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Adoption of mobile banking services: A comparative analysis of four competing theoretical models

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A comparative analysis of four competing theoretical models

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Abstract

Purpose – The purpose of this paper is to investigate which of four well-established theoretical models (i.e. technology acceptance model, theory of planned behavior, unified theory of acceptance and use of technology, decomposed theory of planned behavior (DTPB)) best explains potential users' behavioral intentions to adopt mobile banking (MB) services.

Design/methodology/approach – Drawing on data from 931 potential users in Greece, the structural equation modeling method was used to examine and compare the four models in goodness-of-fit, explanatory power and statistical significance of path coefficients.

Findings – Results indicate that the best model is an extension of the DTPB with perceived risk (PR). Customers' attitude, determined by three rationally-evaluated MB attributes (usefulness, easiness and compatibility), is the main driver of consumers' intentions to adopt MB services. Additionally, consumers' perceptions of availability of knowledge, resources and opportunities necessary for using the service, and the pressure of interpersonal and external social contexts toward the use of MB are the other two, less important, adoption drivers. Finally, PR negatively affects attitude formation and inhibits willingness to use MB services.

Practical implications – Findings can help marketers of financial institutions to select the more parsimonious model to develop appropriate marketing strategies to increase adoption rates of MB services.

Originality/value – This is the first study that compares the performance of four well-known innovation adoption models to explain consumers' behavior in the MB context.

Keywords Online consumer behaviour, Perceived risk, M-banking, Innovation adoption models comparison, Technology-based services

Paper type Research paper

1. Introduction

Mobile banking (MB), also known as m-banking, is one of the recent technology-based financial services provided by banks and other financial service providers (Shaikh and Karjaluoto, 2015) that allows its customers to conduct banking transactions remotely through an application and on a 24 h basis (Oliveira *et al.*, 2014). MB provides access to customers' bank accounts through mobile devices in order to execute bank transactions such as checking account status, transferring money, etc. (Tam and Oliveira, 2017). Luo *et al.* (2010) define

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MB as an innovative method for accessing banking services via a channel where the customer interacts with a bank using a mobile device.

Practitioners agree that mobile internet is a main growth opportunity for banks and financial service providers (Rilling, 2015). Many banking institutions around the globe have made substantial investments in mobile applications in order to provide better services to their customers and become more efficient by decreasing operating costs. Broeders and Khanna (2015) of McKinsey & Co., argue that "revenues and profits will migrate toward banks that successfully use digital technologies to automate processes, create new products, improve regulatory compliance, transform the experiences of their customers, and disrupt key components of the value chain." Studies, however, show that banks do not seem to benefit as much from MB in terms of significant cost savings as they benefit from the migration of traditional banking to e-banking (Shaikh and Karjaluoto, 2015). Although banks might not have strong benefits to advance MB services, scholars argue that the future development of MB is highly dependent on the consumer perspective (e.g. Koenig-Lewis *et al.*, 2010).

There is a proliferation of studies on the factors that affect customer intentions to adopt MB services. Shaikh and Karjaluoto (2015) and Tam and Oliveira (2017), among others, provide recent systematic reviews of MB adoption literature, and Baptista and Oliveira (2016) perform a combination of weight and meta-analysis in order to identify the frequency and relevance of the most used constructs and the most important relationships of different constructs with customers' intentions to adopt MB services. From previous research efforts, we observe that there are five well-known theoretical intention-based models used as theoretical research frameworks in order to explain the MB adoption process. These are the innovation diffusion theory (IDT) (Rogers, 1995), the technology acceptance model (TAM) (Davis *et al.*, 1989), the theory of planned behavior (TPB) (Fishbein and Ajzen, 1975), the decomposed theory of planned behavior (DTPB) (Taylor and Todd, 1995) and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh *et al.*, 2003). Most studies on MB adoption extend the TAM framework with elements from the TPB (social influence) and/or the IDT (compatibility) in order to analyze, apart from the innovation features and consumer's attitude, the personal and social factors of the innovation adoption process (e.g. Mehrad and Mohammadi, 2017; Muñoz-Leiva *et al.*, 2017; Raza *et al.* 2017; Roy *et al.*, 2017; Arif *et al.* 2016; Mohammadi, 2015; Deb and Lomo-David, 2014; Akturan and Tezcan, 2012; Koenig-Lewis *et al.*, 2010; Wessels and Drennan, 2010). Other studies use the IDT as an innovation adoption theoretical framework in which five innovation-related characteristics determine potential customers' willingness to use MB (e.g. Al-Jabri and Sohail, 2012; Khraim *et al.*, 2011). Others rely on the UTAUT (e.g. Raza *et al.* 2017; Afshan and Sharif, 2016; Bhatiasevi, 2016; Tan and Lau, 2016; Oliveira *et al.*, 2014; Yu, 2012) to explain the MB adoption process. Finally, four studies use the DTPB, a model that integrates all the other four models of innovation adoption, as a theoretical framework of the MB acceptance process (Khasawneh and Irshaidat, 2017; Kazemi *et al.*, 2013; Püschel *et al.*, 2010).

While these theoretical models initially consider only constructs that facilitate innovation adoption, various previous studies identify the importance of considering also the risk factors that inhibit innovation adoption (Featherman and Pavlou, 2003). Therefore, the combination of the different innovation adoption theories with the perceived risk theory (PRT) is useful to explain the innovation adoption mechanism (Featherman and Pavlou, 2003). MB adoption studies also consider the risk level associated with a service, expressed as consumers' feelings of uncertainty or anxiety about using the service or as the seriousness or importance of possible negative outcomes, as one of the salient determinants of MB adoption (e.g. Muñoz-Leiva *et al.*, 2017; Roy *et al.*, 2017; Giovanis and Athanasopoulou, 2017; Raza *et al.,* 2017; Arif *et al.,* 2016; Tan and Lau, 2016; Mohammadi, 2015; Akturan and Tezcan, 2012; Yu, 2012; Koenig-Lewis *et al.*, 2010; Wessels and Drennan, 2010).

Previous studies rely on the theory of comparison approach (Lin, 2007) to compare certain innovation adoption models in their capacity to explain consumer intentions in the contexts of e-banking (Tan and Teo, 2000; Taylor and Todd, 1995), business information technology (Huh *et al.*, 2009; Huh *et al.*, 2009; Chau and Hu, 2001) and online shopping (Grandón *et al.*, 2011; Lin, 2007). However, despite the rapid growth of MB worldwide, there are no studies that compare the capability of different theoretical models to explain the MB adoption process. To fill the research gap, this study aims to investigate which relevant basic theoretical intention-based model is best in explaining potential customers' willingness to adopt MB services.

To do this, the TAM, the TPB, the DTPB and the UTAUT combined with the PRT are used to model the MB adoption process. Then, following the theory of comparison approach proposed by Rust *et al.* (1995), the four models are compared with respect to overall model fit, explanatory power, statistical significance of path coefficient, and, overall, in terms of the extent to which each model can explain customers' intentions to use mobile devices to perform banking transactions. Finally, the theoretical and managerial relevance of the investigated models is discussed and directions for further study are provided.

2. Literature review and description of innovation adoption models

Although there are several models used to explain innovation adoption in the online financial services context, most of them are extensions or combinations of the four models compared in this study. This section describes the theoretical models used in the comparison study (i.e. TAM, TPB, DTPB and UTAUT) and reviews the most recent studies that use each of these models in the context of MB adoption.

2.1 Theory of planned behavior (TPB)

The TPB, proposed by Ajzen (1991), is the first model considered in this study. It is an extension of the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975) that assumes that an individual's behavior is mainly affected by its behavioral intentions (BI) to perform an action, which is in turn determined by its attitude (ATT) and subjective norms (SN). Attitude is defined as "an individual's positive or negative feeling towards performing the target behavior" (Taylor and Todd, 1995; p. 149). SN represent "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen, 1975, p. 302). In the context of technology-based service adoption, ATT expresses consumers' predisposition or tendency to respond positively or negatively toward the use of services, and SN refer to consumers' perceptions regarding the opinions of a reference group toward the use of services. The TPB extends the TRA to consider conditions where individuals do not have complete control over their behavior (Ajzen, 1991). For this reason, an additional factor is proposed, called perceived behavioral control (PBC), to express an individual's perception about the internal and external constraints on behavior. In the context of MB adoption, PBC describes consumer perceptions of the availability of knowledge, resources and opportunities necessary for using the service.

