



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

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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 (Munyoka & Maharaj, 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 (Alzaharani et al., 2017a).

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 suggests 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 have been reported regarding the impact of citizens' trust in government and trust in the internet on e-government trust, creating barriers to 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, and its subsequent impact on behavioral intention. 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) method (Jeyaraj & Dwivedi, 2020) to examine the interrelationships among trust, risk, and privacy and security and develop a more in-depth understanding of e-government systems.

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 & 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 & 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, 2023; Rana et al., 2015). For instance, Hooda et al. (2022) examined the impact of UTAUT factors (i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions) whereas Hooda et al. (2023) analyzed the impact of ISS factors (i.e., system quality, information quality, service quality, user satisfaction) on e-government trust and system use. Thus, the need for research attention on psychological factors of individuals in the context of e-government acceptance is significant. Prior research has frequently examined factors such as trust, risk, privacy, and security

within the context of e-government, but these factors are not prominently featured in models like TAM, UTAUT, or ISS (Belanger & Carter, 2008; Carter & Bélanger, 2005; Tan & 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 government 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 reputational assets and therefore, they 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 of the overall institutional environment, encompassing regulations and structures that may ensure the environment's safety.

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 of 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 Fig. 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.

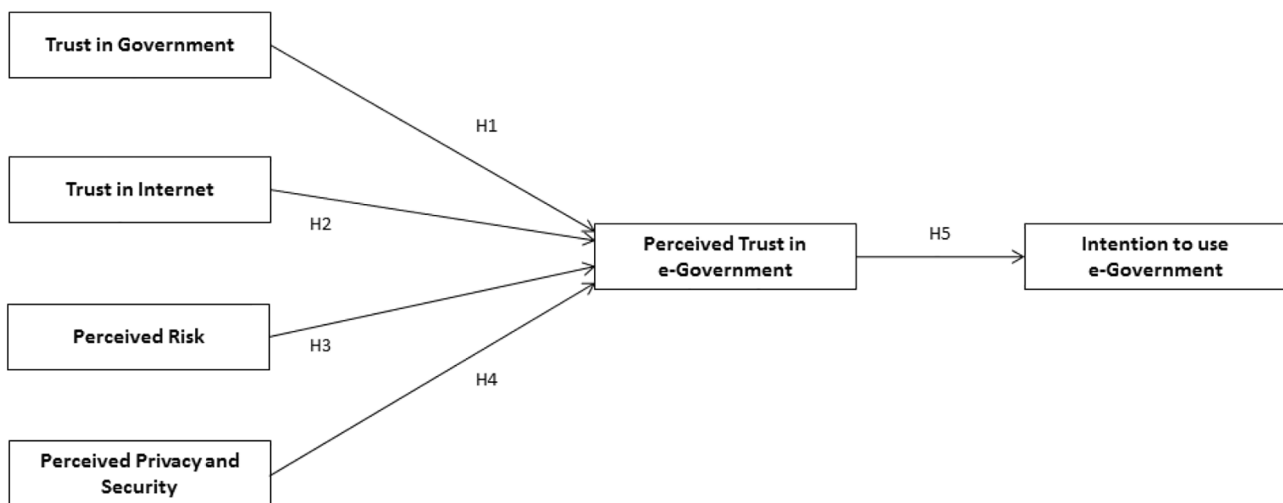


Fig. 1 Research model

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 the vulnerability of people to cyber-attacks heighten citizens' perceptions of risks associated with e-government service usage (Xie et al., 2017; Schaupp & Carter, 2010; Carter & Belanger, 2005). Citizens' concern for confidentiality and reliability of information is likely to adversely affect trust in e-government services (Xie et al., 2017). Liu and Zhou (2010) claim that risk is so closely associated with trust that there is no requirement for trust if there is no risk. Bélanger and Carter (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 will 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; Munyoka & Maharaj, 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 (IU) 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; Ruffin 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., 2017a; 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 et al., 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). The final sample of this meta-analysis study comprised 68 studies. Fig. 2 provides a summary of the process. The studies in our sample are shown in the Appendix.

4.2 Data Coding

Following the approach of previous studies, 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 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) were 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).

