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Abstract. Much of the prior research on IS adoption recognizes that cultural characteristics of the nations influence their adoption behaviors significantly. In the context of e-government, more empirical research is necessary to understand the adoption behaviors of different nations. Our research focuses on understanding the antecedents of e-government adoption in the German household, which has not been adequately addressed to date. Based on the findings of two representative cross-sectional studies, we derived a comprehensive research model and tested it with 1,000 users in the German household on the specific example of e-filing. While the factors of data protection and security were mentioned as crucial in the descriptive studies, the explanatory analysis with LISREL revealed that compatibility is the main antecedent of e-filing adoption in the German nation, followed by relative advantage and perceived risk. Implications for practice and future research are discussed.

Keywords: IS Adoption, E-Government, Germany, LISREL, Structural Equation Modeling

1 Introduction

Despite the enormous potential of new public management, most e-government initiatives are faced with adoption challenges. Until now, development of e-government services has been primarily guided by supply side factors and technological possibilities rather than user needs [1]. There is an increasing body of research claiming that a user-centered e-government strategy is essential, if e-government is to succeed [2]. Therefore, empirical research becomes critical in understanding the expectations of citizens and their decision making mechanisms towards using online public services.

Prior literature suggests that national culture shapes perceptions of citizens thus facilitates or impedes adoption of new technologies [3]. According to Patel and Jacobson [4], factors influencing e-government adoption can be influenced by cultural backgrounds of the users, however there is a lack of empirical studies examining the impact of national culture on e-government adoption. Some technology related factors may be salient in all cultures. Yet, risk perceptions and privacy concerns, which play key roles in the adoption of other online technologies, vary considerably from one nation to another [5]. Consequently, more empirical research is necessary to under-

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stand the nations' expectations to achieve worldwide adoption of e-government services [1], [4].

The Cap Gemini Report on e-government [6] recognizes Germany as one of the top performers in full online availability and sophistication of online public services. In the Global Competitiveness Report [7] Germany is ranked second for the quality of its infrastructure worldwide. Moreover, the Federal Government provides full support and dedication to make Germany one of the leaders of e-government in Europe. The widespread adoption of e-government services has been part of the national strategy over a decade, with the specific target of "enabling Germany to become one of the e-government leaders of Europe" [8]. However, the adoption problems of e-government in Germany seem to persist, especially in the household context [9]. Other than some municipal level adoption research [10], the major antecedents influencing adoption in Germany have not been subject to empirical research with a representative study. Hence, the factors motivating or hindering households' use of online public services as well as their expectations, demands and concerns for a better e-government adoption are yet to be understood.

The presented research aims to contribute to a better understanding of e-government adoption in Germany by addressing this research gap in literature. In particular, the main research question guiding our research is as follows: What are the antecedents of e-government adoption in the German household?

The document is organized as follows. The next section provides a brief review of the literature and discusses the high sensitivity of the German citizens towards data protection and security. Section three summarizes the insights gained by the descriptive cross-sectional studies. The research model and hypotheses derived are elaborated in the following section. Section five summarizes the methodology used and the results are analyzed in section six. After discussing the main findings, implications and limitations, the paper concludes with a high-level summary of the key findings arising from our research.

2 Literature Review

2.1 Technology Adoption in E-government Research

It is common practice for e-government researchers to draw on constructs, theories and models from IS literature to study e-government adoption [11]. Up to now, various factors have been discussed as being the prominent factors of IS adoption. Some constructs consistently explain a large percentage of variance such as perceived usefulness (relative advantage) [12] and ease of use (simple usability) [12]. Yet, previous research suggests that some determinants related to beliefs and values vary by culture [13], necessitating empirical research conducted in each culture individually [14].

We argue that perceived risk and trust are among the essential constructs that need to be analyzed to understand e-government adoption. Broad literature on e-commerce adoption recommend building trust of consumers [15] for decreasing their risk perceptions to foster adoption [5]. In fact, the risk involved in e-government is actually

much higher than e-commerce [16]. In e-commerce, consumers risk the theft of credit card information and access to personal preferences by third parties. However, in e-government, citizens transmit their income tax records, digital identities and even permanent characteristics such as biometrics, which would have severe life-long consequences in case of an unwanted third party access. Hence, the key factors of perceived risk and trust become crucial for the context of e-government adoption.

