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# ICT Laws, Uncertainty Avoidance, and ICT Diffusion: Insights from Cross-Country Data

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**Abstract.** The economic future of a country depends on the degree to which information and communication technologies (ICTs) diffuse among its key stakeholders—citizens, businesses, and government. Yet, there is a dearth of cross-country analysis of ICT diffusion jointly examining technology diffusion among these key stakeholders in a single research model. Further, while environmental factors are significant for ICT diffusion, there is limited understanding on the impact of ICT laws on ICT diffusion among these three stakeholders across countries. Drawing on the literature on ICT diffusion and Hofstede’s typology of national culture, this study contends that ICT laws in a country can positively influence the ICT diffusion among its citizens, businesses, and the government, and these relationships can be contingent on the national cultural dimension of uncertainty avoidance. The proposed research model is examined using publicly available archival data from 90 countries. The findings suggest that sound ICT laws are necessary for achieving a greater diffusion of ICTs among citizens, businesses, and the government in a country. Further, the study provides important implications that would encourage future research on the phenomenon.

**Keywords:** ICT Laws, Uncertainty avoidance, ICT Diffusion, Citizens, Businesses, Government.

## 1 Introduction

The increasing use of information and communication technologies (ICTs) in the recent decade has led to produce considerable research on ICT diffusion, conceptualized as the extent to which ICTs spread to general use within and across economies [1]. ICT refers to “a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information” [2, p. 63], and is widely realized as an important element for driving economic growth, productivity, and overall competitiveness of a country [3, 4, 5]. Specifically, ICTs are noted to deliver numerous benefits to all the stakeholders in a country. For instance, ICTs can enhance

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the well-being of citizens by enabling access to basic services including health, education, and financial services [4]. For businesses, ICTs can increase choice in the marketplace, widen the geographic scope of potential markets, and reduce transaction costs [4]. For the government, ICTs can increase the transparency of policy making, enhance the quality of public services, and improve the government dealings [6].

It is long believed that the economic future depends on the extent to which ICTs are embraced by citizens, businesses, and the government [7], indicating the importance of these three ICT users in a country. Further, it requires a society-wide effort for fully leveraging ICTs in which the government, the business sector, and the citizenry each have an important and vital role to play [8]. Stakeholders involved in prior research examining ICT use is largely seen to involve citizens, businesses, or governments [7], albeit distinctly most of the time. Accordingly, we identify citizens, businesses, and the government as the key stakeholders in this study, and contend that it is crucial to provide insights into the driving factors of the diffusion of ICTs among these three stakeholders. It is likely that the influence of a potential factor on ICT diffusion would vary depending on the stakeholder [9] as in the extent to which a factor influences the Internet use by citizens would be different from the extent to which that same factor influences ICT use by businesses. Therefore, studying them together may offer interesting insights into the phenomenon of ICT diffusion. Nevertheless, prior studies on technology diffusion have hardly analyzed these three stakeholders jointly in a single research model. To address this void, this study investigates ICT diffusion among citizens, businesses, and government organizations.

Although the diffusion of ICTs is considered as a major factor driving a country's pace of economic growth [11, 12], the ICT-driven growth and productivity has varied significantly across countries, largely due to the difference in the degree of diffusion of ICTs among countries [5]. While some countries appear to be more receptive to the technological changes, other countries are less receptive [13]. Thus, a cross-country analysis becomes important to enhance the understanding of the phenomenon of ICT diffusion. Given that only a few studies have considered cross-country analysis of the diffusion of ICTs [5, 14, 15], this study aims to account for the variation in the level of ICT diffusion across countries, and focuses on ICT diffusion among citizens, businesses, and government organizations across countries.

Acknowledging the myriad benefits of ICTs, efforts have been put to investigate the potential determinants of the diffusion of ICTs, which can broadly be classified into (1) socio-related factors, such as user behavior and organizational characteristics [16]; (2) technology-related factors, such as ICT infrastructure and information technology (IT) knowledge [5]; and (3) environmental factors, such as economic environment and regulatory environment [17]. Nevertheless, little is known about the impact of technology-related regulatory environment on ICT diffusion across countries. Despite the relevance of technology-related regulatory environment, only a handful of studies [14, 18] examined its role in determining ICT diffusion. A well-developed technology-related regulatory framework may not only help countries to formulate legal structure and standards for collecting, storing, and sharing electronic data, but also address various ICT-related legal and regulatory issues. This study, therefore, strives to explore the role of technology-related regulatory environment in influencing ICT diffusion among citizens, businesses, and the government across

countries, and contributes to the literature on technology diffusion by investigating an under-explored but important environmental aspect in the context of cross-country ICT diffusion.