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

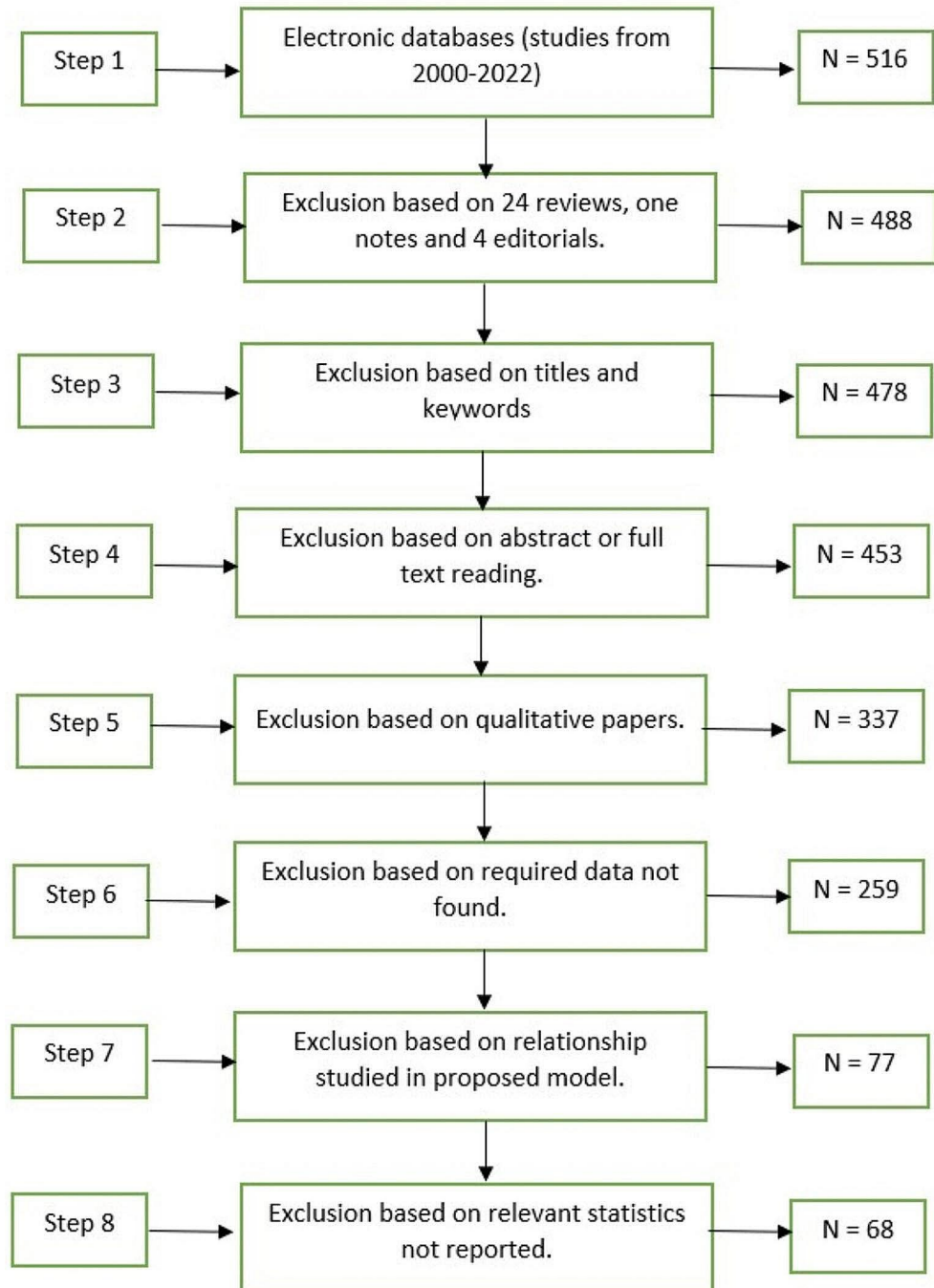
Meta-analytic methods based on Hunter and Schmidt (2004) were applied to compute the corrected correlation for each relationship proposed in our research model. To correct measurement errors, the observed correlation was divided by the square root of the product of the reliabilities of the constructs 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 and mediation analysis in AMOS.

5 Results

5.1 Meta-Analysis

The descriptive statistics for the variables are shown in Table 2 and the results of the meta-analysis are shown in Table 3 which consist of the corrected correlations, number of observations, cumulative sample sizes, failsafe-N and

Fig. 2 Sample selection process



credibility intervals. 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.

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 31,741 in this study. Table 2 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 2. 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 (1456) for the analysis.

Table 1 Research constructs and coded variables

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 2 Descriptive statistics

Construct	Mean	SD	CR
Perceived privacy and security (PPS)	5.11	0.76	0.87
Perceived Risk (PR)	3.88	1.14	0.87
Trust in internet (TR_INT)	4.44	0.92	0.87
Trust in government (TR_GOVT)	4.95	0.88	0.88
Perceived trust in e-government (PTR)	5.1	0.93	0.89
Intention to use e-government (IU)	5.05	0.92	0.87

SD: Standard deviation, CR: Construct reliability

Fig. 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). $TLI (< 0.90)$ 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

