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Trust, Risk, Privacy and Security in e-government Use: Insights from a MASEM Analysis

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ABSTRACT

Despite considerable research on the factors influencing the use of e-government, citizens are apprehensive of e-government services due to the concerns primarily related to trust, risk, security and privacy. This study presents a meta-analytic structural equation modeling (MASEM) analysis of the findings reported by 68 prior empirical studies on e-government adoption. Specifically, the model examined the direct effects of trust in government, trust in internet, perceived risk, and perceived privacy and security on e-government trust, and its impact on users' behavioral intention to use e-government. The findings bear significant theoretical and practical implications.

Keywords: E-government trust; Perceived privacy and security; Perceived risk; Trust in Internet; Trust in government

**Trust, Risk, Privacy and Security in E-government Use:
Insights from a MASEM analysis**

1. INTRODUCTION

Utilization of Information and Communication Technology (ICT) for the modernization of governmental activities and its efficient implementation is an important institutional reform that improves delivery of public service and provides access to accurate information to citizens, businesses firms and government organizations (Rose et al., 2015). In prior years, governments worldwide have extensively invested in e-government projects. According to Gartner, government expenditure on information technology (IT)- enabled public services is expected to increase by 6.5% (Gartner, August 2021). Despite growing investments in e-government projects and enormous benefits of e-government services in terms of improved transparency in governmental transactions and processes, citizens prefer traditional methods to avail public services such as visits to public service offices and telephonic conversations rather than e-government services (Saylam & Yıldız, 2021; Yıldız, 2016).

Key reasons for the citizens' deficit in trust include fear of misuse of sensitive financial and personal information shared on e-government services and the potential lack of security of online transactions (Maharaj & Munyoka, 2019; Meiyanti et al., 2018). Users' apprehensions about the security and privacy are not without merit as the diffusion of technological advancements in societies more often pave the way for identity thefts and privacy breaches (Myron, 2004). The security and privacy concerns are rooted in the distant and impersonal nature of the internet that facilitates e-government (Ejdys et al., 2019). In 2021, 2.8 million consumers complained against online frauds to the Federal Trade Commission and around nine million citizens in the USA experienced identity theft (FTC, 2021; Identity Theft Statistics, 2022). In online environments, users are deprived of the natural benefits of in-person communications and opportunities for direct

observation and assurance that foster the basic psychological need of trust in humans (Alzahrani et al., 2017).

Perceptions of e-government trust is frequently reported as a critical factor for predicting citizens' intention to use e-government systems (IU) (Meiyanti et al., 2018; Sulistyowati et al., 2020). There is a general consensus that the formation of e-government trust is significantly affected by several factors (Gil-Garcia & Pardo, 2006). Extant literature views trust as a psychological concept and provides that individuals' trust in a technology or an object is determined by a broad spectrum of impressions and factors (Huijts et. al., 2012; Rotter, 1980). Scholarly research on trust formation in different contexts uncovered various cognitive and psychological cues which affect how individuals form trust (e.g., Al-Jamal & Abu-Shanab, 2015; Sharif, et al., 2014). Prior literature on e-government has shown that technology factors (e.g., ease of use) and contextual factors (e.g., facilitating conditions) are significant considerations in e-government use based on models on technology acceptance (Al-Jamal & Abu-Shanab, 2015; Mansour et al., 2018). While psychological factors (e.g., risk) have also been portrayed in prior literature, they have not received significant attention as they do not feature dominantly in technology acceptance models (Al-Hujran et al., 2015). Further, the empirical findings in prior studies for these factors have also been inconsistent. For instance, studies found strong relationships (Ejdys et al., 2019) and non-significant or weak relationships (Abu-Shanab & Al-Azzam, 2012; Elmansori & Ishak, 2021) for perceived risk and PPS with e-government trust. Similarly, contradictory empirical findings were reported about impact of citizens' trust in government and trust in internet on e-government trust creating barriers for e-government adoption (Elmansori & Ishak, 2021; Mensah & Adams, 2020).

This study aims to bridge the gap by examining how citizens' psychological perceptions influence perceptions of trust in e-government. Specifically, we examine the effects of trust in government,

trust in internet, perceived risk, and perceived privacy and security on citizens' perceived trust in e-government. In doing so, this also resolves inconsistent empirical findings on the relationships involving trust, risk, and privacy and security. Since it is not unusual to observe conflicting results in social science studies (Demsetz & Villalonga, 2001) and variations in constructs, populations, sampling bias, and/or statistical analysis (Trotman & Wood, 1991), we apply meta-analytical methods to synthesize prior findings, overcome the limitations of individual studies, and develop a generalized understanding of the phenomenon. Specifically, this study uses meta-analytic structural equation modeling (MASEM) methods to examine the interrelationships among trust, risk, and privacy and security and develop a more in-depth understanding of e-government systems (Jeyaraj & Dwivedi, 2020).

2. LITERATURE REVIEW

E-government acceptance has received considerable attention in prior literature. It has been examined using different dependent variables such as intention to use, adoption, use, and continuance (e.g., Carter et al., 2016; Munyoka, W., & Maharaj 2019; Sahu & Gupta, 2007). Studies have used various theories and models such as the Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Information Systems Success (ISS) model, Diffusion of Innovations (DoI), the Unified Theory of Acceptance and Use of Technology (UTAUT), and several extensions such as TAM2 and UTAUT2 and combinations such as TAM and TPB to understand e-government acceptance (Aloudat et al., 2014; Horst et al., 2007; Krishnaraju et al., 2016; Lawson-Body et al., 2014; Phang et al., 2006).

Such models largely portray technological attributes such as usefulness, ease of use, system quality, and information quality and contextual factors such as facilitating conditions and

subjective norms as influential in technology acceptance (e.g., DeLone and McLean 2003; Venkatesh et al. 2003). While earlier models such as TRA and TPB have proposed individual characteristics such as attitude, more recent models such as the ISS model and UTAUT have generally given greater importance to technological and contextual factors in technology acceptance by individuals, which is also evident in prior reviews and meta-analytic studies that have examined e-government acceptance (Hooda et al., 2022; Hooda et al., 2023; Rana et al., 2015). Thus, the need for research attention on psychological factors of individuals in the context of e-government acceptance is significant. Prior research has sporadically examined such a few factors including trust, risk, privacy, and security in the context of e-government although they are not featured in models such as TAM, UTAUT, or ISS (Belanger & Carter, 2008; Carter & Bélanger, 2005; Tan and Thoen, 2000; Shareef et al., 2011; Zhang & Zhu, 2021). However, since the e-government context requires users to interact with a third-party such as government through an impersonal medium such as the internet and evaluate risks when sharing personal and sensitive information, an understanding of trust, risk, privacy, and security are of considerable importance to research.