The impact of ATT, SN and PBC on potential customers' BI to use technology-based self-services to perform their banking transactions is empirically validated in many relevant studies (e.g. Giovanis and Athanasopoulou, 2017; Khasawneh and Irshaidat, 2017; Deb and Lomo-David, 2014; Püschel *et al.*, 2010; Tan and Teo, 2000). Drawing on the so-called internalization mechanism, Venkatesh and Davis (2000) suggest the partial mediation effect of ATT on the relationship between SN and BI, while Rao and Troshani (2007) argue that SN affect BI indirectly, through ATT. Also, relevant empirical studies provide evidence that if a peer or an industry expert or a media report suggests that a service might be good, a potential adopter may tend to form a positive attitude toward it before expressing an

intention to use it (Del Bosque and Crespo, 2011; Schierz *et al.*, 2010). Also, Grandón *et al.* (2011) conclude that crossover effects from normative beliefs to ATT are significant and improve TPB model fit and Tran and Corner (2016) find that the attitude of potential customers toward the usefulness of MB services partially mediates the impact of social influences on customers' intention to use the service. The effect of SN on ATT formation increases for services that are in the early stages of the diffusion process, where potential adopters lack reliable usage information. Therefore, if the social context supports the usage of a technology, this affects the adoption decision process.

2.2 Technology acceptance model (TAM)

The second model under investigation is the TAM. Davis *et al.* (1989) propose the TAM to explain and predict the adoption and usage of information technology products and services. The development of TAM is also based on the TRA (Fishbein and Ajzen, 1975), since it considers ATT to be the main determinant of BI while ATT is further affected by customer's salient beliefs about the desirability of the innovation's attributes. TAM anticipates that customers' perceptions about the innovation's usefulness and easiness are two beliefs that determine ATT toward customers' intentions to use MB. Perceived usefulness (PU) expresses the degree to which "a person believes that use of the system will enhance his or her performance," and perceived ease-of-use (PEOU) is the degree to which "a person believes that using the system will be free of effort" (Venkatesh and Davis, 2000; p. 187). Additionally, Davis *et al.* (1989) find that PU acts as a mediator since PEOU influences BI primarily through PU. Venkatesh and Davis (2000) introduce, at a later stage, TAM2 that does not consider ATT to be a mediating variable between PU, PEOU and BI. They suggest that the effect of ATT on BI decreases over time, while the effects of PU and PEOU on BI increase (Venkatesh and Davis, 2000).

Both TAM and TAM2 are extensively used and supported in various studies in the MB acceptance context. Several studies use the TAM to model the MB adoption process and find that ATT, either partially or fully, mediates the relationship between consumers' beliefs about MB attributes (i.e. PU and PEOU) and their intentions to use it (BI) (e.g. Mehrad and Mohammadi, 2017; Muñoz-Leiva *et al.*, 2017; Raza *et al.,* 2017; Roy *et al.*, 2017; Arif *et al.*, 2016; Deb and Lomo-David, 2014; Akturan and Tezcan, 2012; Lin, 2011; Wessels and Drennan, 2010). Other studies prefer the TAM2 to model directly the effects of consumers' beliefs about MB attributes (i.e. PU and PEOU) on BI (e.g. Alalwan *et al.*, 2016; Cheah *et al.*, 2011; Kesharwani and Bisht, 2012). While all previous studies empirically confirm the significant impact of PU on BI, some of them fail to come to the same conclusion about the relationship between PEOU and BI (Kesharwani and Bisht, 2012; Koenig-Lewis *et al.*, 2010).

2.3 Decomposed theory of planned behavior (DTPB)

The third theoretical model under investigation is the DTPB. It is proposed by Taylor and Todd (1995) and extends the TPB by identifying the beliefs and factors that directly affect ATT, SN and PBC and, through these, BI. According to Taylor and Todd (1995), the attitudinal, normative and control BI determinants can be decomposed into multidimensional constructs.

Based on the IDT (Rogers, 1995), the DTPB decomposes ATT into three innovation characteristics: relative advantage, complexity and compatibility. Relative advantage expresses the degree to which a new technology provides more benefits than its precursor. Economic benefits, efficiency, convenience, image enhancement and satisfaction are among the benefits used by potential adopters to evaluate the superiority of an innovation (Rogers, 1995). The complexity construct refers to the degree to which an innovation is perceived to be difficult to understand and use (Lin, 2007). Moore and Benbasat (1991) find that the relative advantage and complexity constructs are similar to PU and PEOU, respectively,

and that TAM and IDT reconfirm each other's findings, which enhances the confidence in the validity and reliability of these approaches (Lin, 2007). Compatibility (COMP) refers to the extent to which an innovation is perceived as being consistent with potential customers' existing values, past experiences and needs (Rogers, 1995). According to Moore and Benbasat (1991), the probability of innovation adoption is positively related to the consistency of the innovation with potential adopters' value systems and procedures. The importance of COMP as an ATT driver is also proved from the fact that it is added as an extension to empirical studies that use TAM as the dominant theory (Lin, 2011; Wessels and Drennan, 2010).

Furthermore, regarding the structure of normative beliefs, previous studies consider personal and environmental influences as antecedents of SN (e.g. Bhattacherjee, 2000; Del Bosque and Crespo, 2011; Lin, 2007; Taylor and Todd, 1995). Bhattacherjee (2000) and Lin (2007) consider interpersonal influence (IPI) and external influence (EXI) as the two main determinants of SN. IPI reflects the influence of friends, colleagues and superiors through word-of-mouth communication, and EXI includes mass media reports, opinion leaders' suggestions and other information transmitted by non-personal sources.

Moreover, the decomposition of PBC includes two constructs: self-efficacy (SEF) and facilitating conditions (FC). SEF refers to potential users' perceptions about their capabilities to use the innovation, and FC reflect the availability of necessary resources to perform particular behaviors (Taylor and Todd, 1995).

Overall, four previous studies use the DTPB to explain the adoption of MB (Giovanis and Athanasopoulou, 2017; Khasawneh and Irshaidat, 2017; Kazemi *et al.*, 2013; Püschel *et al.*, 2010). Püschel *et al.* (2010) find that mainly ATT and, to a lesser extent, SN significantly affect customers' BI to use MB, while the effect of PBC on BI is insignificant. Moreover, COMP and relative advantage and both FC and SEF significantly contribute to the formation of potential customers' ATT and PBC beliefs, respectively. Kazemi *et al.* (2013) empirically validate the importance of potential customers' attitudinal and behavioral control beliefs as determinants of BI but do not find a significant impact of normative beliefs on BI. All innovation-related attributes (i.e. PU, PEOU and COMP) significantly affect ATT, IPI is the only significant determinant of SN and, finally, SEF is the most significant driver of PBC followed by SEF. Khasawneh and Irshaidat (2017) confirm the results of Püschel *et al.* (2010) regarding the nature of relationships among the attitudinal, normative and behavioral control beliefs and potential customers' intention to use MB services. Among the three utilized determinants of ATT, relative advantage and compatibility are the most significant contributors of individuals' attitudinal beliefs, while complexity is not. Social influence, a construct reflecting IPI, is the only determinant of SN and both FC and SEF explain the formation of behavioral control beliefs. Finally, Giovanis and Athanasopoulou (2017) validate the importance of the three antecedents of BI (ATT, SN, PBC) as well as their proposed structure.