We characterize technology-related regulatory environment by ICT laws, described as the regulations designed to address variety of ICT-related legal and regulatory issues [19]. It can be conceived as a significant environmental factor considering ICT to be a double-edged sword [20]. To elaborate, though ICTs have enormous potential to improve human, organizational, and governmental performance, ICTs have brought various legal and regulatory challenges, ranging from the validity of electronic ways of contracting and the associated security risks, to concerns over protecting intellectual property rights online and over cybercrime [19, 20]. Given that ICT laws would be able to address such legal and regulatory issues [21], it becomes imperative to understand the extent to which ICT laws can affect the diffusion of ICTs among different stakeholders (i.e., citizens, businesses, and the government) in a country. Accordingly, this study focuses on the impact of ICT laws on cross-country ICT diffusion.

A country's culture is often found to have profound influence on the way the country conducts [22]. Consistent with this, prior research has argued that national cultural values account for the significant variation in ICT diffusion among countries [23, 24, 25]. Therefore, it can be expected that though technology diffusion would be influenced by a country's ICT-related legal framework, the degree of such influence would vary depending on the cultural values embedded in that country. This study draws on Hofstede's typology of national culture [26, 27], and focus on the cultural dimension of uncertainty avoidance, in particular. Uncertainty avoidance describes the degree to which members of a society feel comfortable with uncertainty [27]. Considering that uncertainty avoidance could have the most direct influence on the use of an electronic medium [22], we believe that it will be interesting to know how the relation of ICT laws in a country with the ICT diffusion is contingent on the uncertainty avoidance culture. In essence, the key research questions that the current study addresses are:

**RQ1:** *What is the relationship between ICT laws in a country and the diffusion of ICTs among its citizens, businesses, and government organizations?*

**RQ2:** *How does the national cultural dimension of uncertainty avoidance affect the relation of ICT laws in a country with the diffusion of ICTs among its citizens, businesses, and government organizations?*

In an effort to address the above research questions, the current research uses the publicly available archival data of 90 countries, and analyses (1) the direct effects of ICT laws on ICT diffusion among citizens, businesses, and the government; and (2) the moderating effect of uncertainty avoidance on the relationships of ICT laws with ICT diffusion among citizens, businesses, and the government. The study makes several crucial contributions to research and practice. First, this research is one among the very few empirical studies that understand the diffusion of ICTs from a macro-level perspective. Second, this study explores the importance of an under-explored environmental factor, ICT-oriented regulatory environment, in facilitating the diffusion of ICTs, and understands whether ICT laws can influence the diffusion of ICTs among three key stakeholders—citizens, businesses, and the government. Third, drawing on Hofstede's typology of national culture, this study investigates how the relationship between ICT laws in a country and the ICT diffusion is contingent on the

cultural dimension of uncertainty avoidance. From a practical viewpoint, this study underscores the need for developing ICT laws in order to harness the benefits of ICTs for citizens, businesses, and the government in a country. Second, the interaction effects would help practitioners to have insights into the significance of the national cultural dimension of uncertainty avoidance in explaining the differences in ICT laws and ICT diffusion relationships across countries.

## 2 Theory and Hypotheses

This section describes the related literature and theories in the context of ICT diffusion, and develops the research hypotheses by relating ICT laws, the culture of uncertainty avoidance, and ICT diffusion. Figure 1 shows the proposed research model.

### 2.1 ICT Diffusion and ICT Laws

In general, technology diffusion research is characterized by two metaphors [28]. The dominant representation suggests that diffusion is a process whereby potential users are communicated about the availability of new technologies and are persuaded to adopt by prior users [10]. The other metaphor takes an economic standpoint to perceive diffusion in terms of cost and benefit; the higher the cost, the slower diffusion will take place [28]. We define ICT diffusion as the degree to which ICTs spread to general use within and across economies [1]. The extant literature has investigated ICT diffusion from several theoretical lenses. Some of the predominant theories and models are Technology Acceptance Model (TAM) [29], Theory of Planned Behavior (TPB) [30], the Diffusion of Innovation (DoI) theory [11, 59-60], Unified Theory of Acceptance and Use of Technology (UTAUT) [31, 61-63], the Technology-Organization-Environment (TOE) framework [32, 64], and Institutional theory [33, 65]. As argued by Xiao and associates [7], the potential determinants of the diffusion of ICTs can broadly be classified into (1) socio-related factors [34]; (2) technology-related factors [14]; and (3) environmental factors [17]. Table 1 shows the classification and describes some of the primary factors determining ICT diffusion.