Trust may be understood in two dimensions—first, it refers to an individual’s beliefs about the service provider (i.e., government), and second, it refers to the individual’s beliefs about the technology (i.e., internet) through which the service is exchanged with the provider (Tan & Thoen, 2000). These dimensions can be conceptualized as trust in public service provider and trust in internet (Carter & Bélanger, 2005). Trust in government refers to an individual’s beliefs that the integrity and ability of the government agency providing the service is trustworthy (Carter & Bélanger, 2005). Reputed government agencies are perceived to be cautious about their reputation assets and therefore do not act opportunistically (Beldad et al., 2012). Additionally, citizens must

be confident that the government has enough capacity, commitment, and technical know-how to extend safe and secure transactions (Mensah, 2019). Trust in internet refers to an individual's beliefs about the reliability of the technology for providing accurate information and facilitating secure transactions (Carter & Bélanger, 2005). It includes individuals' perceptions about the overall institutional environment comprised regulations and structures that may make the environment safe.

Risk can be visualized as degree of uncertainty experienced by individuals due to unpredictable and unknown situations while using e-government systems (Aloudat et al., 2014). Uncertainty may result from the environment, partnership, or task and can present risks to individuals engaged with e-government (Bensaou & Venkatraman, 1996). Environment uncertainty stems from the perceived lack of information about events and actions taking place in both the internal and external environments, and likelihood of incurring a loss due to the lack of protection against fraudulent events (Bensaou & Venkatraman, 1996; Verhagen et al., 2006). Partnership uncertainty represents the potential loss of benefits experienced by an individual in relationship with another as is possible when engaging with e-government systems (Bensaou & Venkatraman, 1996; Verhagen et al., 2006) Task uncertainty stems from the lack of clarity on procedures, sequence of steps, and who to contact in case of any unanticipated and novel events that individuals may encounter when using e-government systems (Bensaou & Venkatraman, 1996; Verhagen et al., 2006). Further a study by Dwivedi et al. (2017) conceptualizes that perceived risk consist of environmental risk and behavioral risk. Environmental risk is owing to the capricious nature of internet related technology. Behavioral risk is owing to risk related to the unfriendly nature of internet. Perceptions of risk strongly influences e-government users' behaviors (Jasimuddin et al., 2017). Since e-government systems involve the exchange of confidential personal information,

citizens may be reluctant to adopt and use e-government systems when faced with uncertainties (Bhuasiri et al., 2016; Xie et al., 2017). Such risks may negatively influence the citizens' intentions to adopt new systems (Horst et al., 2007; Carter et al., 2016; Dwivedi et al., 2017).

Privacy and security are two interrelated aspects (Munyoka, 2020; Palanisamy & Mukerji, 2011), i.e., it represents the degree to which an individual feels safe in divulging personal and financial information when using e-government systems and having the assurance that the information will not be misused (Shareef et al., 2011; Zhang & Zhu, 2021). Privacy represents the government's duty to protect citizens' personal information, not sharing it with third parties without the consent of citizens, maintaining anonymity and ensuring archival of personal data (Munyoka, 2020; Palanisamy & Mukerji, 2011). Security refers to the possible technical and administrative measures undertaken to protect the data and information against fraudulent access, misuse, destruction or disclosure (Munyoka, 2020; Palanisamy & Mukerji, 2011). Governments should be obliged to protect the citizens' personal data, archive securely, and share only if needed with informed consent (Colesca, 2009). Further, governments should also adhere to the technical procedures and methods adopted to protect the data against theft, destruction, unauthorized use and disclosure. Data protection and privacy legislation worldwide indicates that the confidentiality and security of online personal information and transactions must be guaranteed by e-government systems (UNCTAD, 2022).

3. RESEARCH MODEL

Perceived trust in e-government represents an individual's confidence about the reliability, security, and integrity and the e-government platform and the extent to which its response is efficient and effective (Shareef et al., 2011). The research model examined in this study is shown

in the **Figure 1**, which shows that perceived trust in e-government will be impacted by four psychological factors and will in turn impact intention to use e-government.

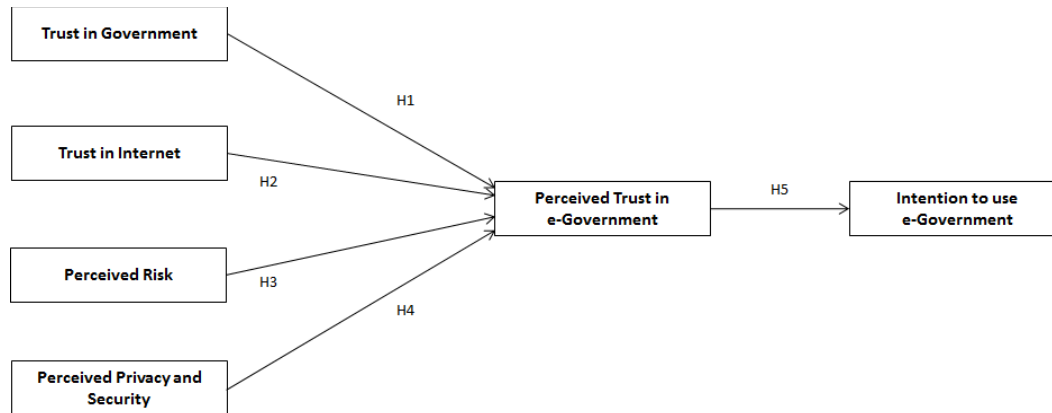


Figure 1. Research Model

3.1 Effects on Perceived Trust in e-government

3.1.1 Trust in government

Trust in e-government refers to citizens' perception of online public service platforms' capability to provide secured, accurate and reliable information and transactions (Shareef et al., 2011) while citizens' trust in government demonstrates their confidence and belief in the integrity and ability of government agencies/institutions to provide effective public services (Carter & Bélanger, 2005). Before they use e-government platforms, citizens must believe that their government is capable of providing technical and managerial resources that are required for safe and reliable online public service transactions (Dwivedi et al., 2012). Further, citizens should have confidence that their government is honest and concerned about them. Thus, trust in government emerges as an important antecedent of e-government trust. The relationship between trust in government and e-government trust emanates from trust transference literature. In the absence of adequate information about a new/unknown party, individuals rely on other related sources of evidence to