While several previous studies empirically confirm the validity of the originally formulated DTPB, there are other studies in the field of technology-based service adoption that support extra relationships that are not included into this version of the model and can be used to extend the model's theoretical relevance (Del Bosque and Crespo, 2011). By considering the TAM framework, potential customers' BI are also influenced by PU of MB services in the presence of their ATT about this service which, in turn, is affected by PEOU (Davis *et al.,* 1989). While empirical evidence obtained from previous studies in the field of MB acceptance supports the positive influence of PEOU on PU (e.g. Akturan and Tezcan, 2012; Lin, 2011; Mehrad and Mohammadi, 2017; Mohammadi, 2015; Wessels and Drennan, 2010), the results regarding the relationship between PU and BI in the presence of ATT are somehow contradictory. Several studies fail to empirically validate the partial mediation of ATT in the PU–BI link and, therefore, to support the relevant direct link (e.g. Muñoz-Leiva *et al.*, 2017;

Arif *et al.,* 2016; Akturan and Tezcan, 2012), while other studies provide empirical evidence that PU, along with ATT, affects BI (e.g. Mehrad and Mohammadi, 2017; Raza *et al.,* 2017; Mohammadi, 2015; Wessels and Drennan, 2010). Moreover, IDT studies suggest that individuals who feel compatible with a new technology (i.e. m-banking) are in a better position to evaluate the usefulness of the new technology (Rogers, 1995). Such studies integrate COMP into the TAM framework and propose a direct impact of COMP on PU in addition to that on ATT (Raza *et al.* 2017; Mohammadi, 2015). Finally, following the aforementioned relationship between SN and ATT, as discussed during the presentation of the TPB, highlighting the role of normative beliefs in potential customers' attitude formation, the current version of the DTPB considers SN to be an additional determinant of ATT that further enhances its relationship with BI (Del Bosque and Crespo, 2011; Schierz *et al.*, 2010).

2.4 Unified theory of acceptance and use of technology (UTAUT)

The fourth model, the UTAUT, emerged from an in-depth literature review of the main theoretical models developed to explain technology acceptance (Venkatesh *et al.*, 2003). According to the model developers, the UTAUT contains the most important contributions of previous theoretical approaches and, as such, is expected to perform better in explaining technology adoption. The UTAUT contains four key drivers of innovation adoption: performance expectancy (PE), effort expectancy (EE), social influence (SI) and FC. These determinants are defined as follows (Venkatesh *et al.*, 2003; pp. 447-453). PE refers to "the degree to which a potential adopter has the opinion that the innovation adoption will help him to improve the performance of a task or work." Thus, this variable is similar to PU (TAM, DTPB) and relative advantage (IDT). EE refers to "the degree of ease associated with use of the innovation." It is similar to variables included in previous suggested models such as PEOU (TAM, DTPB) and complexity (IDT). SI is defined "as the degree to which an individual perceives that important others believe he or she should use the innovation." It reflects the normative drivers of the innovation adoption process and has the same meaning with SN (TPB, DTPB). Finally, FC is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (TPB, DTPB). The original UTAUT considers that PE, EE and SI are antecedents of BI, while BI and FC are antecedents of potential customers' actual behavior. Hence, this model assumes that the concept of "BI captures the motivational factors that affect the potential adopters' behavior and reflects the effort that they are willing to undertake in order to develop an action" (Ajzen, 1991). On the other hand, FC expresses the environmental factors that restrict or enhance the acceptance of an innovation (Venkatesh *et al.*, 2003). The empirical evidence regarding the role of FC on the innovation adoption process is contradictory. Some authors exclude FC from the UTAUT framework (e.g. Van Raaij and Schepers, 2008). Other authors assume that FC directly affect BI instead of actual behavior (e.g. San Martín and Herrero, 2012). This is probably so because FC affect the cognitive process that generates potential adopters' intentions and not necessarily their behavior. Therefore, this study adopts the latter approach and considers FC as an additional determinant of BI. In accordance with many previous studies that use UTAUT (Bhatiasevi, 2016; Tan and Lau, 2016), this study does not explore the role of moderating variables included into the originally developed model (i.e. gender, age, experience, voluntary use).

There are five previous studies using UTAUT to explain the factors affecting the adoption of MB services. Three of them assume that PE, EE, and SI directly affect BI, while FC and BI are assumed to be antecedents to actual behavior (Bhatiasevi, 2016; Oliveira *et al.*, 2014; Yu, 2012). Yu (2012) empirically validates the impact of PE and SI on BI but not that of EE. He also finds that both BI and FC directly determine actual behavior. Oliveira *et al.* (2014) confirm the direct impact of PE on BI, since other constructs (i.e. task technology fit

and initial trust) neutralize the relevant effects of EE and SI. BI is the only determinant of actual behavior as the relationship between FC and actual behavior is insignificant. Bhatiasevi (2016) confirms the positive effects of PE, EE and SI on BI, while the effect of FC on actual behavior is not significant. Tan and Lau (2016) find that all three antecedents (PE, EE and SI) significantly affect BI. However, they do not consider FC, as they do not investigate MB customers' actual behavior. On the other hand, Afshan and Sharif (2016) use the model proposed by Oliveira *et al.* (2014), but they consider the cognitive character of FC and assume that FC, along with PE, EE and SI, also affect BI. Their findings indicate that only FC affect BI directly while EE and PE affect BI only indirectly, through task technology fit and initial trust.

2.5 Perceived risk theory and technology acceptance

All previously described theoretical frameworks consider certain attitudinal, normative and control beliefs that favor the usage of MB services. However, Featherman and Hajli (2016), based on TRA, assert that potential customers may also develop risk beliefs, focused on MB service performance problems and the ensuing personal losses. Perceived risk (PR) in the context of technology-based services is defined as "the potential for loss in the pursuit of a desired outcome of using the service" (Featherman and Pavlou, 2003, p. 453). Previous studies suggest that when consumers evaluate a technology-based service, they develop beliefs about the service itself and its potential usage, which may include risk beliefs (Featherman and Hajli, 2016). These risk beliefs are used by consumers when they assess the usage risk of a new technology-based service, and this affects their attitudes and intentions toward new service usage. Moreover, high levels of PR, apart from inhibiting new service usage, also extend the information searching stage since potential customers ask for more information from their personal and/or non-personal acquaintances in order to make a more secure decision (Featherman and Hajli, 2016). Those that do not find enough information to reduce usage risk may reject or delay new service adoption. The use of MB services, like the use of mobile services, involves risk because it may be related to negative consequences or losses that are not expected by users (Yang *et al.*, 2015). Since people prefer to avoid risks than maximize utility when faced with a risky decision, PR is one of the key variables that are expected to determine the behavior of potential MB service adopters (Yang *et al.*, 2015).

PR in the digital services context is generally conceptualized as a multidimensional construct (e.g. Park and Tussyadiah 2017; Featherman and Hajli (2016); Hsieh and Tsao, 2014; Crespo *et al.*, 2009). Focusing on the digital banking context, many studies (e.g. Lee, 2009; Martins *et al.*, 2014; Yang *et al.*, 2015; Alalwan *et al.*, 2016) adopt a measure of PR with five-dimensions. These are financial risks that express the potential adopters' perception about the possible loss of money caused by the usage of MB; privacy risk expressing potential loss of control over private information (i.e. phone number, passwords, consumption location, buying records, etc.) that is transmitted during m-banking usage and is exposed to potential theft; performance risk expressing potential adopters' perception about the possibility of the MB system malfunctioning or not operating as intended or expected, and thus not being able to deliver the service; psychological risk reflecting the potential adopters' perception about possible losses of self-esteem; peace-of-mind, or self-perception caused by the frustration; pressure, or anxiety resulting from the usage of MB; and time risk referring to any time losses (e.g. time to install and learn how to use the MB system, time to learn the procedures in MB transaction failures, etc.) from the usage of MB services. A second-order construct is used for the operationalization of PR with the aforementioned five PR types as first-order sub-dimensions. Moreover, Featherman and Hajli (2016) claim that the five PR sub-dimensions are closely related and co-vary, leading to the conclusion that PR can be measured as a second-order reflectively measured construct.

