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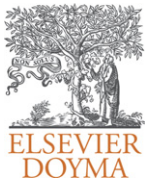
Article

Integrating trust and personal values into the Technology Acceptance Model: The case of e-government services adoption

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ABSTRACT

The Technology Acceptance Model (TAM) is considered one of the best frameworks to understand technology-related adoptions that can be extended and adapted to the different features of many diverse situations. This work analyzes the adoption of e-government services and proposes that trust and personal values contribute to better understand such adoption. Specifically, this study proposes an integration of trust into the TAM, due to the online context characteristics (i.e., uncertainty). In addition, since these services are provided to the whole citizenry, two personal values very much related to e-government advantages (citizens' time consciousness and environmental concern) are proposed as moderators of the aforementioned relationships. Results reveal the mediating role of trust into the TAM framework which is confirmed by a rival models analysis. Besides, citizens' personal values moderate the influence of some antecedents of the intention to use e-government services, which suggests some interesting implications for public administration strategic marketing.

Integración de la confianza y los valores personales en el Modelo de Adoción Tecnológica: el caso de la adopción de la administración electrónica

RESUMEN

El Modelo de Aceptación Tecnológica (TAM) es conocido por ser uno de los mejores marcos conceptuales que puede adaptarse a las características de diferentes escenarios de adopción tecnológica. Este trabajo analiza la adopción de servicios de administración electrónica y propone que la confianza y los valores personales contribuyen a entender mejor este proceso. Concretamente, dada las características del entorno online y la variedad de usuarios potenciales, se propone una integración de la confianza en el TAM y se analiza como dos valores personales de los ciudadanos (la conciencia de tiempo y la conciencia medioambiental) moderan las relaciones anteriores en este contexto. Los resultados revelan que la confianza desempeña un papel mediador en el modelo TAM, lo que se confirma con el análisis de modelos rivales. Asimismo, los valores personales moderan la influencia de las variables TAM sobre la intención de uso, sugiriendo algunas implicaciones de interés para el marketing estratégico de las Administraciones Públicas.

1. Introduction

The need to reduce their costs and increase efficiency compels the majority of organizations to migrate to e-services, including public administrations (Sahu and Gupta, 2007). Since Information and Communication Technologies have changed the daily life of people, e-government is revealed as a great opportunity to provide better public services adapted to citizens' needs (i.e., ubiquity) (Teerling and Pieterson, 2010). However, despite the numerous benefits for both citizens and governmental agencies (Verdegem and Verleye, 2009), the users of e-government services are still a minority (Coursey and Norris, 2008; Bélanger and Carter, 2008;

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Chen, 2010). For example, approximately a 20% of Internet users in Spain, which is less than 10% of total population, only carried out a public service online (i.e., vehicle registration online) in 2010 (INE, 2011). Considering that a critical mass of e-government users guarantees efficiency in the medium term (Tung and Rieck, 2005), spreading e-government use among citizens is a challenge that needs to be faced without delay, especially in times of continuous public budget cuts. There is, thus, a managerial need to thoroughly understand the factors that affect citizen adoption of e-government services in order to face this lack of success from a managerial perspective.

The TAM developed by Davis (1989) has been traditionally described as one of the best frameworks to understand e-government adoption (Carter and Bélanger, 2005). Certainly, this is the most successful adoption model with regards to the number of studies on online behavior relying on TAM and its high explanatory power (see Schepers and Wetzels, 2007). However, TAM has been criticized because of its parsimony, and the reliability of such a simple and deterministic model has been called into question (Bagozzi, 2007). To solve this limitation, several researchers have proposed new models of adoption adapted to specific contexts by broadening TAM (Venkatesh et al., 2003). Analogous to e-commerce, e-government literature identifies citizen trust on online public services as a crucial aspect for adoption (Gefen et al., 2003; Warkentin et al., 2002). Indeed, because they are being provided online, e-government services feature certain level of perceived (or real) uncertainty and risk of vulnerability for citizens; emphasizing the relevance of trust in e-government adoption (Warkentin et al., 2002; Wu and Chen, 2005). Surprisingly, despite the numerous works relating TAM and trust (see Appendix A), few of them have attempted to justify the integration of trust into the relations proposed by TAM, and almost no one has assessed the suitability of trust or any other variable as an underlying mechanism explaining the original TAM framework (Bagozzi, 2007). As well, empirical assessments of the antecedents of behavioral intentions suggest that their influence may be also subject to cross-sectional heterogeneity across users depending their personal characteristics, such as values or life-styles (e.g. Sun and Zhang, 2006; Jeong et al., 2009).

Therefore, a deep understanding of the aspects beyond the key TAM variables could help managers in public administration and other organizations in their aim to implement an efficient and widely accepted service (Bhattacherjee, 2000; Tung and Rieck, 2005). To move on this topic, this study contributes to the emerging body of literature on e-government services adoption by addressing two issues:

- The first objective of this study is to confirm the validity of the relationships proposed by TAM in the e-government context and to better understand the role of trust into this model. This proposal considers that citizens' trust in the e-service is a partial mediator in the relationship between two basic components of TAM: ease of use and usefulness perceptions. The inclusion of trust in the research is based on the important role that this variable plays in the online context, which is under vulnerability and uncertainty perceptions by many people (Gefen et al., 2003; Harris and Goode, 2004). This fact is especially relevant in this context of analysis due to the wide range of potential e-government users in terms of Internet experience, age or culture (Warkentin et al., 2002).
- Secondly, the study addresses how personal values and citizens' life-styles may interact with the antecedents of the intention to use e-government services in order to form this intention. More specifically, two of the most prominent cited features of e-government services are time efficiency – that results from the ubiquitous nature of Internet, which enables citizens to use

e-services anytime and anywhere – (Carter and Bélanger, 2005), and ecological benefits (Centeno et al., 2005) – i.e., in terms of amount of paper reduced. Therefore, two personal values of citizens (their time consciousness and environmental concern) are considered as moderators of the effect of attitude, usefulness and trust on behavioral intentions. The analysis of these moderating effects might be useful to implement marketing strategies focused on citizens' demands and requirements.

This research thus contributes to better know the trust–TAM relationship proposed theoretically in the literature and to empirically determine the suitability of a trust-inserted model of adoption through a rival model analysis. As well, the study identifies two up-to-day personal life-styles and values which are related to e-services benefits (and particularly to e-government) and remain almost unexplored in previous research on adoption. This article thus clarifies how the inclusion of citizens' time consciousness and environmental concern can raise intentions to use e-government by moderating the effects predicted in TAM.