predict how the new/unknown party will perform in a relationship (Doney et al., 1998). For instance, users' trust in a company's website was significantly influenced by their experience with the company in offline environments. Thus, the users' trust in "new/unknown" environment was shaped by their trust in "familiar/known" environment (Koufaris & Hampton-Sosa, 2004). Thus, citizens' trust in government (the known environment) serves as a reliable source of evidence for trust in e-government (new/unknown environment). Trust in government reflects people's belief in the trustworthiness of public service providers and politicians (Yang, 2006). Since citizens have used public services and they are familiar with government operations, they evaluate trustworthiness of government based on their personal experience. However, citizens usually do not have a history of transactions with e-government and they may largely consider their offline experience with public officials and government to evaluate trustworthiness of e-government. Citizens who perceive politicians and public service providers to act appropriately and do the right things are likely to accept e-government websites as trustworthy (Abu-Shanab & Al-Azzam, 2012). Citizens having lower trust levels in government are found to carry suspicious views of the government's policies and pronouncements, leading to resistance and mistrust for the government's initiatives (Shakaryan, 2007). Citizens' trust in government can be improved by ensuring that their data would be used for their benefits and not for monitoring society (Bélanger & Carter, 2008). Therefore,

H1: Trust in government positively influences e-government trust.

3.1.2 Trust in internet

ICT enabled services offer not only advantages but also pose certain challenges, specifically in terms of users' trust in technology. Scholars argue that ICT can be efficiently used only when users trust it (Al-Muwil et al., 2019; Gatautis, 2008). Users' trust in technology-aided services influences

their trust in the means by which services are delivered (Wang, 2014). Citizens' confidence that the internet is able to provide reliable and efficient services fosters e-government trust (Almaiah & Man, 2016). Citizens with negative attitude and low trust disposition may not trust e-government services and refrain from engaging with them. Regular users of e-government had high degree of trust in internet relative to nonusers who may be apprehensive about the uncertainties of e-government (Lee et al., 2011). Thus, high trust in internet is likely to strengthen citizens' trust in e-government. Therefore,

H2: Trust in internet positively influences e-government trust.

3.1.3 Perceived risk

Internet's impersonal and unpredictable nature heightens citizens' perceptions of risk associated with e-government services which may ultimately impact their trust level (Featherman & Pavlou, 2003). Risky situations created by uncertainties linked with the technology adversely affect citizens' confidence in e-government services (Aloudat et al., 2014). Public services provided by the government on online platforms do not automatically build up citizens' trust on how the information and services are delivered. The issues concerning privacy, security, fraudulent activities, and vulnerability of people to cyber-attacks heighten citizens' perceptions of risk associated with e-government service usage (Xie et al., 2017; Schaupp & Carter, 2010; Carter & Belanger, 2005). Citizens' concern for confidentiality and reliability of information assumes high risk perceptions and users' trust in e-government services is adversely affected (Xie et al., 2017). Liu and Zhou (2010) claim that risk is so closely associated with trust such that there is no requirement of trust if there is no risk. Carter and Bélanger (2008) argued that citizens' risk perceptions built on their expectation of suffering a loss in their quest of using e-government services may jeopardize their trust in e-government. It is highly unlikely that citizens trust and use

e-government service portals if perceived risk is more than expected benefits of e-government services (Aloudat et al., 2014). Therefore,

H3: Perceived risk negatively influences e-government trust.

3.1.4 Perceived privacy and security

PPS are crucial in building citizens' trust in e-government (Li & Xue, 2021; Maharaj & Munyoka, 2019). Effective policies for cybersecurity measures and their implementation are needed to build citizens' e-government trust (Singh & Karaulia, 2011). The security levels for data confidentiality and user authentication in e-government services determine citizens' e-government trust (Liu & Zhou, 2010). If e-government is equipped with appropriate administrative and technical procedures to protect against potential losses associated with cyberattacks, unauthenticated access, and disclosure of personal information, then citizens may trust e-government and use it more frequently (Mistry & Jalal 2012; Shalhoub, 2006; Sarabdeen et al., 2014). E-government service platforms must ensure that personal and transactional information of citizens are fully secured (Choudrie et al., 2017). Prior literature supports a direct relationship between PPS and e-government trust (Ejdys et al., 2019; Khan et al., 2021; Abu-Shanab, 2014). Therefore,

H4: Perceived privacy and security positively influences e-government trust.

3.2 Effects on Intention to use e-government

Intention to use e-government refers to the degree of strength of an individual's intention to demonstrate a specific behavior (Sahu & Gupta, 2007). IU is the measure of citizen's conscious plan to use or not use e-government services. Thus, it predicts citizens' future behavior which is largely driven by their internal evaluation results of prior experience (Kamarudin et al., 2021;

Ajzen & Fishbein, 1980). IU has been frequently used as a surrogate measure of the actual use of e-government services (Sahu & Gupta, 2007).

Citizens accept that e-government can significantly improve operations, but are generally concerned about the privacy and security of sensitive information shared with the government over the internet (Bélanger & Hiller, 2006). The internet's impersonal nature and the lack of control over the shared information heighten the perceptions of privacy and security risks (Abu-Shanab, 2014). Due to the poor coordination in developing and implementing authentication and identification processes for e-government services, citizens may incur monetary loss (Lean et al., 2009). Due to these risks, citizens may resist the move from traditional face-to-face interactions with public service providers unless supported by high levels of trust. Therefore, to condition citizens' IU, it is necessary to win their trust in the capabilities of e-government services to protect them from misuse of personal information. Trust plays an indispensable role in strengthening citizens' IU by reducing anxiety generated by perceived risks associated with online service usage. This argument has considerable support in the IS literature (e.g., O'Neill, 2018; Zahid & Haji, 2019).

Prior empirical studies found that trust plays a significant role in strengthening citizens' IU (Meftah et al., 2015; Rana et al., 2015; Rufín et al., 2014). Akkaya et al. (2013) reported that trust in e-government was the fundamental requirement to enhance individuals' IU. Lee and Kim (2014) observed that e-government trust enabled active e-participation by promoting citizens' sense of cooperation with government. Belanche et al. (2012) found that trust was one of the strongest predictors of citizens' IU. Carter and Bélanger (2005) also reported findings supporting the

association between e-government trust and citizens' IU. Alharbi, et al. (2016) showed that trust was the primary determinant of Saudi citizens' IU. Therefore,

H5: Perceived e-government trust positively influences intention to use e-government.