Table 3 Results of the meta-analysis

Relationship	Correlation	Number of Observations	Sample Size	Failsafe N	Low and High thresholds of 90% credibility interval
PTR ↔ IU	0.561	39	13,649	31,741	[0.464, 0.639]
TR_GOVT ↔ PTR	0.657	3	1456	2847	[-0.128, 0.888]
TR_INT ↔ PTR	0.558	4	2215	5637	[0.314, 0.705]
PR ↔ PTR	0.042	9	2952	1654	[-0.387, 0.205]
PPS ↔ PTR	0.594	8	3494	5791	[0.292, 0.726]
TR_GOVT ↔ TR_INT	0.549	20	8493	18,576	[0.390, 0.695]
TR_GOVT ↔ PR	0.216	9	2109	1532	[-0.008, 0.379]
TR_GOVT ↔ PPS	0.538	3	3433	4228	[0.364, 0.588]
TR_INT ↔ PR	-0.097	7	1691	5637	[0.314, 0.705]
TR_INT ↔ PR	0.591	3	3433	4228	[0.488, 0.544]
PR ↔ PPS	0.207	5	1680	1528	[-0.242, 0.657]
TR_GOVT ↔ IU	0.497	17	7910	8780	[0.268, 0.660]
TR_INT ↔ IU	0.441	17	5642	8857	[0.216, 0.652]
PR ↔ IU	0.088	22	6226	8725	[-0.110, 0.293]
PPS ↔ IU	0.497	14	5032	8662	[0.284, 0.516]

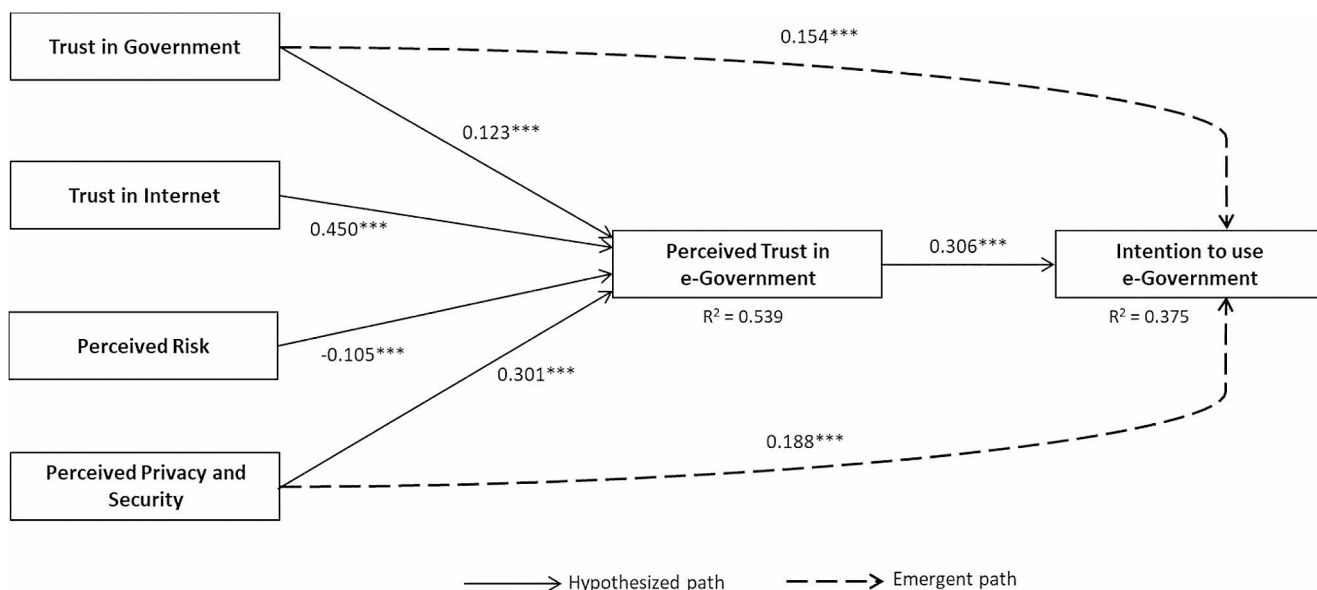


Fig. 3 Emergent model

Table 4 Mediation test results

Relation	Direct (with mediator)	Indirect (with mediator)	Interpretation
PR-> PTR-> BI	0.010	-0.026***	Full Mediation
PPS-> PTR-> BI	0.221***	0.112***	Partial Mediation
TR_GOVT-> PTR-> BI	0.157***	0.145***	Partial Mediation
TR_INT-> PTR-> BI	0.080***	0.038***	Partial Mediation

*** $p < 0.01$

paths were suggested by MIs, and hence the resulting model was considered the final model (Fig. 3). It explained 53.9% of the variance in perceived trust in e-government and 37.5% of the variance in IU.

5.3 Mediation Tests

We conducted post-hoc mediation tests to further examine the role of e-government trust. Table 4 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 ($\beta = 0.112,$

$p < 0.01$), i.e., the effect of PPS on IU was significant even in the presence of trust ($\beta = 0.221, p < 0.01$).

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 (Abu-Shanab & Al-Azzam, 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., Munyoka & Maharaj, 2019; 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 & Doong, 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 policies 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 (Collesca, 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-governments 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.

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Data Availability Data analyzed in this study are included in this article.

Declarations

Competing Interests The authors have no relevant financial or non-financial interests to disclose.

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