Bearing these considerations in mind, this article is structured as follows: The first part presents a brief review of relevant literature of e-government attitude adoption and the proposed links between TAM and trust. Then, the research model hypotheses including the partial mediation role of trust are introduced, as well as the moderating effects of environmental concern and time consciousness. After that, data collection and measures validation processes are explained, followed by the results of the causal model. Next, a rival model analysis is carried out to assess the validity of the TAM–Trust model. Finally, the discussion section includes the main conclusions, managerial implications and limitations of the study.

2. Literature review

2.1. The Technology Acceptance Model in e-government adoption

The use of ICT by public administration is known as e-government (OECD, 1998). Literature on e-government development establishes that e-administration, which means the provision of common public services through the Internet (Royo, 2008); represents an initial stage driving to success in further e-government stages such as e-participation (Carter and Bélanger, 2005). Consequently, this study analyses the adoption of e-administration services by citizens as an essential component in the acceptance of e-government. Similar to e-commerce, e-government is heavily technology-driven (Pavlou, 2003) and thus, it has been argued that technology-related variables have become as important as traditional factors in predicting e-services use (Al-Adawi et al., 2005). The TAM, initially proposed by Davis (1989), is surely the most representative of the theories on adoption of technologies flourished in the eighties. Despite TAM was designed initially to be applied to organizational settings (Davis, 1989; Davis et al., 1989) this framework has been employed by numerous researchers to explain the individuals' adoption of many technological advances such as Internet (Moon and Kim, 2001), e-commerce (Gefen and Straub, 2000; Herrero and Rodríguez-del-Bosque, 2010) or e-government (Wang, 2002; Wu and Chen, 2005). Probably the impact of TAM in research analyzing individuals' behavior is supported by its parsimony and predictive explanatory capacity (Bagozzi, 2007). This supremacy relies on the relations among four key constructs explaining the adoption of a technology: attitude, perceived usefulness (PU), perceived ease-of-use (PEOU) and intention to use.

To be precise, attitude toward a certain behavior has been traditionally defined as "the degree to which a person has a favorable or unfavorable evaluation of the behavior in question" (Ajzen, 1991, p. 188). PU was initially defined by Davis (1989, p. 320) as "the

degree to which a person believes that using a particular system would enhance his or her job performance", or also "the degree that users believe that a particular system facilitates their activity" (Warkentin et al., 2002, p. 161). In turn, PEOU was originally defined by Davis (1989, p. 320) as "the degree to which a person believes that using a particular system would be free of effort" or just "is easy" (Warkentin et al., 2002, p. 161), and its relevance should not be undervalued in e-government adoption due to the wide-range of potential users of these services. Finally, intention to use represents the strength of a person's willingness to perform a certain behavior (Ajzen, 1991) and is a solid signal of how the individual will behave in the future (e.g., McKnight and Chervany, 2001). Actual behaviors and behavioral intentions are therefore highly correlated (e.g., Venkatesh and Davis, 2000) and, as a result, intention to use has been proposed as "the single best predictor of actual usage" (Davis and Venkatesh, 1996, p. 20).

The basic assumption of the model establishes a direct effect of attitude toward the use on intention to use, and is also called behavioral intention. In turn, attitude is preceded by PU and PEOU, being the former also antecedent of intention to use (Davis, 1989; Davis et al., 1989). Finally, as well as to increase the interest of the study, TAM also proposes a direct effect of PEOU on PU.

2.2. The role of trust in the TAM framework

Due to its parsimony and robustness (Sun and Zhang, 2006), TAM compares favorably with other adoption models and explains a substantial portion of the variance (typically about 40%) (Venkatesh and Davis, 2000). However, in concordance with Bagozzi (2007), it seems unreasonable to expect that such a simple and deterministic model would explain such a variety of behaviors in such a wide range of situations. Therefore, different authors have adapted TAM model to specific contexts by incorporating specific variables; nevertheless, little theoretical insight has been provided to explain the mechanism of "the why" behind the interaction effects of TAM (Bagozzi, 2007).

In the online context, trust has been identified as a key driver for adoption (Gefen et al., 2003) due to its relevance to deal with two critical conditions of digital means: uncertainty and risk of vulnerability (e.g., Doney and Cannon, 1997; Gambetta, 2000). Trust is defined by Mayer et al. (1995, p. 172) as "the willingness of a party to be vulnerable to the actions of another party based on the expectations that the other party will perform a particular action important to the *trustor*, irrespective of the ability to monitor or control that other party". Thus, in uncertain scenarios trust reduces vulnerability and helps the human need to understand the social surrounding of the interchange (Pavlou, 2003), which means identifying the what, when, why and how others behave (Gefen et al., 2003). Probably this is the reason why trust has been revealed as an important variable in studies concerning online commerce, and particularly in online services, as it is the case of the study. Several characteristics applicable to electronic service delivery such as the dynamicity of the environment, the lack of sophistication of the user (De Ruyter et al., 2001), and the lack of face-to-face interaction, have situated trust in a pivotal role in e-commerce and e-government relations (Harris and Goode, 2004). Indeed, trust in electronic services has been deeply analyzed in both e-commerce (e.g., McKnight et al., 2002; Gefen et al., 2003) and e-government (e.g., Warkentin et al., 2002; Welch et al., 2005).

As a result, studies of online behavior emphasize the importance of including trust in adoption models to better comprehend the user acceptance of electronic services (Carter and Weerakkody, 2008). Although several researchers related trust and TAM variables in different ways (see Appendix A), based on previous research, this study proposes, explains and tests a partial mediation role of trust in the TAM relationship between perceived ease of use and PU.

2.3. Moderating effect of personal values

As e-government represents a new channel to interact and provides citizens with public services, current citizens' personal values and life-style could strongly affect the citizen decision to adopt e-government services. In other words, the strength of the antecedents of intention to use might be stronger in those citizens that found this new channel more congruent with their values. Indeed, values and life-styles are considered as criteria that individuals use to select and justify their actions (Fraj and Martinez, 2006; Sun and Zhang, 2006), and therefore, they should be considered by adoption research. In accordance with previous research suggesting individual attributes to be conceptually relevant to investigate moderating effect, rather than direct effects (Wiertz and de Ruyter, 2007), this study introduces two specific personal values (environmental concern and time consciousness) to moderate the effects of TAM and trust variables on intention to use e-government services. These two personal values that will be described in the hypotheses formulation section represent respectively two prominently cited features of e-services nowadays: ecological benefits (i.e., e-government helps save paper) and time efficiency (i.e., e-government allows citizens to conduct services 24 h a day and without having to go to the physical agency).