4. RESEARCH METHODS

4.1. Sample

To empirically test our research model, we gathered studies published between 2000 and 2021 using multiple online databases including Scopus, Google Scholar, and Digital Government Reference Library (DGRL). Keywords for the search included “success,” “adoption,” “usage,” and “intention”, “diffusion”, “performance”, along with related phrases such as “e-government,” “electronic government,” “digital government,” “mobile government,” and “online government”. Of the resulting 500 or more articles, duplicates and others such as teaching notes, editorials (Janowski & Janssen, 2019), qualitative studies (Alzahrani et al., 2017; Jaeger & Fleischmann, 2007; Szopiński & Staniewski, 2017), and reviews (Dwivedi et al., 2009; Koh et al., 2005; Welch et al., 2005a) were excluded first, followed by articles that did not examine e-government success, adoption, usage, or intention (Kumar, Sachan, Mukherjee, & Kumar, 2018; Valle-Cruz, 2019). Also excluded were studies that examined relationships not modeled in our study (Alruwaie et al., 2020; Deng et al., 2018; Lee et al., 2011) or did not report relevant statistics for meta-analysis (Carter & Bélanger, 2005; Grimsley & Meehan, 2007; Welch et al., 2005b) were excluded. The final sample of this meta-analysis comprised 68 studies. [Table 2 provides a summary of the process. The studies in our sample are shown in the Appendix.](#)

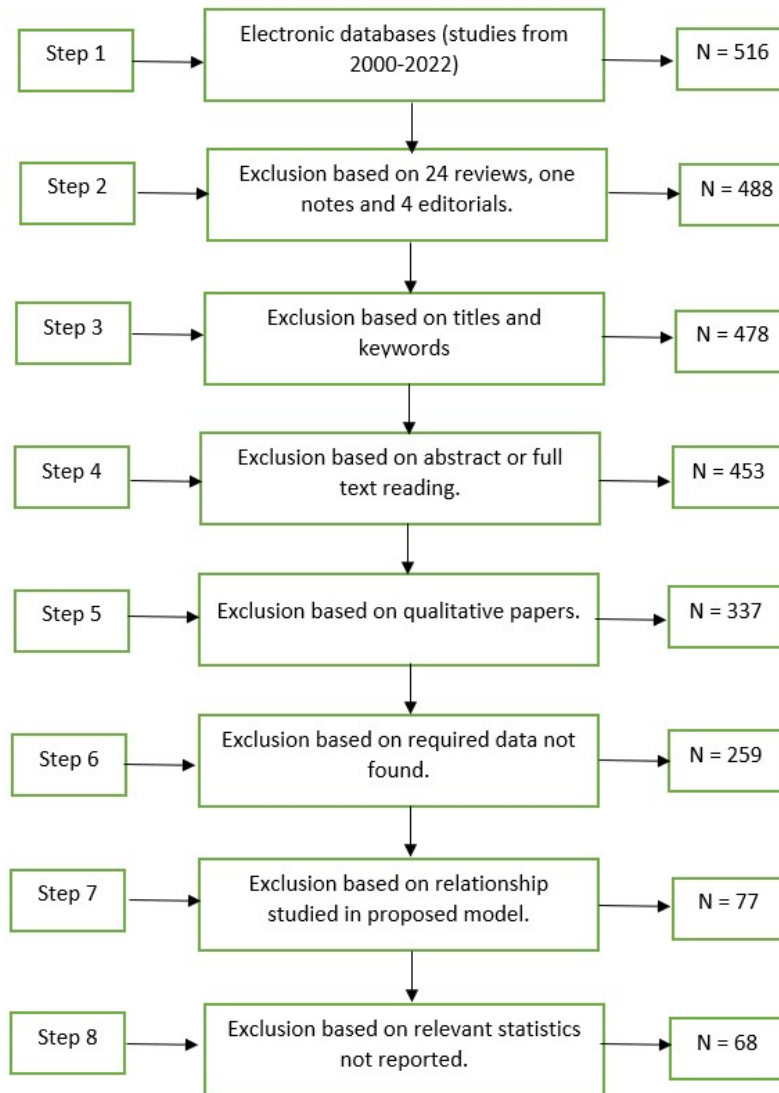


Figure 2. Sample Selection Process

4.2. Data Coding

Following the approach of previous studies (e.g., Hooda et al., 2022), data were recorded using a uniform coding process. We captured basic information of each sample study such as; name of authors and journal, publication year, and country from where data was collected. The data were coded at for constructs and relationships. Specifically, the reliability, mean, and standard deviation for each construct and the Pearson correlation for each relationship were coded.

The consistency of the recorded data was thoroughly examined to fulfil the requirements of various analyses. First, differently-worded constructs across studies were combined as a single construct. **Table 1** depicts examples of the variables in prior studies coded for our research constructs. Trust in technology (Abu-Shanab, 2014) and trust in platform (Hu et al., 2019) was categorized as trust in internet. Studies that reported perceived privacy or perceived security were combined into a single construct “perceived privacy and security” (Aloudat et al., 2014; Eid et al., 2020; Vejačka, 2016) using average of the effect sizes (Alharbi et al., 2017; Al-Zahrani, 2020; Munyoka & Maharaj, 2019).

Construct in research model	Variables used in prior studies	Reference
Trust in government	Trust in government	Kurfali et al., 2017; Teo et al., 2008
Trust in internet	Trust in mobile technology	Teo et al., 2008
	Trust in technology	Teo et al., 2008
	Trust in internet	Kurfali et al., 2017; Mensah, 2019
Perceived risk	Perceived risk	Dwivedi et al., 2017; Horst et al., 2007
Perceived privacy and security	Perceived security	Gilbert et al., 2004; Al Nidawy et al., 2020
	Security perception	Alharbi et al., 2017
	Transaction security	Rehman & Esichaikul, 2012
	Perceived privacy	Lean et al., 2009
	Perceived privacy and security	Ayyash et al., 2013
Perceived trust in e-government	Perceived trust	Al-Hujran et al., 2015
	Trust	Alharbi et al. (2017)
	E-governance	Al Nidawy et al. (2020); Xie et al., 2017
Intention to use e-government	Behavioral intention	Dwivedi et al., 2017
	Intention	Xie et al., 2017
	Intention to use	Gultom et al., 2020; Jasimuddin et al. (2017)

Table 1. Research constructs and coded variables

Second, the data were screened for observation independence to ensure that findings from a sample study for a bivariate relationship are not duplicated, i.e., if a sample study reported more than one finding for a bivariate relationship then we computed the average of the reported correlations. For example, if study has reported both perceived security and perceived privacy, then average of correlations for both was taken (Alharbi et al., 2017; Al-Zahrani, 2020; Munyoka & Maharaj,

2019). Finally, it was found out that not all sample studies reported the construct reliability. In such cases, only the reported reliabilities were coded such that reliabilities were missing for certain constructs (Azam et al., 2013; Bhuasiri et al., 2016; Krishnaraju et al., 2016). Overall, 185 findings from the studies were coded.