The role of PR in explaining potential adopters' BI to adopt MB services has been widely investigated so far (Tam and Oliveira, 2017; Shaikh, and Karjaluoto, 2015). Based on previous studies on consumer behavior, which suggest that online customers use various mechanisms in order to effectively reduce purchasing risks, PR has been integrated into previously described theoretical models in various ways. There are several studies suggesting that PR directly and negatively affects BI to express the fact that potential customers' willingness to use MB becomes weaker when they perceive a higher level of risk (e.g. Alalwan *et al.*, 2016; Baptista and Oliveira, 2016; Tan and Lau, 2016; Al-Jabri and Sohail, 2012; Kesharwani and Bisht, 2012; Cheah *et al.*, 2011; Koenig-Lewis *et al.*, 2010; Luo *et al.*, 2010). On the other hand, Muñoz-Leiva *et al.* (2017) fail to confirm the previous relationship. Other studies in the contexts of e-banking, m-banking (e.g. Arif *et al.*, 2016; Kazemi *et al.*, 2013; Wessels and Drennan, 2010; Lin, 2007; Tan and Teo, 2000) and m-payment (e.g. Liébana-Cabanillas *et al.*, 2014; Liébana-Cabanillas *et al.*, 2013) provide strong empirical evidence of the negative effect of PR on potential customers' ATT. As PR expresses potential customers' expectations of potential future losses associated with MB usage, it is likely to negatively influence their attitude toward MB service usage. Finally, there are studies that combine the previous two PR integration options to model online customer behavior (e.g. Giovanis and Athanasopoulou, 2017; Lin, 2008). In these studies, ATT toward MB service use works as a risk reduction mechanism for potential customers. Since MB is in its infancy, uncertainty is very high and PR of service use is one of the most important reasons for potential adopters to delay or reject the use of MB. The current study integrates potential adopters' beliefs about MB usage risk into the four theoretical innovation adoption models to investigate its impact either directly or indirectly, through ATT, on BI.

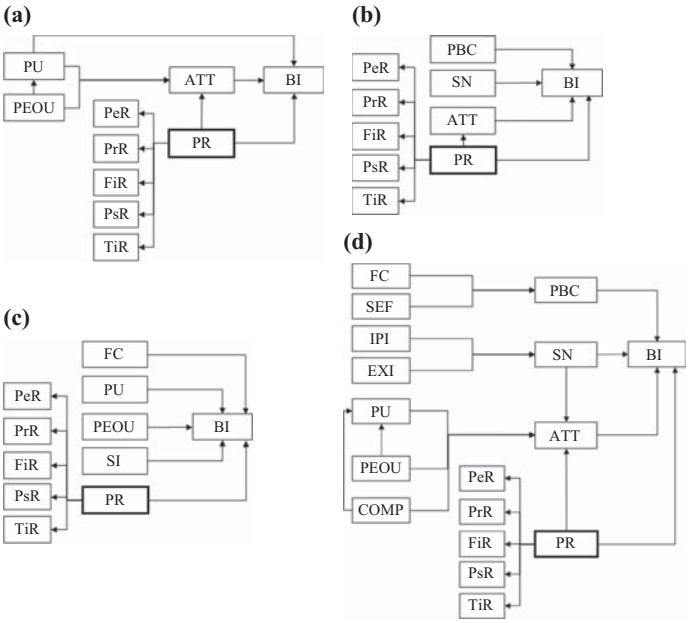
2.6 Necessity for model comparison

The four competing models are illustrated in Figure 1(a)–(d). Based on the above discussion, it is obvious that the four competing theoretical models have certain similarities and differences. Previous studies concerning the comparison of these models underscore the importance of developing simultaneous tests for understanding user adoption of technology-based services such as MB (Grandón *et al.*, 2011; Huh *et al.*, 2009; Lin, 2007). Rust *et al.* (1995) and Huh *et al.* (2009) suggest that there is a well-established approach to simultaneously test the four theoretical innovation adoption models. This approach is used in this study to reveal the distinctive and clear advantages of each model.

3. Research methodology

3.1 Research setting

The study is conducted in Greece. The use of alternative channels for banking purposes in Greece has substantially increased, especially after the implementation of capital controls in July 2015. The severe financial recession that the country has been facing over the last eight years has led the government to restrict citizens' access to their financial deposits and cash withdrawals. On the other side, the use of electronic money transactions is promoted through new legislation. Before the implementation of capital controls, there were 2.6m customers enabled to perform MB transactions, of which 208,000 have performed one MB transaction during the last 12 months and 144,000 were frequent users of MB services. The total value of MB transactions in 2014 was estimated to be €130m (Lidorikis, 2014). After the implementation of capital controls, the number of transactions increased by 142 percent and the value of MB transactions increased to €359m. By the end of 2017, the number of MB users has risen to 1m and the market value of MB transactions to €1.5bn (Lidorikis, 2017a, b).



Notes: Perceived ease-of-use, PEOU; perceived usefulness, PU; compatibility, COMP; perceived risk, PR; attitude, ATT; interpersonal influence, IFI; external influence, EXI; subjective norms, SN; self-efficacy, SEF; facilitating conditions, FC; perceived behavioral control, PBC; behavioral intentions, BI; Performance risk, PeR; privacy risk, PrR; financial risk, FiR; psychological risk, PsR; time risk, TiR. (a) TAM with PR; (b) TBP with PR; (c) UTAUT with PR; (d) DTPB with PR

Figure 1.
Competing models

3.2 Measures

To ensure the content validity of the scales used to measure the constructs of the four models, validated scale items from prior studies are used and their sources are given in Table I. Following Huh *et al.* (2009), the same scale items are used to measure constructs shared by different competing models. All scale items are measured using a seven-point Likert scale with 1 corresponding to "strongly disagree" and 7 to "strongly agree." In order to maintain the technical and conceptual equivalence of the scales, a translation and back-translation strategy was applied during the development of the Greek version of the questionnaire. Finally, reliability analysis of scales was performed on the data collected from the pilot study. The results are satisfactory, given that Cronbach's α values for all scales are well above the commonly accepted threshold value of 0.70.

3.3 Data collection

Survey participants of the study were 18+ years old mobile telephony users living in Athens, where around 50 percent of the total population of Greece lives. This choice was made for two reasons: first, because the number of adopters of MB is very small and, thus, it is very difficult to identify them, and, second, it is of interest to study the factors that affect the acceptance of MB at the early stages of the product life cycle where most people do not fully understand the benefits and risks of the new service (Luna *et al.*, 2017). Given the difficulty in obtaining a comprehensive sample and the limited research

Construct	Glossary	References
Perceived usefulness	PU	Bhattacherjee (2000), Muñoz-Leiva *et al.* (2017)
Perceived ease-of-use	PEOU	Davis *et al.* (1989), Taylor and Todd (1995)
Compatibility	COMP	Schierz *et al.* (2010)
Attitude	ATT	Schierz *et al.* (2010)
Interpersonal influence	IPI	Lin (2007)
External influence	EXI	Lin (2007)
Subjective norms	SN	Lin (2007)
Self-efficacy	SEF	Taylor and Todd (1995)
Facilitating conditions	FC	Taylor and Todd (1995)
Perceived behavioral control	PBC	Taylor and Todd (1995)
Financial risk	FiR	Yang *et al.* (2015)
Privacy risk	PrR	Yang *et al.* (2015)
Performance risk	PeR	Yang *et al.* (2015)
Psychological risk	PsR	Yang *et al.* (2015)
Time risk	TiR	Yang *et al.* (2015)
Behavioral intentions	BI	Venkatesh and Davis (2000)

Table I. Measurement scales' sources

resources, a mall-intercept procedure (i.e. a non-probabilistic sample) is used for collecting primary data. The fieldwork was carried out by 20 trained and supervised senior students during the second quarter of 2017 (April–May). In total, 3,000 questionnaires were distributed in malls located in three different areas of Athens with different socioeconomic profiles. Contacts were made at different times of the day and days of the week in order for day- and time-related bias to be eliminated. This procedure resulted in 958 questionnaires. After eliminating those with unanswered items, 931 questionnaires were coded for data analysis, yielding a net response rate of 31 percent. Table II lists the socio-demographic characteristics of the respondents. Using the Armstrong and Overton's (1977) procedure,

Characteristic	Frequency (n = 931)	%
Gender		
Male	436	47
Female	495	53
Age		
18–24	301	32
25–34	361	39
35–44	165	18
45–54	65	7
55+	39	4
Education		
High school or below	290	31
College degree	50	5
University degree	456	49
Postgraduate degree	135	15
Profession		
Public servant	262	28
Private employee	324	35
Self-employed	163	18
University student	150	16
Other	32	3

Table II. Sample profile

non-response bias is evaluated by comparing early respondents with late respondents for all constructs considered in this study. No significant differences are recorded at the 0.05 level of significance.