3. Hypotheses formulation

The proposed model is based on the TAM framework which entails the five initial hypotheses. Since TAM hypotheses have been clearly established and repeatedly confirmed by previous literature (Bagozzi, 2007), this research mainly focuses on the integration of trust into the TAM framework. Thus, hypotheses one to five are given in brief while hypotheses six to nine describing how trust is related with TAM receive more attention in terms of length. Finally, the moderating effects that personal characteristics may have on the previous relationships are also described.

3.1. TAM-related hypotheses

First, according to most basic models of human behavior, TAM proposes that behavioral intentions depend basically on attitudes and PU (Davis et al., 1989). Second, TAM is linked to the cost-benefit paradigm in which the decision-making is based on subjective perceptions of the individual about performance and effort. Consequently, TAM also proposes that PU and ease of use affect attitude. Finally, Davis et al. (1989) argued that improvements on PEOU are also instrumental and contribute to increase performance, and hence the PU. In the words of Davis et al. (1989) a person could accomplish more work thanks to effort saved due to improved PEOU, for example reducing the likelihood of error. Taking all these into account, the following TAM-related hypotheses are proposed:

H1. Attitude-towards-the-use positively affects the intention to use a given e-government service.

H2. PU positively affects the intention to use a given e-government service.

H3. PU positively affects attitude-towards-the-use of a given e-government service.

H4. PEOU positively affects attitude-towards-the-use of a given e-government service.

H5. PEOU positively affects PU of a given e-government service.

3.2. Integration of trust into the TAM

Additionally trust is proposed as a key variable affecting the process of adoption of e-government services in the online context. According to several authors in online services literature (see Appendix A), the last four hypotheses described in the following paragraphs propose trust as a partial mediator in the PEOU–PU relationship as well as consider trust as a direct antecedent of both attitude and intention to use.

In this context of analysis, which refers to online transactions between citizens and the government, it has been proposed that apart from the effect on attitude and performance, PEOU could motivate users by increasing their trusting beliefs. PEOU has been hypothesized to have a positive influence on trust in e-commerce since the former helps promote customers favorable impressions on the e-vendor in the initial adoption of an online service (Wu and Chen, 2005). It is supported by cognition-based trust conceptualization which determines that trust is built on first impressions rather than through experiential person interactions (Gefen et al., 2003), which could be relevant in initial stages of the adoption process. In addition, an easy-to-understand website prevents user's misunderstandings and favors transparency along the transactional process (Flavián et al., 2006). Sometimes PEOU favors trust perceptions by indicating a situational normality as well as representing an investment by the other part which can be interpreted as a certain level of commitment to the relationship (Gefen et al., 2003) or an adjustment to the user's needs (Flavián et al., 2006). Therefore, a direct link between PEOU and trust is expected:

H6. PEOU positively affects trust in a given e-government service.

Following Gefen et al. (2003) explanations relating trust to TAM variables, the Social Exchange Theory (Homans, 1961; Kelley, 1979) views interactions in a similar manner to economic exchange based on cost paid and rewards received. To this concern, since rewards cannot be guaranteed in a social exchange, trust is essential and determines people's expectations from the relationship. Based on the definition of trust, users may suffer a loss from the transaction or service when the other part does not behave as expected, which means that trust positively influences PU; in that it allows users to become vulnerable to the other part (Pavlou, 2003; Wu and Chen, 2005). Considering this, the seventh hypothesis proposes a positive effect of trust on PU:

H7. Trust positively affects PU of a given e-government service.

According to the previous argumentation linking trust to the cost–benefit paradigm, trust can increase outcome expectations and attitudinal beliefs based on the benefits of a trustworthy relation. Indeed, research has shown that trust also increases the confidentiality, controllability and familiarity of the relationship (Van der Heijden et al., 2003) as well as the perception of a particular outcome expectation (Wu and Chen, 2005) that can be different from those related with the PU of the service. In other words, trust perception allows individuals to create a miscellaneous positive atmosphere leading the user to a positive sentiment and predisposition toward the use. In these sense, it is proposed a direct effect of trust on attitude:

H8. Trust positively affects attitude-towards-the-use of a given e-government service.

Finally, taking into account the line of thinking expressed in the last two hypotheses, behavioral intention could be also directly influenced by trust. This hypothesis has been proposed by a great number of researchers although they do not always consider other indirect effects of trust through PU and attitude (Pavlou, 2003). Trust positively influences behavioral intentions since it reduces uncertainty and provides expectations for a satisfactory

transaction (Pavlou, 2003), beyond the PU of the service and user's personal attitude. Following several authors in the e-commerce and e-government context (e.g., Gefen et al., 2003; McKnight et al., 2002; Warkentin et al., 2002), the ninth hypothesis proposes a direct and positive effect of trust on intention to use:

H9. Trust positively affects the intention to use a given e-government service.

## 3.3. Moderating role of environmental concern and time consciousness

3.3.1. Environmental concern

Environmental or green values have become an important issue for people considering respect toward the environment as a factor to take into account in their decisions and behaviors. The number of individuals who are aware of environmental problems and try to do something about is continuously increasing (Fraj and Martinez, 2006), and therefore there is an increasing demand on organizations to be environmentally concerned (López et al., 2008). It could be said that environmental values are an emerging trend by which citizens committed to a green life-style are motivated to use products or services considered environment-friendly (Zimmer et al., 1994). Therefore, adoption of e-government services by those citizens who are more concerned about environmental matters could rise considering the environment-friendly nature of some characteristics of e-services (i.e., paper reduction). Under identical circumstances, since the online provision of the service will be more congruent with their values, citizens with greater environmental concern will be more likely to consider PU or affective feelings such as attitude and trust in order to form their behavioral intentions. Additionally, the link between ecological behavior and people with enterprising spirit – those who are prompted to accept new challenges – has been confirmed empirically and suggests a higher effect of the antecedents of adoption (a new challenge) for citizens that show an environmental concern (Kalafatis et al., 1999; Fraj and Martinez, 2006). To sum up, it is proposed that the effect of PU, attitude and trust on the intention to use an e-government service will be higher for those citizens expressing greater levels of environmental concern than for those expressing lower levels.

H10. The effect of: (a) PU, (b) attitude, and (c) trust in intention to use will be strengthened if citizen's environmental concern increases.