4.3. Data Analysis

Meta-analytic methods based on Hunter and Schmidt (2004) were applied to compute the corrected correlation for each relationship proposed in our research model. To correct measurement errors, the observed correlation was divided by the square root of the product of the reliabilities of the constructs in the relationship. To correct sampling error, the observed correlation was weighted by the sample size, the summation of which was divided by the total sample size across all studies. Finally, the meta-analytic correlations for all relationships were used to conduct the MASEM analysis in AMOS. The mediating effect of e-government trust was evaluated by using Sobel tests (Sobel, 1982).

5. RESULTS

5.1. Meta-analysis

The results of the meta-analysis are shown in **Table 2**. The corrected correlations, [number of findings](#), and cumulative sample sizes are shown in the lower triangle while the failsafe-N and credibility intervals are shown in the upper triangle. The credibility intervals did not include 0 for most relationships and confirmed the positive effects (Whitener 1990) except for one relationship, i.e., the effect of perceived risk on intention.

Table 2. Results of Meta-Analysis

Construct	Mean (SD)	CR	PPS	PR	TR_INT	TR_GOV	PTR	IU
Perceived privacy and security (PPS)	5.11 (0.76)	0.87		[-0.242, 0.657] 1528	[0.488, 0.544] 4228	0.364, 0.588] 4228	[0.292, 0.726] 5791	[0.284, .516] 8662
Perceived Risk (PR)	3.88 (1.14)	0.87	0.207 (5, 1680)		[0.314, 0.705] 5637	[-0.008, 0.379] 1532	[-0.387, 0.205] 1654	[-0.110, 0.293] 8725
Trust in internet (TR_INT)	4.44 (0.92)	0.87	0.591 (3, 3433)	-0.097 (7, 1691)		[0.390, 0.695] 18576	[0.314, 0.705] 5637	[0.216, .652] 8857
Trust in government (TR_GOV)	4.95 (0.88)	0.88	0.538 (3, 3433)	0.216 (9, 2109)	0.549 (20, 8493)		[-0.128, 0.888] 2847	[0.268, 0.660] 8780
Perceived trust in e-government (PTR)	5.10 (0.93)	0.89	0.594 (8, 3494)	0.042 (9, 2952)	0.558 (4, 2215)	0.657 (3, 1456)		[0.464, 0.639] 31741
Intention to use e-government (IU)	5.05 (0.92)	0.87	0.497 (14, 5032)	0.088 (22, 6226)	0.441 (17, 5642)	0.497 (17, 7910)	0.561 (39, 13649)	

SD: Standard deviation; CR: Construct reliability (average across studies)

Based on the Failsafe-N, the probability of the publication bias in this meta-analysis was rejected. It indicates the number of other studies which reported non-significant results that are needed to overturn the results of this meta-analysis (Sabherwal et al. 2006). Failsafe-N values ranged from 1528 to 31741 in this study, with an average of 111 across all relationships. Table 1 also shows the means, SD, and reliability for each construct in the model.

5.2. Structural Equation Modeling

For performing MASEM, the means and SDs were taken from Table 1. While a single sample size is required for MASEM analysis, the sample size differed across the relationships in our sample. Thus, we used the minimum sample size for the analysis (1456).

Figure 1 was used as the initial model for the MASEM analysis. The model fit was reasonable: $\chi^2 = 134.22$, $df = 4$, $p < 0.01$, $TLI = 0.855$, $CFI = 0.961$, $RMSEA = 0.15$, and $SRMR = 0.065$. We found support for all hypothesized paths. The χ^2 / df ratio was above the recommended threshold

of 3 (Sabherwal et al. 2006). TLI (< .90) and CFI (> 0.90) were acceptable (Bentler & Bonnett 1980) while SRMR and RMSEA were above the recommended threshold of 0.08 (Sabherwal et al. 2006).

Further, modification indices (MI) showed that the research model could achieve better fit by adding few other paths. Based on $MI > 10$, we first added the path between PPS and IU ($MI = 56.86$). The model fit considerably improved: $\chi^2 = 43.56$, $df = 3$, $p < 0.01$, $TLI = 0.94$, $CFI = 0.988$, $RMSEA = 0.096$, and $SRMR = 0.029$. All the hypothesized paths were significant. CFI, TLI, and SRMR were acceptable but the χ^2 / df ratio and RMSEA were not. MIs showed other possible paths for better fit.

Next, we added the path between trust in government and IU ($MI = 19.04$). The model further improved: $\chi^2 = 7.536$, $df = 2$, $p > 0.10$, $TLI = 0.988$, $CFI = 0.998$, $RMSEA = 0.044$, and $SRMR = 0.011$. All hypothesized paths were significant. The χ^2 / df ratio was slightly above recommendations but TLI, CFI, RMSEA, and SRMR were acceptable. No other paths were suggested by MIs, and hence the resulting model was considered the final model (**Figure 2**). It explained 53.9% of the variance in perceived trust in e-government and 37.5% of the variance in IU.