It is necessary to distinguish between the trust of the transmission medium and trust of the service provider, as in the case of e-commerce [17]. Consumers' decision to adopt e-commerce is affected not only by the perceptions of technology but also by the beliefs about the credibility of the e-vendor. Likewise, the perceptions of users on technological security of the transmission medium are significantly different from the perceptions on public organizations' ability to deliver their commitments or the ethical use of the collected data. The latter requires trust in government, which may be difficult to establish. In particular, citizens tend to suspect that government watches everything and gathers data about citizens through various channels [18]. Worldwide data scandals and identity thefts intensify concerns of users towards online public services even more.

It is widely acknowledged that national culture influences how people react to perceived risk and handle trust [19]. Previous studies have demonstrated how espoused cultural values affect a nation's behavior by altering their belief structures [3], [14], also in the context of e-government [20-21].

2.2 High Sensitivity of the German Nation towards Data Protection and Security

The German nation is highly sensitive towards the issues of data protection and security. The high risk-aversion of the German nation is a widely recognized phenomenon [22] as confirmed by the well-known cultural classifications [19], [23]. The past experience of surveillance state in the German history may be seen as an influence factor on the high risk-aversion at the national level, which deserves further research.

An overview of data protection laws in Germany reflects that Germany has one of the strictest data protection laws in the European Union. In 1983, the German Federal Constitutional Court acknowledged an individual's "right of informational self-determination" and ascertained that the privacy of personal data is a fundamental right in German constitutional law [24]. Since then, the basic criterion for handling personal data – including analysis, processing and further use – by any third party has been a given right to the individual who owns the data. Processing of personal data is only permitted with the consent of the individual, independent of its context and sensitivity. Indeed, various nationwide initiatives involving transfer of sensitive personal data have been protested nationwide by citizens, non-governmental organizations and political parties and even abandoned due to infringement to personal privacy [25].

The term "transparent citizen" (in German "gläserner Bürger") – which was originally used to define an anatomical human model made of plastic – has become the metaphor for violating the privacy of citizens in Germany [26]. It implies a complete fluoroscopy (X-Ray screening) of a citizen in terms of his complete personal data and

tracking of his activities by the government. We argue that the data privacy and security concerns of the citizens need to be analyzed carefully, if e-government in Germany is to succeed. Especially, large-scale projects involving transfer of sensitive personal data are not likely to be successful without a thorough understanding of various risk perceptions of citizens.

3 Insights Gained from Descriptive Research

We have followed a two-step methodology, which combines descriptive and explanatory research. Firstly, we conducted two descriptive studies in 2010 and 2011 – with two different nationwide representative samples – to receive insights into the factors that influence e-government adoption in Germany, which were then analyzed in 2011 as part of an explanatory study. Two cross-sectional studies over these two years were conducted to increase the validity of findings, as one time cross-sectional design would only provide a 'snapshot' at a given point of time [27].

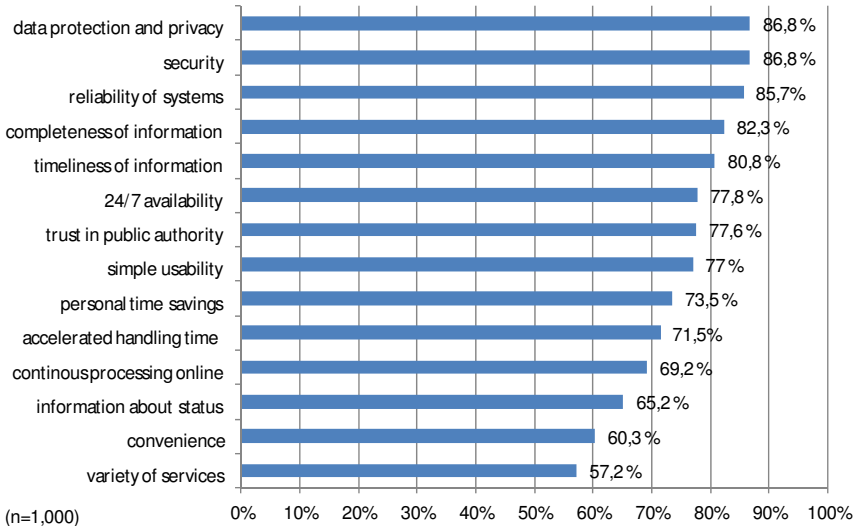

Fig. 1. Factors influencing the adoption of e-government in Germany (2011) (based on [28])