3.3.2. Time consciousness

Since time is a limited resource in citizens' lives, there are an increasing number of people considering that employing time efficiently is essential to improve performance in their activities and quality of life (Dijst and Kwan, 2005). In this sense, research has demonstrated that individuals differ in their "time budget" as well as in their awareness of how they spend their time (Lee, 2007) and their avoidance to lose time (Aldás et al., 2011). This concept has been denominated over time consciousness and is defined as a person's disposition to consider time a scarce resource (time-constraint) and plan its use carefully (Kleijnen et al., 2007). In this specific context of analysis, it has been proved that e-government services are fast and readily available (Warkentin et al., 2002) and, analogous to virtual stores, they may be perceived by citizens as a way to save time (Lee, 2007; Rodríguez-del-Bosque and Herrero, 2008). It seems that all else equal, the benefits in terms of quickness and convenience will encourage the adoption of e-government services by those citizens with more awareness about time scarcity in their lives. That is, the following hypothesis proposes that the effect of PU, attitude and trust on the intention to use an e-government service will be higher for those citizens expressing a greater
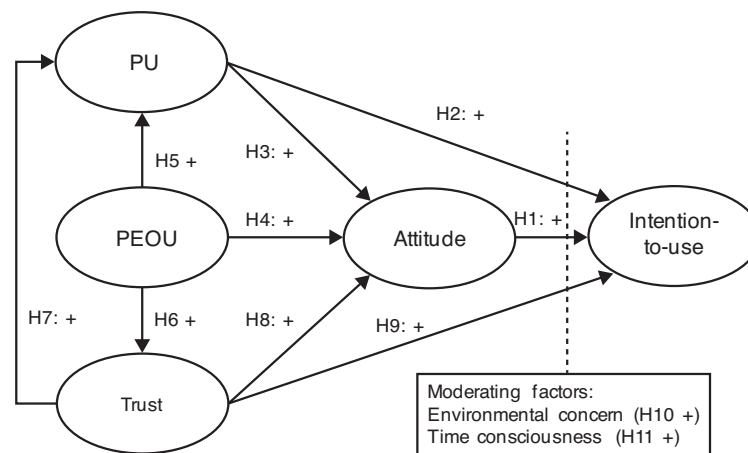
Notes: PU = perceived usefulness, PEOU = perceived ease-of-use

Fig. 1. Proposed model.

concern about time efficiency than for those expressing less concern about time aspects.

H11. The effect of: (a) PU, (b) attitude, and (c) trust in intention to use will be strengthened if citizen's time consciousness increases.

To sum up, the research model can be seen in Fig. 1.

4. Data collection

Data were collected through a web survey targeted to the Spanish-speaking potential users of e-government services. Consistent with studies of technology adoption (Bélanger and Carter, 2008), respondents were demanded to answer to a "questionnaire about public e-services adoption" as an introduction to a conventional survey research. They were simply required to be aware of, or familiar with at least one e-government service involving a form fulfilling or a payment related with public administration at local, regional, or national level of government (each respondent only chose and assessed one e-service of the Spanish public administration). Therefore, these e-services allow citizens to complete transactional administrative services which require the delivery of sensitive personal information from citizens to public administration and often involve payments (e.g., traffic fines payment, residents' registration, subsidy application). These kinds of transactional services were selected because they are highly related with usual tasks in the life of citizens (i.e., driving license renewal) (Wu and Chen, 2005), require delicate personal information exchange (i.e., address, bank account) to be accomplished, and represent a major bureaucratic expenditure for public administrations that could be reduced by e-government adoption (Warkentin et al., 2002). Usually, these transactional services comprise several stages that start at the public agency website; however, from an adoption oriented perspective, this study only considers general citizen perceptions and opinions of the e-service as a whole. E-services that merely provide citizens with one-way information (e.g., information about citizens duties) or with partial support for offline transactions (e.g., form downloading) were deliberately excluded from the study.

In order to obtain a high number of respondents the research counted on the support of several public digital platforms, webpages, and blogs which placed a link to the web survey. This practice is consistent with research in online context that allow respondents to choose the service to be analyzed (e.g., Steenkamp and Geyskens, 2006; Bagozzi and Dholakia, 2006). The survey was also promoted through different discussion forums, e-mail lists and social networks to increase the number of responses. These methods of collecting data generated a sample of internet users who have a basic knowledge about the services offered and the technology employed to be potential users of e-government services. Consequently, citizens responded about a wide range of e-government services (from different kind of tax payments, to educational or labor related administrative tasks), which favored variability in the perceived levels of the measured variables. The final sample was formed by 416 valid questionnaires (after removing atypical cases, repeated responses, and incomplete questionnaires). Respondents were almost equally distributed between males (56.5%) and females (43.5%), most of them had completed university studies (61.5%) and were mostly aged between 25 and 39 years (56.2%) and between 40 and 54 years (36.3%).

The variables were measured through a structured questionnaire containing closed questions about the studied constructs and other socio-demographic data. Specifically, respondents were asked about their perceptions about the e-government service assessed (see Appendix B for the specific questions). All questions related to constructs used 7-point multi-item Likert scales. Considering variation in answers, citizens have a wide variety of opinions ranging from negative to positive ones (see means and standard deviations in Table 1).

5. Measures validation

After an exhaustive revision of the technology adoption literature and works related to e-government and trust, a first version of the scales was proposed. Nevertheless, most of these scales had to be adapted to e-government multidisciplinary context of analysis and more specifically to the public provision of e-services setting. This adaptation helped guarantee the face validity of the measurement instruments; that is, the degree to which respondents could judge the items as appropriate for the targeted construct. Face validity is sometimes mistaken for content validity which actually means that the items of the construct correspond with the theoretical conceptualization. In this study, content validity was guaranteed by the wide literature review carried out in order to obtain the suitable scales. More specifically, the measures are inspired by previous scales regarding PU (Davis, 1989; Wu and Chen, 2005), PEOU (Davis, 1989; Guinalíu, 2005), attitude (Bhattacherjee, 2000; Wu and Chen, 2005; Hsu et al., 2006; Taylor and Todd, 1995), intention to use (Bhattacherjee, 2000; Wu

Table 1
Construct reliability, convergent and discriminant validity.