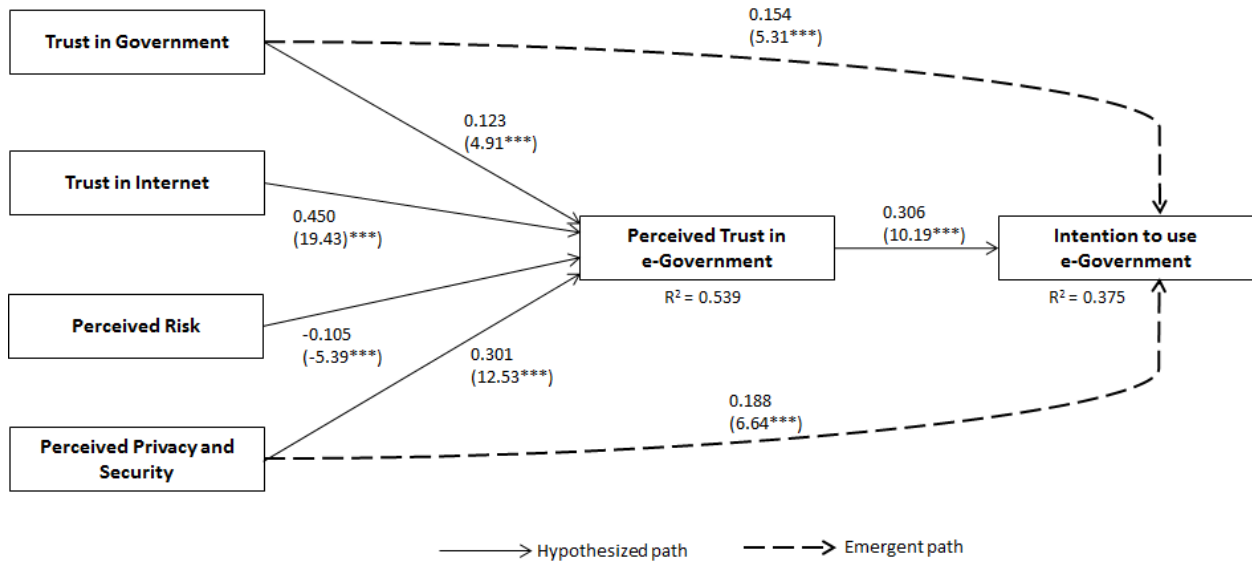


Figure 2. Emergent Model

5.3. Mediation Tests

We conducted post-hoc mediation tests to further examine the role of e-government trust. **Table 3** shows the results, which confirmed the mediating effect of trust on the relationships between intention and other variables. Trust partially mediated the impact of trust in government on users' IU ($b = 0.145$, $p < 0.01$), i.e., the positive effect of trust in government on IU remained significant even in the presence of e-government trust ($\beta = 0.157$, $p < 0.01$). Trust partially mediated the relationship between trust in internet and IU ($\beta = 0.038$, $p < 0.01$), i.e., trust in internet had a significant effect on IU even in the presence of trust ($\beta = 0.08$, $p < 0.01$). However, the association between perceived risk and IU was fully mediated by trust ($\beta = -0.026$, $p < 0.01$), i.e., perceived risk and IU relationship was non-significant ($\beta = 0.01$, $p > 0.05$). Trust partially mediated the relationship between perceived privacy and security and IU ($\beta = .112$, $p < 0.01$), i.e., the effect of PPS on IU was significant even in the presence of trust ($\beta = 0.221$, $p < 0.01$).

Table 3. Mediation Test Results

Relation	Direct (with mediator)	Indirect (with mediator)	Interpretation
PR->PTR->BI	.010	-.026***	Full Mediation
PPS->PTR->BI	.221***	.112***	Partial Mediation
TR_GOVT->PTR->BI	.157***	.145***	Partial Mediation
TR_INT->PTR->BI	.080***	.038***	Partial Mediation

***p<0.01

6. DISCUSSION

6.1. Findings

The research was aimed at understanding the interplay between trust, risk, and PPS in e-government settings. Our analysis shows that trust in government ($\beta=0.123$ $p < 0.05$), trust in internet ($\beta=0.450$ $p < 0.05$), and PPS ($\beta=0.301$ $p < 0.05$) exerted significant positive effects on e-government trust while perceived risk ($\beta= -0.105$ $p < 0.05$) negatively influenced e-government trust, providing support for H1, H2, H3 and H4. Citizens' trust in government (and politicians) influenced e-government trust. It is understandable that citizens who are suspicious of the government are likely to be less engaged with e-government services. They may be limited to information search activities such as for renewal of passport or visa requirements and not include transactional activities (Horsburgh et al., 2011; Carter & Belanger, 2005). Citizens' trust in internet influenced e-government trust (Almaiah et al., 2016; Abu-Shanab et al., 2012). Activities such as filing income tax returns online require citizens' familiarity with the internet and previous pleasant experience of completing internet enabled non-governmental online transactions, which increases citizens' confidence in navigating e-government website portals (Horsburgh et al., 2011). Citizens' PPS showed significant positive effect on e-government trust. E-government trust is induced by citizens' belief that anonymity, personal information, and archiving of personal data are fully protected by e-government service portals and online governmental transactions are secured and risk free (e.g., Maharaj & Munyoka, 2009; Ewurah, 2017). If citizens believe that e-government

websites are vulnerable to cyber-attack and their personal information may be used for fraudulent activities, their trust in e-government would be eroded (Liesbet, 2017). Perceived risk weakens citizens' e-government trust (e.g., Xie et al., 2017; Aloudat et al., 2014). It is a key factor that also predicts users' trust in technology-enabled services such as online banking services (Salem et al., 2019) and online retail stores (Wong et al., 2019). When citizens become aware of the risks and uncertainties associated with online transactions, they might perceive e-government service portals less reliable and trustworthy.

Results also show that e-government trust had a significant positive impact on citizens' IU ($\beta=0.306$ $p < 0.05$), providing support for H5. Supporting the claims of previous studies (e.g., Mensah et al., 2017; Chatzoglou et al., 2015), our results confirmed that citizens' belief of trustworthiness of e-government portals significantly reduces perceived risk of falling victim to opportunistic behavior and thus strengthens IU. Trust plays a crucial role in e-government services which are practically one-sided favoring the government (Alketbi, 2018). Since citizens are not fully aware of the actual implementation of such services, it is important to win citizens' trust in e-government to reinforce their intentions to use e-government portals (Lean et al., 2009).

Two unhypothesized but statistically-significant paths emerged in our analysis: trust in government ($\beta=0.154$ $p < 0.05$) and PPS ($\beta=0.188$ $p < 0.05$) influenced IU. Higher levels of trust in government influenced citizens' IU (Tolbert & Mossberger, 2006; Parent et al., 2005). While dealing with technology enabled services, users are more concerned with the unauthorized use of personal information by private parties due to security failures. If citizens can trust the government to not misuse their personal information or data shared in availing such services, they may be more inclined to use e-government services (Wang et al., 2010). E-government services are not immune

from citizens' concerns for privacy and security issues (Horsburgh et al., 2011; Goldfinch, 2007). Citizens' confidence in privacy and security features of e-government services is particularly important to address citizens' reluctance to use e-government services for more sophisticated transactions such as paying bills and taxes (Kolsaker & Lee-Kelley, 2008). Citizens' unwillingness to use new technologies for governmental transactions could be driven by the vulnerability of technology platforms to unauthorized and fraudulent use.