The descriptive study included question on the familiarity and satisfaction of e-government services in Germany. For the purposes of this paper, we only consider the question that aims to provide better understanding on factors influencing e-government adoption. Figure 1 summarizes the results in 2011 and Table 1 analyzes the change of the factors over the study in 2010 regarding this specific question.

As depicted in Figure 1 above, the factors of data protection, privacy and security are the most important considerations for one's e-government engagement (86,8%) followed by the reliability of systems (85,7%). These factors highlight the importance of citizens' trust in government and technology, including the supporting infrastructure and the transmitting medium. Whilst the trust in government is mentioned implic-

itly under ‘data protection and privacy’, the importance of trust in government became more apparent under ‘trust in public authority’ (77,6%).

Table 1. The change in factors influencing adoption over the two years (based on [28-29])

		N	Mean	Std. Dev.	Std. Err. Mean	t	df	sig. (p)	diff.
data protection and privacy	2010	1002	4,583	0,667	0,021	1,440	1865	.150	No
	2011	1000	4,533	0,876	0,028				
security	2010	1002	4,534	0,673	0,021	0,824	1886	.410	No
	2011	1000	4,505	0,863	0,027				
reliability of systems	2010	1002	4,402	0,697	0,022	-0,060	1895	.953	No
	2011	1000	4,404	0,884	0,028				
completeness of information	2010	1002	4,003	0,707	0,022	-7,388	1886	.000	Yes
	2011	1000	4,271	0,906	0,029				
timeliness of information	2010	1002	4,202	0,696	0,022	0,094	1868	.925	No
	2011	1000	4,199	0,911	0,029				
24/7 availability	2010	1002	4,242	0,738	0,023	2,236	1868	.025	Yes
	2011	1000	4,156	0,967	0,031				
trust in public authority	2010	1002	4,172	0,783	0,025	-0,481	1914	.631	No
	2011	1000	4,191	0,968	0,031				
simple usability	2010	1002	4,160	0,725	0,023	0,440	1883	.660	No
	2011	1000	4,144	0,933	0,029				
personal time savings	2010	1002	4,084	0,794	0,025	1,544	1941	.123	No
	2011	1000	4,024	0,945	0,030				
accelerated handling time	2010	1002	4,057	0,785	0,025	1,788	1915	.074	No
	2011	1000	3,986	0,970	0,031				
continuous processing online	2010	1002	3,924	0,816	0,026	-0,046	1915	.963	No
	2011	1000	3,926	1,008	0,032				
information about status	2010	1002	3,782	0,838	0,026	-1,698	1949	.090	No
	2011	1000	3,851	0,983	0,031				
convenience	2010	1002	3,684	0,912	0,029	-1,776	1969	.076	No
	2011	1000	3,761	1,033	0,033				
variety of services	2010	1002	3,694	0,798	0,025	-0,195	1911	.846	No
	2011	1000	3,702	0,990	0,031				

The independent-samples-t-test analysis presented in Table 1 suggests that, the importance of most factors has not changed significantly in 2011. In the overall, we conclude that the results of the two years did not differ considerably. Afterwards, we proceeded to defining the appropriate research model and developing the hypotheses for our explanatory study, which is explained next.

4 Research Model and Hypotheses

The descriptive studies reveal that perceived risk, trust in technology and trust in government authorities play an important role in German society. Moreover, they illustrate that citizens value relative advantage – correspond to 24/7 availability, accelerated handling time and personal time savings in these studies – and simple usability of

the services, which were regarded as being important by at least 71,5% of the respondents. By combining these results with the prior IS adoption literature, we derived our research model. Gefen et al. [30] suggest that confirmatory research should be conducted by using research models with strong theoretical basis. Hence, we combined the selected constructs from the Roger's [31] 'Theory of Perceived Attributes' and the 'Trust and Risk Model' of Belanger and Carter [32].