Construct	Mean	S.D.	ρ_c	AVE	(1)	(2)	(3)	(4)	(5)
Perceived usefulness (1)	5.18	2.02	.940	.829	**.910**				
Perceived ease-of-use (2)	4.02	1.95	.940	.838	.634	**.916**			
Attitude (3)	5.34	1.68	.915	.729	.801	.633	**.854**		
Intention to use (4)	5.13	2.14	.950	.863	.757	.686	.764	**.929**	
Trust (5)	4.65	1.91	.973	.923	.585	.600	.625	.641	**.960**

Note: Diagonal elements (bold figures) are the squared root of the AVE (the variance shared between the constructs and their measures). Off-diagonal elements (in italics) are the correlations among constructs; all these correlations are significant to a level of .01.

and Chen, 2005; Venkatesh and Davis, 2000), and trust (Lee and Turban, 2001). The scales for the TAM constructs only needed minor adaptations from the original ones just to reflect that the adoption process referred to an e-government service (questionnaire items are disclosed in Appendix B). Although different theoretical and operational conceptualizations of trust have been provided by previous research, the definition of Mayer et al. (1995) agrees with a general belief that another party can be trusted instead of a set of specific beliefs (Gefen et al., 2003). In concordance to this view based on perceptions, and similar to PU and PEOU measures, trust was conceptualized and measured as a general belief (e.g., TRUST2 "This e-service is reliable"). To measure time consciousness, an item was borrowed from Kleijnen et al. (2007) ("I am concerned about how I use my time") and another one from Fraj and Martinez (2006) was employed to measure environmental concern ("I am concerned about environment conservation"). On the other hand, face validity was tested through a variation of the Zaichkowsky method (1985), whereby each item is qualified by a panel of experts as "clearly representative", "somewhat representative" or "not representative" of the construct of interest. In line with Lichtenstein et al. (1990), an item was retained when a high level of consensus was observed among the experts.

Exploratory analyses of reliability and dimensionality were developed to initiate the validation process (Anderson and Gerbing, 1988). The Cronbach's alpha indicator was used to assess the initial reliability of the scales, considering a minimum value of .7 (e.g., Cronbach, 1970). All items were adjusted to the required level. Secondly, the unidimensionality of the proposed scales was evaluated by carrying out a principal components analysis. Factor extraction was based on the existence of Eigenvalues higher than 1. Moreover, it was required that factor loadings were higher than .5 points and a significant total explained variance (Hair et al., 1998). After the analysis, only one factor was extracted from each scale: PEOU, PU, attitude, intention to use and trust in the service. For these initial tasks the statistical software SPSS v.17.0 was employed.

The Confirmatory Factor Analysis was employed to confirm the dimensional structure of the scales and to allow for a stringent test of convergent and discriminant validity (Steenkamp and Geyskens, 2006). For this purpose EQS v.6.1 was used as statistical software and Maximum Likelihood as estimation method. In order to depurate the scales, the criteria proposed by Jöreskog and Sörbom (1993) were followed:

- The weak convergence criterion, which means eliminating indicators that do not show significant factor regression coefficients (t student > 2.58; p = .01).
- The strong convergence criterion, which involves eliminating non-substantial indicators; that is, those whose standardized coefficients are lower than .5.
- According to the suggestion of Jöreskog and Sörbom, the indicators that contribute less to the explanation of the model were eliminated, taking R^2 < .3 as a cut-off point.

All items complied with these recommendations which allow us to obtain acceptable levels of convergence, R^2 and model fit

(χ^2 = 370, 116 d.f., p = .00000; Bentler–Bonett Normed Fit Index (NFI) = .98; Bentler–Bonett Nonnormed Fit Index (NNFI) = .98; Comparative Fit Index (CFI) = .99; Bollen (IFI) Fit Index = .99; Root Mean Sq. Error of A (RMSEA) = .073; 90% Confidence Interval of RMSEA (.064, .081)), with the exception of the χ^2 indicator, as is common to research that uses structural equation modeling (Bagozzi et al., 1991). Indeed, the χ^2 indicator has some potential problems (i.e., sample size) in evaluating model fit; so that it is recommended to examine other criteria in addition to this test when evaluating model fit.

The composite reliability indicator (ρ_c) was also employed to evaluate construct (Jöreskog, 1971). The values obtained were above .65 (see Table 1), exceeding the benchmarks that are suggested as acceptable (Steenkamp and Geyskens, 2006). Finally, convergent validity, which indicates whether the items that compose a scale converge on one construct, was tested by checking that the factor loadings of the confirmatory model were statistically significant (level of .01) and higher than .5 points (Steenkamp and Geyskens, 2006). As well, the Average Variance Extracted (AVE) was used to contrast the convergent validity and obtained acceptable values greater than .5 (see Table 1), which implies that items that compose a determined scale contain less than 50% error variance and converge on only one construct (Fornell and Larcker, 1981).

In turn, discriminant validity reveals whether a determined construct is significantly distinct from other constructs that are not theoretically related to it. According to Real et al. (2006), the squared root of the AVE (diagonal elements in bold in Table 1) was compared with the correlations among constructs (off-diagonal elements in italics in Table 1). In other words, it was checked that the construct shares more variance with its measures than the variance it shares with the other constructs in the model (Wiertz and de Ruyter, 2007). Results showed acceptable levels of discriminant validity since all pairs of constructs satisfied this criterion.

6. Results

In order to test the proposed hypotheses, a structural equation model was developed; results are shown in Fig. 2. The model fit indicators presented acceptable values with the exception of χ^2 indicator (χ^2 = 356, 95 d.f., p < .001; NFI = .96; NNFI = .96; CFI = .97; IFI = .97; RMSEA = .08; 90% Confidence Interval of RMSEA (.07, .09); normed χ^2 = 3.84).

All the effects proposed in the model were significant at the level of .01 confirming the nine hypotheses. The suitability of this model to analyze the adoption of e-government services is reinforced by the relatively high explained variance obtained for intention to use (R^2 = .676). This intention to use variance is explained by PU (β = .356), attitude (β = .346) and also trust (β = .216). Consecutively, results also reveal a high explained variance of attitude (R^2 = .690), which is obtained thanks to the effects received from PU (β = .598), PEOU (β = .148) and trust (β = .186). Although the influence of PEOU on attitude seems be the lowest, PEOU still has a relevant role in the adoption process due to its significant effects on both PU (β = .448) and trust (β = .559). In turn, and according to the initial proposal,
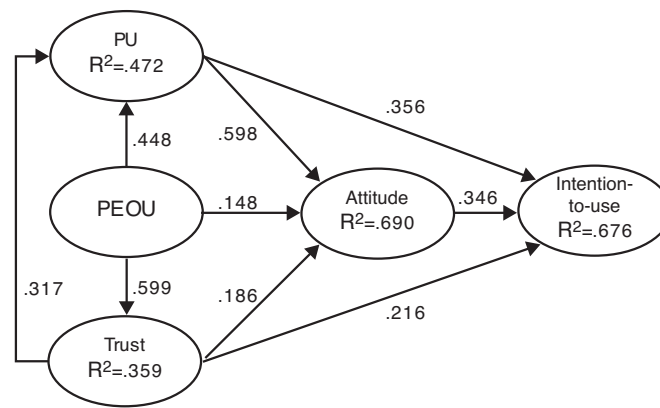
Note: All coefficients are significant at the level of .01, PU = perceived usefulness, PEOU = perceived ease-of-use

Fig. 2. Structural equation model: standardized solution.

trust also affects PU directly (β = .317). The circled effect relating PEOU, trust and PU let us obtain considerable levels of explained variance of trust (R^2 = .359) and PU (R^2 = .472).