Motivated by the findings in prior studies examining the mediating role of perceived e-government trust in shaping citizens' IU (Kamarudin et al., 2021; Venkatesh et al., 2016), we examined the mediating role of trust. The results of the mediation analysis uncovered unique dimensions of relationships between IU and its antecedents in the presence of trust (Alkali & Abu Mansor, 2017; Kamarudin et al., 2021). According to Lallmahomed et al. (2017), IU is linked to citizens' beliefs in government's ability to successfully launch and manage e-government service portals. Higher trust in government will lead to stronger intention of citizens to use online public services. The opposite is equally true; lower levels of trust in government are reported to be detrimental to citizens' desire to respond to government's polices and initiatives, including e-government ventures (OECD, 2017). Similarly, citizens' trust in internet positively impacts citizens' IU (Mensah, 2019; Chiou & Shen, 2012). These results can be explained by the concept of pre-use trust and perceived post-use trust. Pre-use trust typically refers to individuals' trust during the initial stages of acceptance when they have not yet used the technology. It is therefore significantly affected by the opinion and feedback of others. However, when individuals use the technology, their personal experience modifies perceived trust formed during the initial stages (Al-Swidi & Enazi, 2021). The perception of trust formed during this later stage is known as perceived post-use trust which is closely associated with pre-use trust (Hernandez-Ortega, 2011). While perceived post-use trust

directly affects users' intentions, pre-use trust motivates users to use services only in the presence of perceived post-use trust. Thus, trust formation is a cumulative process (Colesca, 2009). Our results support these claims in that trust in internet (pre-use trust) influenced citizens' IU only in the presence of perceived trust in e-government (post-use trust). It implies that e-government trust partially mediates the impact of trust in government and trust in internet on citizens' IU. In simple words, the direct impact of these two antecedents of citizens' IU is significantly visible if the service portals generate reliable and accurate information in a consistent manner.

Further, perceived trust mediates the impact of perceived risk and PPS on citizens' IU. Studies in the past have also argued for a negative relationship between perceived risk and citizens' intention to use online public services (Wirtz et al., 2021; Verkijika & De Wet, 2018; Dwivedi et al., 2017). The fear of potential loss of private and financial information (privacy and security risk) and uncertainties linked with online environment (perceived risk) have the potential to limit citizens' interaction and engagement with e-government (Verkijika & De Wet, 2018). Thus, if risk perceptions are higher, citizens are more likely to resist the use of e-government services (Zahid & Haji, 2019). On the contrary, stronger perception of privacy and security offered by e-government services portals strengthens citizens' desire to frequently use online public services (Zhang & Zhu, 2021). Prior research has demonstrated the central role of PPS in determining citizens' IU (e.g., Eid et al., 2020; Smith, 2010). Our mediation analysis results clarify that perceived e-government trust fully mediates perceived risk's impact on IU. It implies that risks associated with online environment will impact citizens' willingness to switch from offline public services to e-government service only when they are not confident about consistency, reliability, adequacy, security and integrity of e-government (perceived e-government trust). On the other

hand, e-government trust partially mediated the impact of PPS on citizens' IU, suggesting the possibility of PPS influencing citizens to use e-government service portals.

6.2. Limitations

This meta-analysis study has a few limitations. First is that the study did not gather primary data but used statistics reported in prior studies. We relied on the quality of study because it was not possible for us to evaluate the goodness of the statistics reported by sample studies. Second, though the prior studies used different theoretical models, this meta-analysis study assumed that it was acceptable to combine findings reported by them. Third, only prior studies published in journals were included in this study while excluding studies reported in other outlets such as conference proceedings and doctoral dissertations. High value of failsafe-N for the investigated relationships mitigates this limitation to some extent. Fourth, we could include only those empirical studies which reported Pearson correlations which might have biased the results. Fifth, statistics such as reliabilities were assumed if they were not reported in prior studies. Sixth, we treated privacy and security as a combined construct partly because they are interrelated and partly because prior studies had modeled them as combined construct. However, some prior studies have set a precedent for privacy and security to be modeled as separate constructs. Finally, it can be argued that our research model is somewhat limited in that it portrays trust in e-government as the only antecedent of intention to use e-government although prior research has shown that models such as UTAUT portray several other antecedents to intention. Future meta-analysis studies may strive to develop research models that integrate technological, contextual, and individual psychological factors as antecedents of intention to use e-government.

6.3. Research Implications

Among several research implications of this study, first, is that this study has tested a conceptual model using the MASEM approach and established the combined effect for the dominant relationships by reconciling the inconsistencies. [In doing so, this study highlights the role of trust in government, trust in internet, perceived risk, and perceived privacy and security on perceived trust in e-government and ultimately on intention to use e-government.](#) These findings provide a framework for upcoming studies on e-government use.

Second, several technology acceptance models are used in context of e-government. While several of technology adoption theories such as TAM, TRA, ISS, and UTAUT are used to examine e-government, there is a paucity of research that holistically examines the interplay between trust, risk, privacy and security factors influencing e-government use. [Looking beyond the technical dimensions, this study offers a systematic synthesis of e-government research by combining psychological factors and offers insights of interplay between trust in government, trust in internet, perceived risk, perceived privacy and security, and IU.](#) Irrespective of the types of e-government systems, there will be variations in salient trustworthiness cues and citizens' perceptions. [Understanding these relationships has important research implications for the study of non-technical factors in altering the trust relationship between citizens and e-government systems. In particular, this study emphasizes the need for more micro level empirical research that explores citizens' perceptions of risk and non-technical dimensions of different types of online public services.](#) Our findings can serve as a basis for more insightful models of e-government use.

Finally, this study proposed an integrated model of e-government acceptance which is based on extensive literature review. This study departs from the dominant models such as TAM and UTAUT and examines factors that have received disparate attention in prior research. The

MASEM analysis not only provided support for our hypotheses but also showed emergent paths that can further inform our understanding of e-government acceptance. These findings provide opportunities to redefine existing models of e-government use largely based on technological considerations with alternate explanations.

6.4. Practical Implications

The findings of this study offer several implications for public service officials and governments. Our findings revealed that trust in e-government is a significant consideration for e-government strategies. E-government service providers may attach greater importance to factors that influence citizens' trust in e-government such as trust in e-government, trust in internet, perceived risk, and privacy and security. Governments may share success stories of online public services and statistics revealing citizens' satisfaction with e-government service portals to bolster e-government among users. For instance, The American Customer Satisfaction Index is used to record overall satisfaction of citizens and to predict their future behavior such as intention to revisit and recommendations to peers. By sharing the feedback and experience of satisfied users, e-government service providers can boost nonusers' confidence in government regarding use of their personal data (Freed, 2003). Multiple channels, including internet and social media may be used to publicize and communicate privacy and security features of e-government web sites and the ability of agencies to offer safe and secure e-government transactions. Such positive publicity may help the service providers win non-users' trust in e-government and improve the risk perceptions associated with online transactions, which will ultimately promote citizens' IU. A common reason for the low level of e-government trust is citizens' perceptions that governments waste money by spending it on wrong things (Tolbert & Mossberger, 2006; Baldassare 2000) and engage in e-surveillance of citizens through e-government service platforms (Reitz, 2006). Thus, to encourage

the use of online public service portals, it is crucial to win the trust of “critical citizens” of e-government service portals who have heightened expectations and low evaluations of government and e-government web sites in terms of privacy and security of personal data (Tolbert & Mossberger, 2006; Norris, 1999). In order for public officials to encourage citizens to move from brick and mortar public service offices to online service platforms, citizens need to trust e-government processes. Positive word-of-mouth about the positive intentions of governments in collecting data from citizens and the ability of governments to protect data from unauthorized access are key to encourage use of e-government service portals among citizens.