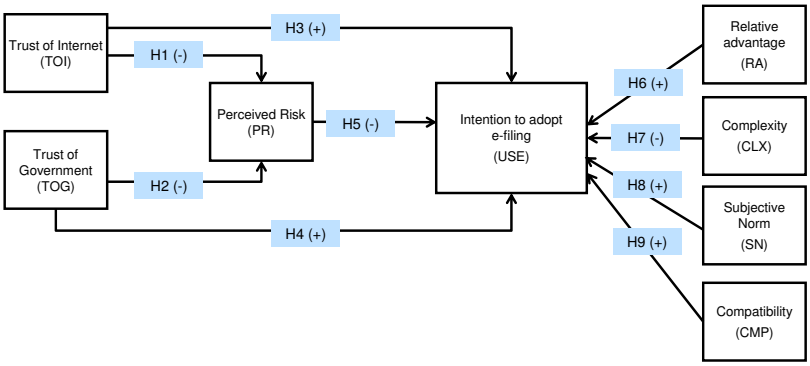

Fig. 2. Research Model

Roger's theory states that potential adopters judge an innovation based on their perceptions of five attributes: relative advantage, complexity, compatibility, observability and trialability [31]. Based on a comprehensive review and meta-analysis, Tornatzky and Klein [33] found that relative advantage, complexity and compatibility are the most significant factors in explaining adoption of innovations, so these were included in our research model. In order to reflect the issues of trust and perceived risk, we included trust of the Internet, trust of the government and perceived risk from the Belanger and Carter's model of e-government adoption. Finally, we added the construct of subjective norm. There is a considerable amount of literature indicating that social influences play an important role in determining the acceptance and usage behavior of new adopters of information technologies [34]. Figure 2 presents our proposed research model and hypotheses.

The intention to use e-government services was questioned by the specific example of e-filing for a number of reasons. First, due to the federal structure of the government in Germany, there may be differences among the services offered by different states and municipalities. Yet, individual income tax filing is a nationwide service of the German Tax Administration, without any specific differences in states or municipalities. Second, tax filing is a civic obligation, which should be familiar to a large amount of the population. Third, the acceptance rate of e-filing in Germany is still relatively low compared to other countries. Thus, questioning particularly based on this example would also deliver the reasons hindering its nationwide acceptance. Finally, some of the existing studies on e-government adoption [35-37] use the specific example of e-filing as well, which would enable cross-cultural comparison of different nations.

5 Methodology

5.1 Data Collection

The sample for the explanatory study was randomly selected to be representative of the German population to ensure high validity. The online survey was conducted between 8th and 31th of August 2011. The final sample included 1,000 Internet drawn from the target population of all German households over 18 years old, who had household Internet access, for an error margin of 3,1% at a 95% confidence level. The data is weighted to be representative for the total online population by central features like gender, age and formal education. The sample's age ranged from 18-75, while 81,1% respondents were in the 18-54 age group. 51,8% of the participants were female, 83,5% of them used the Internet several times a day and 84,6% had already been using the Internet for more than five years.

5.2 Instrument Development

Survey instrument was developed by using existing pre-validated measures of similar constructs in literature [17], [34], [38-40] that were modified to fit to the research context. The instrument consisted of thirty-two indicators on a structured seven-point Likert scale ranging from "strongly agree" to "strongly disagree". The initially developed instrument was initially pilot tested, which helped to reveal problems with question wording, lack of clarity and ambiguity. Such questions were improved before administrating the scale to the intended sample. Face and content validity of the instrument were evaluated by two professors who are experts in the area of trust and IS research, two IS experts with PhD degrees in IS and one marketing research expert.

The internal consistency of the scale, the Cronbach's alpha, has ranged between 0.74 and 0.93. Four items having lower reliability were removed which were the reverse-scored ones on the survey instrument, suggesting that the direction of the wording may have caused the problem. The reliabilities of all measures surpassed the 0.70 cut-off value [41] thus all constructs had acceptable reliability.