3.4 Data analysis method

The four competing models are independently tested and compared through structural equation models using AMOS 18. A two-step approach is used to analyze the data (Anderson and Gerbing, 1988). First, confirmatory factor analysis (CFA) is used to assess the adequacy of the measurement model (i.e. whether the measured variables reliably reflect the latent variables). Second, the structural models are tested to determine the overall model goodness-of-fit, path coefficients' significance and explanatory power of the four competing models.

Following Rust *et al.* (1995), Taylor and Todd (1995) and Huh *et al.* (2009), the comparison of competing theoretical models that are not nested within one another (as in this case) includes three steps. First, several goodness-of-fit indices (i.e. normed χ^2, GFI, RMSEA, AGFI, NFI, TLI and CFI) are used to assess the appropriateness of each model. Second, for those models that successfully fit the data, the significance of path coefficients and their explanatory power are compared. Third, for models that perform equally in the previous two steps (i.e. multiple model fit indices and explanatory power being equivalent), the best model is the most parsimonious one (Huh *et al.*, 2009; Rust *et al.*, 1995). The latter step of the comparison process is questioned by Taylor and Todd (1995) among others. They argue that "[…] parsimony, in and on itself, is not desirable but rather is desirable only in the extent that it facilitates understanding" (Taylor and Todd, 1995, p. 169). Based on the above, they suggest that for competing models presenting reasonable fit and explanatory power, both parsimony and their contribution to understanding should be taken under consideration. If the objective is to predict consumers' behavior toward MB usage, parsimony may be more heavily weighted. When the objective is a better understanding of the MB adoption process, a degree of parsimony may be a trade-off. By implementing the above procedure, in this study, we evaluate the overall fit of each of the four competing models, their contribution in explaining BI to use MB and their parsimony.

4. Results

4.1 Measurement model assessment

Since the extended DTPB is a model that includes all constructs from the TAM, TPB, and UTAUT, only the DTPB's measurement model is assessed (Huh *et al.*, 2009). First, CFA is used to verify the dimensionality, reliability, convergent validity and discriminant validity of the 15-item risk scale (Featherman and Hajli, 2016). Three measurement models are compared to test the scale's dimensionality, and convergent/discriminant validity (see Table III). Model 1 hypothesizes one-dimensional first-order factor that accounts for the variance among the fifteen measurement items. Model 2 hypothesizes that the fifteen measurement items are grouped into five correlated first-order factors. Model 3 assumes that a second-order latent variable parsimoniously explains the 15 inter-factor correlations among the five first-order risk-related constructs. Model 2 exhibits lower normed χ^2 and higher fit indices with respect to

Model	χ^2	df	Normed χ^2	GFI	AGFI	CFI	RMSEA	TCI
Model 1: one-dimensional 1st-order factor	2,978.668	77	38.684	0.657	0.533	0.701	0.201	
Model 2: five-correlated 1st-order factors	227.680	67	3.400	0.967	0.948	0.982	0.051	
Model 3: 2nd-order factor model	256.520	71	3.610	0.963	0.945	0.980	0.053	0.888

Table III. Goodness-of-fit indices for alternative models of perceived risk

Model 1, leading to the conclusion that, overall, PR is a multidimensional construct comprised of five correlated sub-dimensions. The standardized loadings of model 2 are statistically significant ($p < 0.001$), indicating convergent validity. Additionally, the results also support discriminant validity as the measurement items converge on their respective factors and the factors are distinct from each other. To test whether overall PR is better modeled as a second-order construct, the following criteria must be met (Featherman and Hajli, 2016): high model goodness-of-fit indices; high value of the target coefficient index (TCI) expressing the ratio of the χ^2 of the lower-order model to the χ^2 of the higher-order model; and significant factor loadings of the first-order risk-related constructs. The fit indices of Model 3 are similar to those of Model 2, indicating that both models fit the data well. Considering the high number of first-order risk-related factors, the TCI value of 0.89 provides strong support for a second-order construct for overall PR.

Following the acceptance of a second-order structure for the overall PR, the overall measurement model is tested. The results are given in Table IV. The observed fit indices are $\chi^2 = 2{,}569.83$; df = 1,145, $p < 0.001$; normed $\chi^2 = 2.244$; GFI = 0.897; RMSEA = 0.037; AGFI = 0.881; NFI = 0.931; TLI = 0.956; and CFI = 0.960. Most of the fit indices meet the requirements for structural equation modeling (SEM) analysis, meaning that the measurement model adequately fits the data. Even though the value for GFI does not exceed 0.9 (the threshold value), it still meets the requirement suggested by Baumgartner and Homburg (1996), Doll *et al.* (1994) and Cheng (2011), who suggest that values greater than 0.8 are still acceptable.

The measurement model is also assessed for construct validity and reliability of its first-order constructs. Individual item reliability is adequate when an item has a factor loading greater than 0.60 on its respective construct, which implies more shared variance between the construct and its measures than the error variance (Anderson and Gerbing, 1988). The factor loadings of all items, as shown in Table III, exceed the threshold value of 0.60 and provide strong support for item reliability of latent constructs. The reliability of all constructs was examined using Cronbach's α (CA) and composite reliability (CR) measures. Anderson and Gerbing (1988) suggest that a value of 0.70 provides adequate evidence for internal consistency. As shown in Table IV, CA and CR values of all measures included in the study exceed 0.782 and 0.894, respectively. This suggests that all measures are good indicators of their respective components. The average variance extracted (AVE), which indicates the amount of variance that is captured by the construct in relation to the variance due to measurement error, was used to assess convergent validity. The AVE value for each construct was above 0.54, indicating convergent validity, as all AVE values exceed the recommended cut-off value of 0.50 (Anderson and Gerbing, 1988).

Finally, discriminant validity among first-order constructs is examined by investigating their correlation matrix (Table V). Using the Fornell and Larcker (1981) criterion, the matrix of constructs' intercorrelations shows that the square root of AVE extracted from each construct is higher than its shared variance (i.e. the correlations between that construct and any other constructs), except for the square root of AVE of PBC, which is slightly lower than the correlation between FC and PBC. Moreover, the correlation between SN and IPI (0.782) is high but still lower than the square root of AVE value of IPI (0.835). Therefore, results indicate that all constructs in the proposed model, except those measuring FC and PBC, satisfy the discriminant validity criterion. To further test the discriminant validity between FC and PBC, the χ^2 difference test is used. This test allows us to compare two models, one in which the two constructs are correlated (constrained model) and one in which they are not (unconstrained) (Anderson and Gerbing, 1988). When the test is significant, the constructs present discriminant validity. The fact that the value of χ^2 for the constrained model ($\chi^2 = 2{,}632.65$; df = 1,146) is higher than that of the unconstrained model ($\chi^2 = 2{,}569.83$; df = 1,145) and the significance of the χ^2 difference test ($\Delta\chi^2 = 62.17$; df = 1; $p < 0.005$)

Table IV. Measurement model assessment I (reliability, internal consistency and convergent validity)

Construct	Measurement items	Loadings
First-order constructs		
Perceived usefulness (CR = 0.837, AVE = 0.568, CA = 0.921)	MB would be useful mode of doing your banking transactions	0.868
	Using MB would make the handling of banking transactions easier	0.747
	MB allows to do my banking transactions more quickly	0.638
	The use of the MB would improve my efficiency in consulting and/or conducting my banking transactions	0.723
Perceived ease-of-use (CR = 0.834, AVE = 0.560, CA = 0.921)	It would be easy to become skillful in using MB	0.837
	Interactions with MB would be clear and understandable	0.886
	It would be easy to follow all the steps to use MB	0.647
	It would be easy to interact with MB	0.606
Compatibility (CR = 0.847, AVE = 0.649, CA = 0.925)	Using MB would be compatible with my life style	0.837
	Using MB would fit well with the way I do my finances	0.814
	Using MB would fit into my working style	0.764
Attitude (CR = 0.898, AVE = 0.689, CA = 0.951)	Using MB is a good idea	0.893
	Using MB is wise	0.775
	Using MB is beneficial	0.845
	Using MB is interesting	0.802
Interpersonal influence (CR = 0.873, AVE = 0.698, CA = 0.937)	My family thinks that I should use MB	0.925
	My friends think that I should use MB	0.815
	People I knew think that using MB is a good idea	0.758
External influence (CR = 0.843, AVE = 0.645, CA = 0.922)	I have read/seen news reports which say that MB is effective	0.936
	The popular press adopts a positive view toward MB	0.756
	Mass media reports have influence me to try MB	0.698
Subjective norms (CR = 0.836, AVE = 0.630, CA = 0.920)	People whose opinions I value would approve that I used MB	0.774
	People who influence my behavior would think that I should use MB	0.785
	People who are important to me would agree if I used the MB	0.821
Self-efficacy (CR = 0.903, AVE = 0.756, CA = 0.952)	If I wanted I could easily use MB by myself	0.858
	I would be able to use MB even if I would not have any help	0.911
	I would feel comfortable using MB by myself	0.838
Facilitating conditions (CR = 0.878, AVE = 0.707, CA = 0.940)	I have the resources necessary to use MB	0.864
	I have the knowledge necessary to use MB	0.808
	I can get help from others when I have difficulties using MB	0.849

(*continued*)

Table IV.