7. CONCLUSION

This study synthesized empirical findings from prior e-government studies to resolve the inconsistencies and reconcile differences. Specifically, the effects of key factors such as trust, risk, and privacy and security on e-government acceptance were examined using MASEM methods. Results show that all security variables exerted significant influences on e-government trust, which in turn influenced citizens' IU. Thus, e-government trust was found to be significant mediator between trust, risk, privacy and security and e-government use. The research model in this study can enable future researchers to further examine the significant antecedents of e-government adoption. The findings of this study inform practitioners on the relevance of security factors for encouraging citizen to use e-government services. The results of this study may be used to formulate effective strategies for e-government adoption among citizenry.

DECLARATION OF COMPETING INTERESTS

No funding was received for conducting this study. The authors have no relevant financial or non-financial interests to disclose.

DATA AVAILABILITY STATEMENT

Data analyzed in this study are included in this article.

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Appendix

Studies included in the meta-analysis

Study	Country	Sample size	Model
Ahmad & Khalid (2017)	UAE	120	TAM
Al Zoubi (2019)	Jordan	416	TAM
Al Nidawy et al. (2020)	Iraq	694	UTAUT2 and TOE
Alharbi et al. (2017)	Saudi Arabia	625	UTAUT2
Al-Hujran et al. (2015)	Jordan	413	TAM
Almaiah & Nasereddin (2020)	Jordan	320	UTAUT
Almaiah et al. (2020)	Jordan	807	GAM and UTAUT
Al-Omairi et al. (2020)	Oman	406	D&M ISS Model
Aloudat et al. (2014)	Australia	290	TAM
Alryalat et al. (2015)	India	377	TRA
Al-Sulami & Hashim (2018)	Iraq	160	D&M IS Success Model
Al-Zahrani (2020)	Saudi Arabia	211	TAM and UTAUT
Ayyash et al. (2013)	Palestine	364	D&M ISS Model & TAM
Azam et al. (2013)	Pakistan	435	UTAUT
Belanche et al. (2012)	Spain	416	TAM
Bélanger & Carter (2008)	USA	214	TRA
Bhuasiri et al. (2016)	Thailand	372	UTAUT
Bin et al. (2019)	Libya	248	Customized Model
Burhanuddin et al. (2019)	Thailand	396	UMEGA
Carter et al. (2016)	USA, United Kingdom	140	TAM
Colesca & Dobrica (2008)	Romania	418	TAM
Dwivedi et al. (2017)	India	377	UMEGA
Eid et al. (2020)	UAE	326	Customized Model
Emad (2014)	Jordan	759	TAM
Gilbert et al. (2004)	UK	111	TAM and DOI
Gultom et al. (2020)	Indonesia	477	TRA
Horst et al. (2007)	Netherlands	129	TAM and TPB
Hung et al. (2011)	Taiwan	750	TPB
Hussein et al. (2010)	Malaysia	411	TAM
Hussein et al. (2011)	Malaysia	411	TAM
Jasimuddin et al. (2017)	UAE	83	TAM
Kamarudin et al. (2021)	Malaysia	388	UTAUT
Krishnaraju et al. (2016)	Arabic countries	143	UTAUT2
Kurfalı et al. (2017)	Turkey	529	UTAUT

Lallmahomed et al. (2017)	Mauritius	247	UTAUT2 and GAM
Lawson-Body et al. (2014)	USA	183	DOI
Lean et al. (2009)	Malaysia	150	TAM and DOI
Liang et al. (2021)	China	93	TOE+TR
Mensah & Adams (2020)	China	198	UTAUT
Mensah (2018)	china	347	TAM
Mensah (2019)	African students in China	326	UTAUT
Mensah (2019)	China	369	UTAUT
Mensah (2019)	China	338	TAM
Mensah et al. (2017)	South Korean students in China	375	TAM
Mensah et al. (2020)	Ghana	289	UMEGA and UTAUT
Moreno et al. (2013)	Spain	402	TAM & DOI
Munyoka (2020)	Zimbabwe	247	TAM2 and UTAUT2
Panda et al. (2019)	Lebanon	148	Customized Model
Peppas et al. (2012)	Greece	150	Customized Model
Phang et al. (2006)	India	139	D&M IS Success Model
Riyadh et al. (2018)	Iraq	727	UTAUT
Rufin et al. (2014)	USA, Spain	105	TAM
Sang et al. (2010)	Cambodia	112	TAM, TAM2, and DOI
Saxena (2017)	India	311	TAM+UTAUT+TPB
Shahzad et al. (2019)	Pakistani students in China	505	Customized Model
Shahzad et al. (2020)	Pakistan	574	DOI + TAM
Shuib et al. (2019)	Malaysia	801	TAM + DOI
Sijabat (2020)	Indonesia	219	TAM
Teo et al. (2008)	Singapore	214	D&M ISS Model
Tsui (2019)	Taiwan	400	TAM
Vejačka (2016)	Slovakia	326	TAM
Verkijika & De (2018)	Saharan Africa	282	UMEGA
Wenjuan & Lan (2021)	China	1867	D&M ISS Model
Willard & Manoj (2019)	Zimbabwe, Zambia	489	Customized Model
Wirtz et al. (2019)	Germany	161	TAM
Xie et al. (2017)	Germany	268	TAM+TPB
Zahid & Din (2019)	Pakistan	396	TPB
Zhang & Zhu (2020)	China	596	TAM

D&M – DeLone & McLean, DOI – Diffusion of Innovations, GAM – e-Government Acceptance Model, ISS – IS Success, TAM – Technology Acceptance Model, TOE – Technology-Organization-Environment, TPB – Theory of Planned Behavior, TRA – Theory of Reasoned Action, UMEGA – Unified Model of e-Government Adoption, UTAUT – Unified Theory of Acceptance and Use of Technology

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