Podsakoff et al. [42] suggest that studies using single source, self-reported data should be checked for common method bias. Harman's single-factor test [43] was applied by conducting an exploratory factor analysis to examine the presence of the bias. The principal components factor analysis resulted in seven factors with no factor accounting for the majority of the variance, while the first factor accounted for 34,75% of the variance. This suggests that method bias did not overly influence the responses in this study.

6 Data Analysis and Results

Due to the existence of various latent variables, the second generation multivariate analysis technique Structural Equation Modeling (SEM) [30] was selected for data analysis. We carried out the analysis in accordance with the two-stage methodology

suggested by Anderson and Gerbing [44]. The first step was to establish convergent and discriminant validity of the proposed constructs.

6.1 Measurement Model

Convergent and discriminant validity of the constructs were examined with several tests. The confirmatory factor analysis (CFA) conducted by using LISREL 8.80 [45] demonstrated a good model fit (SRMR = 0.039, CFI = 0.98, RMSEA = 0.061, NFI = 0.97) [41], [45], supporting both convergent and discriminant validity.

Table 2. Convergent and discriminant validity

	CR	AVE	MSV	ASV
TOI	0,774	0,547	0,269	0,074
TOG	0,882	0,714	0,269	0,090
PR	0,897	0,688	0,339	0,165
RA	0,866	0,622	0,615	0,284
CLX	0,934	0,779	0,618	0,262
USE	0,830	0,644	0,601	0,274
SN	0,914	0,729	0,038	0,018
CMP	0,917	0,788	0,618	0,324

In addition to CFA, we also checked the construct validity to ensure convergent and discriminant validity of the variables before including them into the hypotheses testing. As illustrated in Table 2, all variables in the study have provided a sufficient convergent validity. The standardized factor loadings were highly significant. Composite reliabilities of all variables exceeded the minimum limit of 0.70 and were larger than the average variance extracted (AVE). The average variance extracted estimates were all above the recommended 0.50 level [41], [46], which implied that more than one-half of the variances observed. With regard to discriminant validity, we compared the maximum shared squared variances (MSV) between factors and average shared squared variance (ASV) with the average variance extracted. All constructs surpassed this test thus the discriminant validity was established [45].

As another test for discriminant validity, the square root of the average variance extracted for each construct was compared against its correlations with other constructs [46], as shown in Table 3. This discriminant validity assessment has also revealed that all constructs displayed sufficient discriminant validity.

Table 3. Construct correlation matrix

	SN	TOI	TOG	PR	RA	CLX	CMP	USE
SN	**0,854**							
TOI	0,161	**0,740**						
TOG	0,178	0,519	**0,845**					
PR	0,054	-0,187	-0,208	**0,829**				
RA	0,194	0,252	0,284	-0,483	**0,789**			
CLX	0,037	0,213	0,272	-0,461	0,689	**0,883**		
CMP	0,140	0,220	0,272	-0,541	0,784	0,786	**0,887**	
USE	0,074	0,169	0,234	-0,582	0,695	0,638	0,775	**0,803**

To sum up, the conducted CFA and convergent validity tests showed that we did not have any issues of convergent and discriminant validity. Next, the structural model and the hypotheses were examined.

6.2 Structural Model

The structural equation model was estimated using the maximum likelihood method of LISREL 8.80 [45] to examine the relationships among the proposed constructs. The model fit measure of 'standardized root means square residual' (SRMR) had a value of 0.086, exceeding both the good fit level of 0.050 and the acceptable fit level of 0.080 [47]. In order to improve the model fit, the modification indices of LISREL suggested the addition of a path from compatibility to perceived risk. This modification was made in accordance with the previous empirical studies which found that compatibility is negatively related to perceived risk [48]. With this modification, the model provided a very good fit (SRMR = 0.041, CFI = 0.98, RMSEA = 0.059, NFI = 0.97) [41], [45], which is considered to be 'excellent' according to [47] with the fit indices of SRMR < 0.08, CFI > 0.95 and the RMSEA < 0.06.