Construct	Measurement items	Loadings
Perceived behavioral control (CR = 0.825, AVE = 0.613, CA = 0.915)	If I wanted it I could use the MB	0.720
	I have the resources and the knowledge and the ability to make use of the MB	0.771
	I would be able to use the MB	0.852
Financial risk (CR = 0.908, AVE = 0.766, CA = 0.955)	The use of MB would cause the exposure of capital accounts and passwords	0.857
	The use of MB would cause malicious and unreasonable charges	0.885
	The use of MB can cause financial risk	0.884
Privacy risk (CR = 0.895, AVE = 0.740, CA = 0.948)	If I use MB, privacy information could be misused, inappropriately shared or sold	0.814
	If I use MB, my personal information could be intercepted or accessed	0.893
	If I use MB, transactions' information could be collected, tracked and analyzed	0.871
Performance risk (CR = 0.908, AVE = 0.768, CA = 0.954)	MB may be unstable or blocked	0.907
	MB might not work as expected	0.923
	MB may not much its communicated level	0.793
Psychological risk (CR = 0.853, AVE = 0.660, CA = 0.927)	MB would cause unnecessary tension, e.g. concerns about errors in operation	0.815
	A breakdown in MB system could cause unwanted anxiety and confusion	0.888
	The usage of MB could cause discomfort	0.726
Time risk (CR = 0.782, AVE = 0.544, CA = 0.894)	Time loss could be caused by instability and low speed of MB	0.740
	It takes too much time to learn how to install and use MB	0.742
	More time is required to fix MB errors offline	0.731
Intention to use (CR = 0.947, VE = 0.819, CA = 0.974)	Given the opportunity, I will use MB	0.894
	I am likely to use MB in the near future	0.878
	I am open to using MB in the near future	0.919
	I intend to use MB when the opportunity arises	0.927
Second-order construct		
Perceived risk (CR = 0.893, AVE = 0.605, CA = 0.945)	Performance risk	0.812
	Privacy risk	0.777
	Financial risk	0.863
	Psychological risk	0.808
	Time risk	0.604

Notes: Composite reliability, CR; Cronbach's α, CA; average variance extracted, AVE

Construct	1	2	3	4	5	6	7	8	9	10	11	12
1 PEOU	*0.754*											
2 PU	0.520	*0.748*										
3 COMP	0.582	0.699	*0.806*									
4 PR	−0.434	−0.475	−0.525	*0.778*								
5 ATT	0.573	0.685	0.735	−0.570	*0.830*							
6 IPI	0.292	0.388	0.419	−0.344	0.481	*0.835*						
7 EXI	0.250	0.329	0.315	−0.276	0.386	0.497	*0.803*					
8 SN	0.435	0.534	0.559	−0.475	0.653	0.782	0.703	*0.794*				
9 SEF	0.577	0.293	0.406	−0.360	0.425	0.281	0.223	0.378	*0.869*			
10 FC	0.420	0.258	0.334	−0.235	0.367	0.239	0.219	0.359	0.616	*0.841*		
11 PBC	0.568	0.330	0.425	−0.379	0.481	0.279	0.246	0.404	0.713	0.784	*0.783*	
12 BI	0.502	0.590	0.636	−0.579	0.767	0.440	0.350	0.600	0.405	0.367	0.488	*0.905*

Notes: Perceived ease-of-use, PEOU; perceived usefulness, PU; compatibility, COMP; perceived risk, PR; attitude, ATT; interpersonal influence, IFI; external influence, EXI; subjective norms, SN; self-efficacy, SEF; facilitating conditions, FC; perceived behavioral control, PBC; behavioral intentions, BI. Diagonal entries represent the square root of average variance extracted, while the other entries are the correlations between constructs

Table V.
Measurement model assessment II (discriminant validity)

provide evidence that the two scales measure different concepts. Based on the above, we conclude that discriminant validity was achieved.

As far as the overall PR's assessment is concerned, this second-order scale exhibits construct reliability and validity. As seen in Table IV, CA and CR values for PR are 0.945 and 0.893, respectively, and the AVE value is 0.605. Together, these values provide evidence for construct reliability and convergence validity (Featherman and Hajli, 2016). Additionally, each risk-related sub-dimension loading is highly significant ($p < 0.001$) with values greater than 0.6. All these tests suggest that the confirmatory model adequately fits the data. The four competing theoretical models are then independently assessed using SEM.

4.2 Structural model

Table VI shows the fit statistics for each structural model and summarizes the variance explained (R^2 value) by each dependent construct to demonstrate its explanatory power. Path coefficients and their significance are also presented in this table.

TAM. In the TAM, the goodness-of-fit indices indicate that the model provides a good fit to the data ($\chi^2 = 1{,}072.787$; df = 386, $p < 0.001$; normed $\chi^2 = 2.779$, GFI = 0.928; RMSEA = 0.044; AGFI = 0.913; NFI = 0.951; TLI = 0.964; and CFI = 0.968) as they exceed the recommended cut-off values. The investigation of the path coefficients in Table VI shows that PEOU ($\beta = 0.535$; $p < 0.001$) significantly affects PU. PU ($\beta = 0.449$; $p < 0.001$) and PEOU ($\beta = 0.233$; $p < 0.001$) are significant positive determinants of ATT toward use, and PR ($\beta = -0.281$; $p < 0.001$) is a significant negative determinant of ATT toward use. Finally, ATT ($\beta = 0.593$; $p < 0.01$) and PU ($\beta = 0.097$; $p < 0.05$) positively affect BI, while PR ($\beta = -0.205$; $p < 0.001$) negatively affects BI. With respect to explanatory power, the model explains 28.6 percent of the variance in PU, 59.7 percent of the variance in ATT and 60.8 percent of the variance in BI.

TPB. In the TPB, results indicate that the model fits the data quite well ($\chi^2 = 947.183$; df = 332, $p < 0.001$; normed $\chi^2 = 2.853$; GFI = 0.929; RMSEA = 0.045; AGFI = 0.913; NFI = 0.954; TLI = 0.965; and CFI = 0.969) as the values of the indices are bigger than the recommended cut-off values. As shown in Table V, all path coefficients are statistically significant, indicating that the most important positively affecting antecedent of BI is ATT ($\beta = 0.537$; $p < 0.001$) followed by PBC ($\beta = 0.138$; $p < 0.01$) and SN ($\beta = 0.113$; $p < 0.05$), while PR ($\beta = -0.172$; $p < 0.001$) is a significant negative antecedent of BI. Finally, SN