6.1. Rival models analysis

In addition, a rival model analysis compared the proposed model against three rival models: a model including only TAM variables without trust (rival model I), a TAM–Trust model where trust is related neither to PEOU nor PU (rival model II), and a TAM–Trust model where trust fully mediates the PEOU–PU relationship (rival model III). The aim of this analysis is to assess the suitability of the partial mediation role played by trust and how much the research proposal adds to other TAM related proposals. According to Bloemer and Odekerken-Schröder (2003), the comparison of the hypothesized model with a rival one may also serve to strengthen the support found for the meaningfulness and robustness of the proposed model. Therefore, it has been traditionally agreed that researchers should contrast rival models and not just evaluate the performance of a proposed one (Morgan and Hunt, 1994; Bloemer and Odekerken-Schröder, 2003). To do that, structural equation modelling was chosen since one of the main advantages of this methodology is that it allows the comparison of several models (e.g., Mitchell, 1992).

In accordance with Morgan and Hunt (1994), the initial model was compared to its rival on the following terms: (1) overall fit, as measured by the CFI indicator; (2) parsimony, as measured by the ratio of chi-square to degrees of freedom; (3) percentage of the model paths that were statistically significant; and (4) the ability to explain the variance of the endogenous constructs. Table 2 compares the proposed partial mediation model against model I which just consider TAM hypotheses, model II in which trust is as an independent variable affecting solely to attitude and intention to use, and model III that describes trust as a full mediator between PEOU and PU. Considering that all the parameters in the four models are significant at *p* < .01, every model reach the highest percentage of significant paths, making this criterion inapplicable to determine the superior model. However, results revealed that the initial proposal based on trust as a partial mediator is better than rival models in terms of overall fit (CFI indicator) and parsimony (normed χ^2). Additionally, the Akaike Information Criterion (AIC) was also employed to compare model fit, which also suggests that the proposed model fits better (lowest AIC value) than the alternative ones. Finally, the partial mediation model is preferred to alternative specifications, since the former shows slightly

highest variance explained (R^2) for the key variables in the adoption model.

Therefore, these findings allow us to conclude that the initially proposed model is superior to specified rival models, which supports the partial mediation role of trust and the inclusion of trust to complete the basic TAM relationships in this context of analysis.

6.2. Multisample analysis

A multisample analysis was performed in order to assess the moderating role of environmental concern (H10) and time consciousness (H11) in the relation between intention to use and its three direct antecedents: (a) PU, (b) attitude and (c) trust. To do that, statistical software EQS version 6.1 was employed.

In the case of environmental concern, the total sample was divided into two groups according to citizens' responses about their level of environmental concern. Following García et al. (2008), total sample was divided into two groups according to the arithmetic mean of the moderating variable. Around this mean some cases were eliminated (±½ standard deviation). The first group was formed by 163 cases representing citizens that showed a lower level of environmental concern. The second group was formed by 149 cases representing citizens with a higher level of these green values. Initially, multisample analysis generates an individual structural solution for each group (citizens with low versus high environmental concern). Afterwards, multisample analysis offers information about the significance of the differences between the coefficients of the two models using the LM-Test.

On the other hand, the same process was carried out to divide the total sample in two groups depending on their time consciousness. In this case the first group was formed by 120 cases representing individuals with lower levels of time consciousness. The second group was formed by 180 cases representing citizens with higher levels of time consciousness. Again, an individual structural solution for each group was generated (citizens with low versus high time consciousness), and possible differences between coefficients of both models were evaluated.

Table 3 shows the results of multisample analysis based on the differences between citizens with low level and high level of environmental concern. Only the effect of attitude on intention to use is significantly different (*p* = .083) in both groups and supports hypothesis 10b. This result represents that the effect of attitude on intention to use an e-government service is greater for citizens with higher environmental concern. However, hypotheses 10a and 10c

Table 2
Rival model analysis.

Relation	Hypothesis		Trust–TAM relation		
		TAM model Rival model I β	Independent variable Rival model II β	Fully mediating PEOU–PU Rival model III β	Partially mediating PEOU–PU Proposed model β
ATT → IUSE	H1	.447	.351	.358	.346
PU → IUSE	H2	.404	.400	.337	.356
PU → ATT	H3	.659	.650	.610	.598
PEOU → ATT	H4	.224	.154	.173	.148
PEOU → PU	H5	.640	.637	–	.448
PEOU → Trust	H6	–	–	.588	.599
Trust → PU	H7	–	–	.601	.317
Trust → ATT	H8	–	.226	.181	.186
Trust → IUSE	H9	–	.249	.222	.216
Rival model test	Preferred		Trust–TAM relation		
		TAM model Rival model I β	Independent variable Rival model II β	Fully mediating PEOU–PU Rival model III β	Partially mediating PEOU–PU Proposed model β
Model fit					
CFI	Highest	.959	.941	.959	.968
Normed χ^2	Lowest	5.163	5.937	4.483	3.755
AIC	Lowest	189.76	381.92	238.33	166.77
R^2	Highest				
IUSE		.653	.595	.668	.676
ATT		.672	.625	.676	.690
PU		.409	.406	.346	.472
Trust		–	–	.361	.359

All parameters are significant at *p* < .01. *Note*: AIC: Akaike Information Criteria; ATT: attitude; IUSE: intention to use; PU: perceived usefulness.

Table 3
Multisample analysis: environmental concern.

Constraints	Estimated coefficients (lower level of environmental concern)	Estimated coefficients (higher level of environmental concern)	d.f.	$\Delta\chi^2$	*p*-Value
PU–IUSE (H10a)	.494[***]	.321[***]	1	0.332	.564
Attitude–IUSE (H10b)	.366[***]	.960[***]	1	3.000	.083[*]
Trust–IUSE (H10c)	.271[***]	.161[**]	1	0.013	.909

Note: PU: perceived usefulness; IUSE: intention to use.

[*] Coefficients are significant at *p* < .10.

[**] Coefficients are significant at *p* < .05.

[***] Coefficients are significant at *p* < .01.

are not supported since the differences between both groups are not significant.