Figure 3 presents the structural relationships among the constructs and standardized path coefficients. Perceived risk is predicted by trust of the Internet (β = -0.14), trust of the government (β = 0.11) and compatibility (β = -0.46). These variables totally explain a variance of 23% on perceived risk (R^2 = 0.23). Intention to use is jointly predicted by perceived risk (β = -0.24), compatibility (β = 0.41), relative advantage (β = 0.26) and subjective norm (β = 0.06) by explaining a total variance of 63% (R^2 = 0.63).

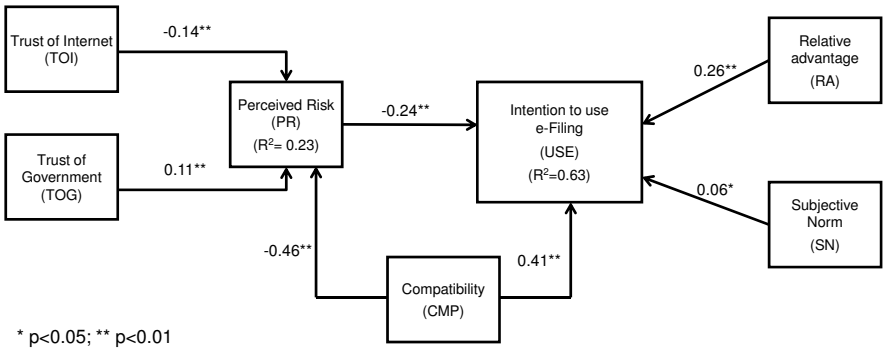

Fig. 3. Standardized path coefficients for significant relationships

Table 4 summarizes the hypotheses tests. Overall, five of the nine proposed hypotheses are accepted. Higher levels of trust of the Internet decrease perceived risk (H1). As the degree of trust on the Internet as the transmitting medium increases, the degree of perceived risk decreases. Similarly, higher levels of perceived risk affect intention to use e-filing negatively (H5). If users perceive high amount of risk to make their tax declarations online due to any reason, they will be less willing to use e-filing.

Table 4. Path coefficients and hypothesis testing

Hypotheses	Relationship	Estimate	Std-Error	t-value	Supported
H1	TOI->PR	-0.14	0.043	-3.25	YES
H2	TOG->PR	0.11	0.040	2.70	NO
H3	TOI->USE	-0.01	0.033	-0.20	NO
H4	TOG->USE	0.03	0.031	1.01	NO
H5	PR->USE	-0.25	0.027	-9.47	YES
H6	RA->USE	0.29	0.039	7.49	YES
H7	CLX->USE	-0.03	0.044	-0.76	NO
H8	SN->USE	0.06	0.025	2.52	YES
H9	CMP->USE	0.39	0.046	8.61	YES

Relative advantage behaves also as expected (H6) by positively influencing intention to use. If an online service provides more advantages than its paper-based version, citizens would prefer to use the former. Subjective norm affects intention to use positively as well (H8), however its effect is barely significant. This finding suggests that, there is only a low amount of peer influence on citizens for determining the behavior of e-filing. Perhaps, this is caused by the sample of experienced Internet users. Yet, the experiences of the peers could have been influential on the people having very limited amount of online experience. We suggest future research to explore this aspect with other samples to understand this relationship.

Compatibility influences intention to use e-filing significantly, therefore H9 is also supported. Overall, we observe that intention to use e-filing is largely driven by compatibility. Besides this direct positive effect, it has also an indirect effect on intention

to use by decreasing perceived risk. Thus it seems that taxpayers are influenced by the compatibility of the e-filing method with their life and work styles.

Notably, H2 is not supported. We expected trust of the government would negatively affect perceived risk however in contrast; it has a slight positive effect. This contradicts with the literature that perceived risk decreases when trust is present [32], [49]. Future research should explore this relationship with new samples. H3 and H4 are also rejected. They suggest that trust of the Internet and trust of the government increase the intention to use e-filing, however such a direct effect cannot be observed. The impact of trust of the Internet is mediated by perceived risk, consistent with findings obtained by previous studies [50]. Future research may focus on understanding the mediating effect of perceived risk on trust rather than analyzing its direct effect.