Path	TAM Value	TAM *t*-value	TPB Value	TPB *t*-value	UTAUT Value	UTAUT *t*-value	DTPB Value	DTPB *t*-value
PEOU – PU	0.535	14.555					0.153	3.809
PR – PU								
SN – PU								
COMP – PU							0.621	14.177
PEOU – ATT	0.233	6.284					0.131	3.932
PU – ATT	0.449	11.737					0.224	5.384
COMP – ATT							0.334	6.969
PR – ATT	−0.281	−7.246	−0.339	−8.024			−0.149	−4.371
SN – ATT			0.499	13.187			0.227	7.450
EXI – SN							0.386	12.218
IPI – SN							0.627	18.938
SEF – PBC							0.388	8.787
FC – PBC							0.635	10.528
ATT – BI	0.593	13.624	0.537	12.943			0.563	14.718
SN – BI			0.113	3.017	0.251	6.717	0.095	2.949
PBC – BI			0.138	4.577			0.125	4.382
PU – BI	0.097	2.496			0.239	6.053		
PR – BI	−0.205	−5.769	−0.172	−4.916	−0.271	−6.986	−0.180	−5.719
PEOU – BI					0.096	2.608		
FC– BI					0.137	4.090		
Explanatory power (R^2)								
PU	0.286						0.520	
SN							0.792	
PBC							0.885	
ATT	0.597		0.523				0.670	
BI	0.608		0.635		0.553		0.634	
Model fit measures								
χ^2	1,072.787		947.183		1,044.406		2,636.911	
df	386		332		439		1,174	
p-value	0.000		0.000		0.000		0.000	
Normed χ^2	2.779		2.853		2.379		2.246	
GFI	0.928		0.929		0.934		0.897	
RMSEA	0.044		0.045		0.039		0.037	
Incremental fit measures								
AGFI	0.913		0.913		0.920		0.884	
NFI	0.951		0.954		0.950		0.929	
TLI	0.964		0.965		0.966		0.956	
CFI	0.968		0.969		0.970		0.959	
Parsimony fit measures								
AIC	1,230.787		1,095.183		1,222.406		2,940.911	
BCC	1,236.235		1,099.947		1,228.955		2,958.915	
PGFI	0.770		0.776		0.776		0.794	
PNFI	0.844		0.838		0.841		0.855	

Table VI.
Competing theoretical models performance's comparison

Notes: Perceived ease-of-use, PEOU; perceived usefulness, PU; compatibility, COMP; perceived risk, PR; attitude, ATT; interpersonal influence, IFI; external influence, EXI; subjective norms, SN; self-efficacy, SEF; facilitating conditions, FC; perceived behavioral control, PBC; behavioral intentions, BI

($\beta = 0.499$; $p < 0.001$) and PR ($\beta = -0.339$; $p < 0.001$) show significant positive and negative effects on BI, respectively. ATT and PR explain 52.3 percent of the variance in ATT and, jointly, the four factors of the model (ATT, SN, PBC and PR) explain 63.5 percent of the variance in BI.

UTAUT. In the UTAUT model, results indicate that the model fits the data quite well since all goodness-of-fit indices exceed the recommended threshold values ($\chi^2 = 1{,}044.406$; df = 439, $p < 0.001$; normed $\chi^2 = 2.379$; GFI = 0.934; RMSEA = 0.039; AGFI = 0.920; NFI = 0.950; TLI = 0.966; and CFI = 0.970). As shown in Table VI, the most important positive determinants of BI are SN ($\beta = 0.251$; $p < 0.001$) and PU ($\beta = 0.239$; $p < 0.001$) followed by FC ($\beta = 0.137$; $p < 0.01$) and PEOU ($\beta = 0.096$; $p < 0.05$), while PR ($\beta = -0.271$; $p < 0.001$) is a significant negative determinant of BI. Jointly, all five factors of the model explain 55.3 percent of the variance in ITU.

DTPB. In the DTPB, all goodness-of-fit indices except GFI ($\chi^2 = 2{,}631.911$; df = 1,174, $p < 0.001$; normed $\chi^2 = 2.246$; GFI = 0.897; RMSEA = 0.037; AGFI = 0.884; NFI = 0.929; TLI = 0.956; and CFI = 0.959) are better than the recommended threshold values, suggesting that the model fits the data well. As shown in Table VI, all path coefficients of the model are statistically significant. The results support the positive effects of COMP ($\beta = 0.621$; $p < 0.001$) and PEOU ($\beta = 0.153$; $p < 0.01$) on PU, the effects of PEOU ($\beta = 0.131$; $p < 0.01$), PU ($\beta = 0.224$; $p < 0.01$), COMP ($\beta = 0.334$; $p < 0.001$), SN ($\beta = 0.227$; $p < 0.001$) and PR ($\beta = -0.149$; $p < 0.01$) on ATT, the effects of IPI ($\beta = 0.627$; $p < 0.001$) and EXI ($\beta = 0.386$; $p < 0.01$) on SN, and the effects of FC ($\beta = 0.635$; $p < 0.001$) and SEF ($\beta = 0.388$; $p < 0.001$) on PBC. Finally, jointly, ATT ($\beta = 0.563$; $p < 0.001$), PBC ($\beta = 0.125$; $p < 0.01$), SN ($\beta = 0.095$; $p < 0.05$) and PR ($\beta = -0.180$; $p < 0.01$) significantly affect BI. In terms of explanatory power, the model explains 52 percent of the variance in PU; 67 percent of the variance in ATT; 79.2 percent of the variance in SN; 88.5 percent of the variance in PBC; and 63.4 percent of the variance in BI.

4.3 Comparison of performance of theoretical models

Model fit performance, significance of path coefficients and explanatory power, provided in Table VI, are used to compare the four competing theoretical models in explaining potential adopters' intentions to use MB services. In terms of the significance of path coefficients, all path coefficients in the four theoretical models are statistically significant, supporting the hypothesis that all these constructs play a significant role in potential customers' decision-making process to adopt MB services. Several goodness-of-fit indices in Table VI show that the four models adequately fit the data, suggesting that all models can be used to explain potential adopters' BI to use MB services. In terms of explanatory power to predict BI, the UTAUT presents the smaller predictive power ($R^2 = 0.553$). From the other three models, the exploratory performance of the TPB ($R^2 = 0.635$) and the DTPB ($R^2 = 0.634$) outperform the TAM ($R^2 = 0.608$). The DTPB has almost the same predictive ability of BI with the TPB, but performs better than the TPB and TAM in explaining ATT ($R^2 = 0.670$). Finally, the DTPB performs well in explaining the formulation of SN ($R^2 = 0.792$) and PBC ($R^2 = 0.885$). Overall, in terms of explanatory power, the findings indicate that the DTPB is superior to the TAM, TBP, and UTAUT.

Given that the four models exhibit good fit to the data, other criteria must be used to identify the best model (Rust *et al.*, 1995; Chau and Hu, 2001; Huh *et al.*, 2009). As the four models are not nested to each other, the χ^2 difference test cannot be used to decide which of the four models perform better than the other (Anderson and Gerbing, 1988).

Following Rust *et al.* (1995) and Taylor and Todd (1995), parsimony fit measures like AIC and BCC are used for model comparison. As shown in Table VI, TPB (AIC = 1,095.183; BCC = 1,099.947) presents the smaller values for AIC and BCC followed by TAM (AIC = 1,230.787; BCC = 1,236.235), UTAUT (AIC = 1,222.406; BCC = 1,228.955) and DTPB (AIC = 2,940.911; BCC = 2,958.915). As smaller values of these criteria indicate a better fit of the model, these results indicate a preference for the TPB over the TAM, UTAUT and DTPB. Additionally, parsimony fit measures such as PGFI (TAM: 0.770;

TPB: 0.776; UTAUT: 0.776; DTPB: 0.794) and PNFI (TAM: 0.844; TPB: 0.838; UTAUT: 0.841 DTPB: 0.855), which assess the parsimony fit of the competing models (Kelloway, 1998), favor the DTPB.

Rust *et al.* (1995) classify the current theoretical models' comparison as a non-nested model comparison with all variables in common. For this type of model comparison, the most common statistical test is normed χ^2 (Rust *et al.*, 1995). In the TAM, normed χ^2 is 2.779 in the TPB, normed χ^2 is 2.853 in the UTAUT, normed χ^2 is 2.379 and the normed χ^2 value for the DTPB is 2.246, respectively. Since a smaller value of this criterion indicates a better parsimony and a better fit of the model, this result indicates a preference for the DTPB over the UTAUT, TAM and TPB.

Overall, the best model for predicting MB usage seems to be the TPB as it presents acceptable fit; all constructs significantly explain potential customers' willingness to us MB; its explanatory power is similar to that of DTPB and is the most parsimonious one (only three variables are able to predict 63.5 percent of variance in BI) among the four competing models. In terms, however, of both model fit and model parsimony, results suggest that the DTPB is superior to the other three models as it more fully explains potential adopters' intentions to use MB services than the other three models.

