.77

Note: ~ indicates the absence of a condition.
[a] Meets 0.65 consistency benchmark for usually necessary conditions.

Table 3
Results of the intermediate solution.

	Mobile banking app							
	Outcome: use		Outcome: non-use					
	1a	1b	2a	2b	2c	2d	2e	2f
Prisk	○	○	●		●	●		●
Comp	●	●	○	○		○	○	○
Peou	●	●	○	○	○	○	○	●
Pu	●	●	○	○	○		○	●
Age		●		○	○	○	●	●
Inc	●			○	○	○	●	○
Consistency	0.46	0.48	0.87	0.86	0.86	0.87	0.84	0.81
Raw coverage	0.35	0.29	0.32	0.14	0.13	0.14	0.14	0.07
Unique coverage	0.13	0.07	0.07	0.02	0.01	0.02	0.02	0.02
Solution coverage	0.42		0.41					
Solution consistency	0.47		0.87					

Note: black circles indicate the presence of a condition; empty circles indicate the absence. Frequency cut-off: 2. Mobile banking app use consistency cut-off: 0.40. Mobile banking app non-use consistency cut-off: 0.80.

Another sufficient condition for MBA non-use is low compatibility, low perceived ease of use, high perceived risk, low income, and being less than 35 years old.

$$\sim comp* \sim pu* \sim peou * inc * age \ (2e, C1 = .84, C2 = .14).$$

Finally, a sufficient condition for MBA non-use is low compatibility, low perceived usefulness, low perceived ease of use, high income, and being over 35 years old.

This study confirms Propositions 1 ("*Low perceived risk is a necessary condition to predict MBA use*"), 2 ("*Perceived ease of use is a necessary condition to predict MBA use*"), 3 ("*Perceived usefulness is a necessary condition to predict MBA use*"), and 4 ("*Compatibility is a necessary condition to predict MBA use*"). The analysis fails to confirm Propositions 5 ("*Age is a necessary condition to predict MBA use*") and 6 ("*Income is a necessary condition to predict MBA use*"). The findings in Table 3 support Proposition 7 ("*Disparate configurations of enablers (restrictors) of mobile banking apps (perceived risk, perceived ease of use, perceived usefulness, compatibility, age and income) are equifinal in leading to mobile banking app use (non-use)*"). MBA non-use is indicated by different configurations which include perceived risk, perceived ease of use, perceived usefulness, compatibility, age and income. For example, there are two distinct configurations which influence MBA non-use in Models 2a and 2b. First, MBA non-use is achieved by high perceived risk, low compatibility, low perceived ease of use and low perceived usefulness. However, MBA non-use is also achieved in the case of younger and lower income customers by low compatibility, low perceived ease of use and low perceived usefulness.

5. Discussion

This study analyzes six conditions (perceived risk, perceived ease of use, perceived usefulness, compatibility, age, and income) that affect MBA use and non-use. FsQCA (Ragin, 1987) is used to identify the combinations of causes in a context, which is a limitation of the traditional probabilistic statistical techniques. Qualitative comparative analysis allows the building of typologies (Fiss, 2011), and each configuration describes a group of banking customers that evaluate MBA use as a distinct combination of factors.

This study departs from prior research, as it examines which configurations, rather than which individual factors cause mobile banking use. The findings show that perceived risk, compatibility, perceived ease of use, and perceived usefulness are usually necessary individual antecedent conditions for MBA use. However, none of the factors is a necessary condition for MBA non-use. Second, results show equifinal configurations leading to MBA non-use, and that age and income can relate to

MBA non-use, depending on their configuration with other characteristics. Banks must consider a combination of variables that enable or restrict MBA use. That is to say, if an MBA adds financial risk, and if it is not compatible with customers' lifestyle, is difficult to use, and is not useful, then the odds are that customers will not use it.

Despite branded app benefits on persuasive impact and an interest in the brand and in the product category (Bellman, Potter, Treleaven-Hassard, Robinson, & Varan, 2011), this is one of the first studies on MBAs. This study is also one of the few studies that examines the interaction among mobile banking antecedents. A major implication of this research is that the use and non-use of MBAs depend on multiple configurations of perceived risk, compatibility, perceived ease of use, perceived usefulness, age and income, which is of interest to banks and other financial institutions which distribute their products and services electronically. This study has certain limitations. First, the results do not factor in changes in use over time. Second, the participants are voluntary banking customers; thus, self-reported measures may not be representative of the general population. Finally, other drivers of mobile banking adoption are missing from the analysis, which is a shortcoming that can be addressed by including other drivers, such as self-efficacy, cost, and trialability.

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