Surprisingly, H7 is rejected. Complexity does not have a significant effect on intention to use. This contradicts with the highly recognized models of IS adoption research [40], [51]. Indeed, e-filing in Germany is a relatively complex e-government service compared to other services. Thus the complexity of e-filing could still be an important antecedent to adoption for the users having limited amount of experience with the Internet and online technologies. Future studies should explore the impact of complexity using such a sample for verification.

7 Discussion

Overall, the descriptive studies of the presented research reveal important insights about the expectations, concerns and demands of the citizens towards adopting e-government services. The findings of the confirmatory research suggest that compatibility, relative advantage and perceived risk are the main antecedents influencing adoption in the German household.

Our research aims both theoretical and practical contributions. Despite its development in recent years, research on adoption of e-government is still in its infancy. Scarce research on adoption of e-filing has mainly utilized the technology acceptance model (TAM) by Davis [40], theory of planned behavior (TPB) by Ajzen [52] and the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. [51]. Except some initial attempts [53], Roger's Theory of Perceived Attributes [31] have not received much attention to analyze adoption of e-filing, which was applied in this research. This research also provides a contribution to the cultural context of e-government adoption. While adoption in different nations receives increasing interest, antecedents of e-government adoption in Germany remained relatively under-researched. Our research should be considered as a building block for future research on understanding the adoption behavior of the citizens in Germany.

Moreover, the empirical findings of this paper provide valuable insights to the policy makers to promote the adoption of e-government nationwide. The cross-sectional studies over the two years have drawn attention to the data protection and security related concerns as important inhibitors of e-government adoption. Thus, citizens should be aware of and have control over the personal information to be stored [54]. Privacy policies involving access control should be documented and communicated.

In addition, government authorities should pay more attention to delivering services that are compatible with the life and working styles of the citizens and concentrate on increasing the relative advantages of the online services over the traditional ones.

Some limitations of the study should be acknowledged which point to directions for future research. First, in order to reach out to nationwide representative samples, we used online questionnaires with households having a PC and an Internet access; therefore the sample had a considerable amount of previous Internet experience. This may have biased our results, especially in terms of the constructs complexity, subjective norm and trust of the Internet. We suggest future research analyze the influences of these constructs on samples having no household PCs and only very limited experience with the Internet. Second, due to the emphases of data protection and security in the cross-sectional descriptive studies, the constructs of trust of the Internet and trust of the government were integrated in the research model. Although our selection was based on prior literature, trust constructs may not have fully reflected the data protection and security concerns of the users. Instead, we suggest future research to test the direct impacts of data protection and security concerns on e-government adoption, rather than the indirect impact of trust, which may seem irrelevant for the respondents. Third, it should be noted that the purpose of this research was to understand the adoption behavior of the German citizens rather than investigating the cultural differences among nations. For such a purpose, a cross-cultural study would be necessary using the same research model and instrument to understand adoption in different nations. Although perceived ease of use [55], social influence [56] and trust of the government [57] found to be among the crucial antecedents of the intention to use e-filing in other cultures, this may or may not be caused by the cultural differences among the nations, which needs to be confirmed further in cross-cultural studies analyzing the moderating effect of national culture on adoption. Finally, the descriptive studies were not based on a specific e-government service but the explanatory research was conducted on the specific example of e-filing. We suggest further research to validate the findings of this research by using other examples of e-government services in Germany.

8 Conclusion

In contrast to IS adoption literature in other online contexts, research in e-government adoption is still in its infancy. Despite its development in the last decade, more empirical research is still necessary, to understand and boost e-government adoption worldwide. Research in similar contexts suggests that adoption behaviors of nations are influenced by the espoused cultural values, beliefs and norms. Even though e-government adoption in some cultures has been subject to research, some others remain relatively under-researched.

We analyzed the determinants of e-filing adoption in Germany with a comprehensive empirical research combining two cross-sectional descriptive studies and an explanatory study, being all nationwide representative. The descriptive studies demonstrated the sensitivity of the nation towards the issues of data protection and security

therefore we included the constructs of trust and perceived risk in our research model. The structural equation modeling analysis conducted in the second stage revealed that compatibility, relative advantage and perceived risk are the main determinants of adoption in the German household. In light of these findings, we suggest future researchers to analyze decision making of households with other research models and samples, in order to contribute to the existing knowledge on e-government adoption.

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