5. Discussion and implications

5.1 Discussion of findings and theoretical implications

The aim of this study is to compare four well-established theoretical models (i.e. TPB, TAM, DTPB and UTAUT) in their capacity to explain potential customers' willingness to adopt MB services in Greece. Drawing on the theory and previous studies on model comparison, this study considers the goodness-of-fit, explanatory power and parsimony of the four models in order to evaluate them and select the best one. The results of the study indicate that all four models exhibit comparable fit performance indices. Thus, overall model fit, significance of path coefficients and explanatory power are used to evaluate model performance.

In terms of explanatory power, the TPB, DTPB and TAM explain better potential customers' BI to use MB services than the UTAUT. This finding agrees with those of previous studies (e.g. Giovanis and Athanasopoulou, 2017; Mohammadi, 2015; Püschel *et al.*, 2010) and suggests the need to consider potential customers' ATT in explaining BI as the MB market is in its early stage of development in Greece (Venkatesh and Davis, 2000). Additionally, Baptista and Oliveira (2016), in their meta-analysis of MB, suggest that ATT is the most significant determinant of BI, and Rao and Troshani (2007) consider consumer attitude as a mediator between the factors included even into the UTAUT model (i.e. EE, PE, SI and FC) and BI. Therefore, potential customers who favorably value the consequences of MB usage are, to some extent, predisposed to use the service.

Regarding the explanatory performance of the other three models, the TPB and DTPB outperform the TAM, justifying the necessity to consider the effect of SN and PBC when MB service adoption is investigated. The presence of these two concepts improves the TPB's and DTPB's explanatory power with respect to TAM, and their effects on BI suggest that they are, albeit at a lesser extent than ATT, direct motivational drivers of MB acceptance. More specifically, the effect of PBC on BI, though significant, is smaller compared to that of ATT. This may be due to the high penetration and use of mobile devices, and the extensive use of e-banking services after the implementation of capital controls in Greece, resulting in higher levels of availability of knowledge; resources and opportunities necessary for using the service (Bhattacherjee, 2000; Tan and Teo, 2000). The direct impact of potential customers' normative pressure on BI, although significant, is even smaller than PBC (Kazemi *et al.*, 2013). The high-risk nature of MB services may lead potential customers not to rely exclusively on the suggestions of existing customers and mass media communications, but to consider the information coming from these two sources, along with their perception about MB attributes,

in their decision to adopt or reject the service (Bhattacherjee, 2000). However, the mediation effect of ATT on the relationship between SN and BI indicates that the influence coming from consumers' personal and non-personal environment improves their perception about the rational advantages of MB and increases their willingness to use MB services (Del Bosque and Crespo, 2011; Schierz *et al.*, 2010; Tran and Corner, 2016).

Within normative beliefs, IPI is more significant than EXI. This means that consumers' attitude and willingness to use MB services is determined firstly by innovators' and early adopters' prior experiences and secondly by non-personal factors such as opinions of industry experts and mass media communication (Del Bosque and Crespo, 2011; Lin, 2007). However, the latter could be of particular importance in enhancing customers' awareness and trial in the early stages of the service life cycle (e.g. Bhattacherjee, 2000; Lin, 2007).

Among the factors shaping consumers' behavioral control beliefs in using MB, FC appear to be more important than SEF, which agrees with other studies studying technology-based services in their early life cycle stages (Taylor and Todd, 1995). This finding highlights again the need of potential customers to have adequate knowledge and support in using MB services.

Meanwhile, DTPB has almost the same predictive ability of BI with TPB, but performs better than the TPB and TAM in explaining ATT toward using MB. This finding reveals the importance of considering MB's rationally-evaluated innovation characteristics of usefulness; easiness; level of risk, and compatibility. Thus, potential customers who feel that MB is compatible with their needs, values and previous experience, and perceive that using MB is better, easier and less risky than visiting a bank branch for their banking transactions, express high willingness to use the service (e.g. Giovanis and Athanasopoulou, 2017; Khasawneh and Irshaidat, 2017; Kazemi *et al.*, 2013). Finally, it is worth highlighting the pivotal role of MB usefulness in relation to the perception of its other two performance attributes (i.e. PEOU and COMP) (Liébana-Cabanillas *et al.*, 2014). MB usefulness enhances the impact of PEOU and COMP on customers' attitude toward MB and, through this, affects their willingness to use MB services.

5.2 Practical implications

From a practical point of view, the implications of this study are two-fold. Findings suggest the use of the eight-variable TPB model, for those financial institutions aiming to predict potential customers' BI toward MB usage. By measuring the attitudes of potential customers toward MB usage as well as their beliefs regarding the impact of social context and their control over MB services, a significant part of variance in BI can be explained. On the other hand, for financial service providers that aim to better understand the factors that affect consumers' willingness to use MB services and use these factors to establish appropriate marketing strategies that will increase penetration and usage of MB services, findings suggest that they should sacrifice some parsimony and adopt the 15-variable DTPB, as this model fits better with their objectives than the most parsimonious models (i.e. TAM, TPB and UTAUT).

Based on the above, financial service providers should use a marketing strategy that ensures, at the first stage, a favorable attitude toward their services. This positive attitude will probably make customers feel that it is worth to take the risk to use those services. Overall attitude toward MB is influenced by certain performance/utilitarian aspects of the service and in particular by its compatibility with customers, usefulness and ease of use. Banks and financial institutions can use potential customers' perception about MB performance characteristics as a basis of knowledge to support the optimal design, analysis and evolution of MB services. This will allow them to adapt the functionalities of MB platforms to potential users' needs, align marketing and customers' training activities, and boost MB acceptance and usage (Baptista and Oliveira, 2016). Moreover, MB service providers should communicate to potential consumers, who feel that MB is compatible with their life style (i.e. e-banking users),

the advantages that the service has in comparison to other service options and promote a simple and user-friendly interface to facilitate service usage. On the other hand, banks can also offer guarantees to customers to reduce their perception of usage risk, especially the risk related to potential financial and performance losses. This will probably lead to an increase in customers' positive attitude and their willingness to use MB services.

In order to exploit the effects of personal and non-personal social factors, financial service providers should use positive testimonials of satisfied adopters. Satisfied customers should share their experience of MB and focus on how easy and useful it is to use MB services. These testimonials will be communicated through mass media advertising campaigns and will probably increase MB services' awareness and PU. Also, it will be useful to design below-the-line campaigns (social media campaigns, phone-call campaigns, SMS campaigns) that will help bring in new customers based on positive word-of-mouth and viral marketing. Furthermore, firms can motivate existing satisfied customers of MB services to spread positive word-of-mouth by providing monetary incentives for referring friends and family. Finally, customer education programs could be offered to bank branches and on YouTube to increase potential customers' self-efficacy and provide support regarding MB services' activation and usage. These training activities will also showcase the user friendliness, usefulness and trustworthiness of MB services.

6. Limitations and further research

This study, despite the significance of its findings, has several limitations. First, it follows a hybrid convenient sampling strategy that does not ensure the full generalization of results. The proposed model can be used for further research using a random, more representative sample that will allow the extraction of more trustworthy results. Second, the findings and implications of this study are obtained using a cross-sectional study. This reduces the ability of the study to reflect the temporal changes in research constructs. A longitudinal study on the subject is necessary in order to clarify the effects of temporal changes. Furthermore, due to the globalization of services, it is important to test the comparison of the four models across various countries with different cultures, to identify differences or similarities due to culture (e.g. Zhang *et al.*, 2018).

Additionally, future studies can measure the real use of MB by comparing consumers' intention and their subsequent behavior. Second, the concept of MB perceived value can be added to the proposed model because it is expected to further improve the explanatory power of the model since perceived value components are amongst the most important motivators of consumer behavior toward new digital services adoption (e.g. Kim *et al.*, 2007; Wu *et al.*, 2014). Moreover, the use of technology readiness, representing the level of consumers' readiness to embrace a new technology and their technical and personal abilities to actually use it (Parasuraman, 2000), and of additional personal characteristics (i.e. mobility; prior experience, need for control, novelty seeking and customer demographics) (Meuter *et al.*, 2005) as moderators of the effect of other belief constructs on BI, is going to provide a better understanding of the MB adoption process. This way, firms can examine the differences in the adoption of MB between individual customers and enable marketing professionals to contact their potential consumers more effectively (Tsourela and Roumeliotis, 2015).

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