Alternatively, Table 4 shows the results of the multisample analysis for citizens with low and high levels of time consciousness. These results support hypotheses 11a and 11b confirming significantly stronger effects of PU (*p* = .025) and attitude (*p* = .050) on intention to use for citizens with high levels of time consciousness compared to those with low levels of time consciousness. Hypothesis 11c is not confirmed since the difference between both groups is non-significant and the effect of trust on intention to use is lower for citizens with higher levels of time consciousness. Following results in Table 4, it seems that citizens more aware about time efficiency base their intention more in PU and attitude and less on trust.

7. Discussion

Due to the increasing provision of public services online but their limited adoption by citizens, it is necessary to understand in more detail which factors help increase the intention to use these e-government services both theoretically and managerially. In order to shed some light on this issue, this work has integrated trust into the TAM model and has analyzed the moderating role that

personal values and citizens' life-styles may exert on the adoption process. The theoretical argumentation and proposed model have been corroborated, considering the results provided by this study. The following paragraphs thus describe the principal conclusions and evoke several managerial implications.

7.1. Conclusions and managerial implications

First, in accordance with previous empirical works (Venkatesh et al., 2003; Hung et al., 2006), PU is revealed as the most important citizen perception affecting both attitude (directly) and intention (directly and indirectly) to adopt e-government services. It seems that, similar to other technology driven services, the perceived benefits derived from their use are the principal reason for citizens to adopt e-government services. Managers in charge of the online provision of public services should take into account that potential users have to perceive the usefulness of the service in order to adopt it. As a result, the Public Administration should carry out campaigns to promote the benefits of e-government services in order to enhance the perception of a worthy service (for example, in terms of time and cost saving, convenience, effectiveness, etc.).

Second, trust is revealed as a third belief able to explain the mechanism underlying TAM framework in this context; trust is

Table 4
Multisample analysis: time consciousness.

Constraints	Estimated coefficients (lower level of time consciousness)	Estimated coefficients (higher level of time consciousness)	d.f.	Δχ^2	p-Value
PU–IUSE (H11a)	.240[**]	.480[***]	1	5.024	.025[**]
Attitude–IUSE (H11b)	.433[***]	.883[***]	1	3.843	.050[**]
Trust–IUSE (H11c)	.514[***]	.169[**]	1	1.549	.213

Note: PU: perceived usefulness; IUSE: intention to use.
[**] Coefficients are significant at the level of .05.
[***] Coefficients are significant at the level of .01.

affected by PEOU and directly affects PU. In other words, after different rival model tests, the initial model proposing a partial mediation of trust in the relation between PEOU and PU is founded as superior to original TAM and other models relating trust and TAM. This finding contributes to previous literature by: (1) confirming that the inclusion of trust as a third belief into the TAM model is relevant in the online context, and (2) showing which way to integrate trust into the TAM is the most suitable. Indeed, several works have previously integrated trust into the TAM model in different ways – proposing mainly the partial mediation and direct effect of trust on adoption (see Appendix A) – so there was a theoretical need for comparing the proposal with other possible specifications. As well, results show that trust is totally connected to the TAM framework by significant and strong direct effects on both attitude and intention to use. Thus, considering results in this study, researchers dealing with online service research are recommended to deep into TAM mechanisms; the positive and integrative effect of trust on adoption should be noted. As it has been previously argued, probably such an integrative role of trust in TAM could be also applicable to other products/services dealing with uncertainty, especially to those based on technology. Analogously, focusing on practical implications, e-government services managers should take into account the importance of citizen trust on the provision of these services. Governmental e-services should strongly consider the characteristics of the online environment and employ a trusted quality system of service management (Corbitt et al., 2003) combined with other techniques that could improve the perception of a trustworthy e-government service by citizens (i.e., promoting e-government reliability in the media; making the virtual office to be integrated to the brick-and-mortar one by using pictures, similar forms, etc.).

Third, PEOU is confirmed as a variable affecting the adoption process through its multiple effects on key variables such as PU, attitude and trust. As far as citizens perceive that the use of e-government services is free of effort their attitude and PU are increased, as well as their trust in the e-government service. A greater PEOU might create a more favorable atmosphere when using the service (Casaló et al., 2007) and should be a sign of the government concern about its citizens' needs. Therefore, the primary role of PEOU in the development of e-government services should not be underestimated and ease-of-use must still be a priority when designing these services. It is therefore a responsibility of the government to elaborate e-services based on users' requirements and knowledge, in order to make them easy to use for the wide-range of citizens that exists in terms of Internet experience. Also, organizing free formation courses for those sectors of population with less knowledge about the Internet and adapting e-services to different devices such as mobile phones might be also useful to increase the PEOU of these services.

Fourth, multisample analyses reveal that personal values and life-styles of citizens are affecting the importance of the variables considered to take the adoption decision. This finding also contributes to existing literature in e-government adoption since previous studies have not analyzed possible differences on the TAM relationships depending on citizen characteristics. In

particular the role of attitude is reinforced for citizens with high levels on environmental concern with respect to those with low levels. The interpretation of this result suggests that citizens with higher environmental concern base their intentions-to-use more in the attitudinal construct. It seems that, to the extent that e-government services are considered environment-friendly and the individual attitude matches with the personal environmental concern, the effect of attitude on intention to use is noticeably reinforced. In turn, citizens with high levels of time consciousness are more affected by PU and attitude that citizens that are less worried about their use of time. The significant increase in the effect of PU seems logical since it explains that citizens with high levels of time consciousness value more the PU of the service (probably because they perceive that e-government services are fast and convenient) than those with low levels of time consciousness. The increase of the effect of attitude on intention to use suggest that time efficiency is not only important to consider the usefulness of the service but also to value the favorable or unfavorable evaluative feelings towards the use. Since attitudes are stored in memory they usually help individuals to take decisions quickly (Eagly and Chaiken, 1993); therefore, those individuals who are more time-conscious should use their attitudes in a greater extent to form their behavioral intentions than by the less time-conscious people. As far as these or other values and life-styles are affecting the adoption process, governments should consider them carefully in order to adapt their marketing strategy in order to promote the use of e-government services according to the needs of specific groups in the society, focusing attention on the relevant factors for each group (i.e., for environmentalists, managers should be aware of these citizens' environmental demands in order to adapt their organization and environmental strategic marketing [Rivera and Molero, 2006]).

Fifth, it is also remarkable for the capacity of the model to explain intention to use and attitude since the latter remain as an interesting variable affecting the process of adoption as well as a target variable by itself. Although PU is the principal variable affecting intention to use, it is interesting to note that the attitude path has also a positive effect on adoptions. Indeed, attitude toward-the-use could be considered more relevant than intention for studies focused on other approaches of e-government (i.e., social influence, advertising, political marketing). Managers promoting the digital channels use for public services should carry out campaigns and citizens tryouts in order to make the advantages of e-government services noticeable and raise a favorable attitude toward the use among citizens.

7.2. Limitations and future research lines

Finally, despite these contributions, several limitations of the study that open new opportunities for future research have to be mentioned. First of all, this work follows the tradition of technology adoption models in which the dependable variable is intention to adopt. Despite intentions play an important role in guiding different kind of behaviors (e.g. to recommend the service to other potential adopters), many authors pointed out that the linkage between intention and actual use represent a critical gap in such

theories (Bagozzi, 2007). A longitudinal study collecting data about actual use of public services would reinforce the findings of this research. As well, the moderating variables (reflecting two personal values) considered in this study only influenced the effects on intention to use; however, more moderating variables and effects could be considered in order to use moderation as a mean to better explain adoption models. From another point of view, given the multidisciplinary nature of e-government, alternative perspectives rooted on law, public management or marketing literatures could also complement the analyses provided in this article.

On the other hand, the sample was formed exclusively by Spanish users of services provided by Spanish public administration (in which most public services share a common e-system platform to carry out transactions), representing another limitation of the study. Some differences could be found if the study was conducted in other countries or considering specifically different e-systems to transfer information. It seems that different user profiles could be found depending on culture, level of use of ICT, etc. Moreover, all services studied were Internet based and other technologies (i.e., mobile phone) were excluded. An interesting way for future research could be based on the analysis of possible differences among services depending on the technology employed to provide them. In a similar way, further research should also focus on confirming the partial mediation role of trust in other contexts of analysis and describing further conditions (i.e., other moderating effects) affecting the public e-services adoption by citizens.

Funding

Appendix A. Studies relating TAM and trust

E-commerce adoption

Study	Category of adoption	TAM — Original hypotheses					TAM2[a]	Trust related hypotheses — Mediation effect				Direct effect on adoption	
		PEOU→PU	PEOU→ATT	PU→ATT	ATT→IUSE	PU→IUSE	PEOU→IUSE	PU→Trust	PEOU→Trust	Trust→PU	Trust→PEOU	Trust→ATT	Trust→IUSE
Suh and Han (2002)	E-banking	●	●	●	●	●		●				●	●
Gefen and Straub (2003)	Travel reservation	●				●							●
Gefen et al. (2003)	Book and CD shopping	●				●	●		●	●			●
Pavlou (2003)	Web retailers	●				●	○		●	●	●		●
Van der Heijden et al. (2003)	CD shopping		◐	○	●							●	
Chen and Tan (2004)	E-commerce in general	○	●	●	●	●						●	
Gefen (2004)	ERP adoption[b]	●	○	●						●		●	
Yu et al. (2005)	Purchasing by interactive television	●	◐	●	●	◐						◐	◐
Wang and Benbasat (2005)	E-recommendations for digital cameras	●				●	○		●	●			●
Cho (2006)	Online legal services	●	○	●		●						●	
McCloskey (2006)	E-commerce by senior citizens	●				●	○			●	●		●
Wang et al. (2006)	M-commerce (e.g. travel tickets)	●				●	●		●	●			●
Reid and Levy (2008)	E-banking	●	●	●	●	●				●	●		
Palvia (2009)	Web vendors	●	●	●	●	●						●	●
Li and Yeh (2010)	M-commerce							●	●				
Lorenzo et al. (2011)	Online social networks	●	○	●	●	●	○		●	●			

E-government adoption

Study	Category of adoption	TAM — Original hypotheses					TAM2[a]	Trust related hypotheses — Mediation effect				Direct effect on adoption	
		PEOU→PU	PEOU→ATT	PU→ATT	ATT→IUSE	PU→IUSE	PEOU→IUSE	PU→Trust	PEOU→Trust	Trust→PU	Trust→PEOU	Trust→ATT	Trust→IUSE
Wang (2002)	Income tax return	●					●		●				●
Warkentin et al. (2002)	Theoretical	T				T	T						T
Carter and Bélanger (2005)	Motor vehicles taxation e-services						●						●
Wu and Chen (2005)	Tax payment services	●	●	●	●	○			●	●		●	
Hung et al. (2006)	Tax payment services		●	●	●							●	
Horst et al. (2007)	E-government services in general					◐				●			
Tung et al. (2008)	Logistic information system at hospitals	●				●	●		●	●			●
Zimmer et al. (2010)	Public information disclosure website				●	○						●	

Notes: ●: significant; ◐: partially significant; ○: not significant; T: theoretical; ATT: attitude toward the use; IUSE: intention to use; PEOU: perceived ease of use; PU: perceived usefulness.

[a] TAM2 refers to Venkatesh and Davis model (2000) in which attitude construct is omitted.

[b] Attitude is measured by a different variable representing system worthiness.

Appendix B. Questionnaire items

Perceived usefulness (*adapted from:* Davis, 1989; Wu and Chen, 2005):
Using this e-service . . .
PU1. . . .is useful for me
PU3. . . .will improve my effectiveness
PU2. . . .will improve my performance

Perceived ease-of-use (*adapted from:* Davis, 1989; Guinalíu, 2005):
PEOU1. In this e-service it would be easy to find the information I need
PEOU2. Learning to operate with this e-service would be easy
PEOU3. This e-service would be easy to use

Attitude (*adapted from:* Bhattacherjee, 2000; Wu and Chen, 2005; Hsu et al., 2006; Taylor and Todd, 1995):
Using this e-service . . .
ATT1. . . . is an idea I like
ATT2. . . . would be a pleasant experience
ATT3. . . . is a good idea
ATT4. . . . is a wise idea

Trust (*adapted from:* Lee and Turban, 2001):
TRUST1. I trust this e-service
TRUST2. This e-service is reliable
TRUST3. This e-service is trustworthy

Intention-to-use (*adapted from:* Bhattacherjee, 2000; Wu and Chen, 2005; Venkatesh and Davis, 2000):
When I will need it . . .
IOU1. . . .I will intend to use this e-service
IOU2. . . .I predict I would use this e-service
IOU3. . . .I would like to use this e-service

Environmental concern (*adapted from:* Fraj and Martínez, 2006):
ENV. I am concerned about environment conservation (paper waste, etc.)

Time consciousness (*adapted from:* Kleijnen et al., 2007):
TIME. I am concerned about how I use my time

Note: *These items were presented in Spanish due to the interviewees' nationality.*

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