**Table 1.** Classification of Determinants of ICT Diffusion

Classification	Potential determinants	Exemplary research
Socio-related factors	User behavior, management behavior, organizational characteristics	[16] [34] [35]
Technology-related factors	ICT infrastructure, IT resources, IT knowledge, IT skills	[5] [14] [36]
Environmental factors	Policy and standards, regulation, economic and cultural environment, competitive pressure	[13] [17] [37]

In this study, we take interest in considering external environmental elements, specifically technology-oriented environmental factors that can impact ICT diffusion across different countries. While a number of socio-centric, technology-centric, and

environment-centric factors are investigated as shown in Table 1, little is known about the role of technology-oriented environmental factors such as technology-related legal frameworks in determining ICT diffusion. We believe that with the rapid advancement of technology, technology-oriented environmental factors would have a more relevant role to play, which is worth investigating.

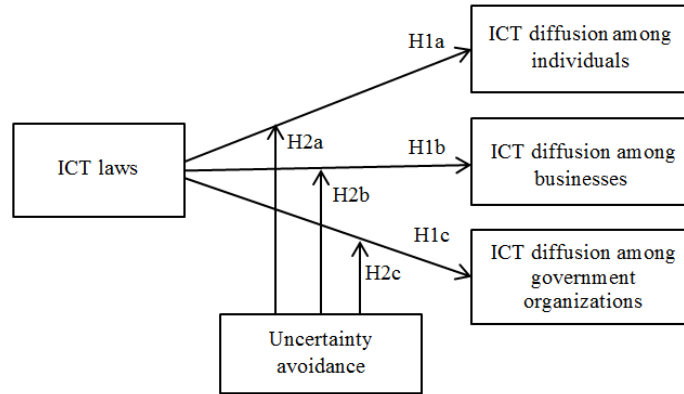
Environmental factors refer to the conditions and settings of the environment within which organizations or businesses operate [32], and are regarded to play a significant role in the technology diffusion [14]. Prior research has explored several environmental conditions in diverse domains. For instance, environmental turbulences and mimetic pressure were found as the main drivers of ICT innovation for the financial services companies [38]. At the country level, the quality of the environment (government support and the presence of a sound institutional environment) appeared to be the key enabler for the development of e-business, but not for e-government [9].

In this study, environmental conditions refer to the development of ICT-oriented legal frameworks or ICT laws in a country. In generic, ICT laws refer to the regulations designed to address variety of ICT-related legal and regulatory issues [19]. These laws enable a legal framework for gathering, storing and sharing electronic information. Specifically, ICT laws provide legal acknowledgment of transactions carried out through electronic data interchange and electronic communication, also referred to as “electronic commerce”, facilitate electronic filling of documents, and provide secure environment to carry out electronic transactions through information technology standards, cryptography, digital signatures, and digital certificates [19, 21]. Prior research has shown the relevance of ICT laws to the adoption of ICTs in different contexts. In their study, Boyer-Wright and Kottemann found the ICT legal environment to be a significant factor for the adoption of online government services [39]. In another study, Qu and Pinsonneault demonstrated that when companies were facilitated by established laws, it influenced the adoption of IT outsourcing [18]. Further, Larosiliere and associates argued that people would be more likely to adopt social networking systems in the presence of a sound ICT-related legal environment [14].

Consistent with these arguments, we posit three mechanisms explaining how ICT laws can influence the diffusion of ICTs in a country. First, as mentioned before, ICT laws enable a secure mode of online transaction. These laws ensure protection of individuals with regard to the ownership, processing and transfer of personal data [19]. Citizens may not participate in online financial transactions and electronic banking unless they are assured of the confidentiality and security of electronic communications. ICT laws can address these issues by facilitating the adoption of security measures, reducing the risks associated with information security and ensuring appropriate protection against harmful conduct over Internet, which would lead citizens to have more confidence in ICT and eventually boost their ICT use. This is also in line with Larosiliere and associates [14] who posited that individuals in countries with well-developed ICT laws would experience less concerns about privacy, data protection, or similar other issues, and thus would be motivated to use social network systems. Hence, when ICT laws are developed in a country, the stakeholders, especially citizens and businesses would have minimal concerns about information security issues, and they would be more likely to use various ICTs to access different services,

leading to a greater diffusion of ICTs among citizens and businesses in a country. Second, when ICT laws are developed and efficient enforcement mechanisms are in place in a country, organizations would experience less uncertainty over the validity, enforceability and treatment of electronic contracts, and would be more willing to use ICTs for business transactions and enter into exchanges with each other [19, 39]. To elaborate, many regulatory provisions specify requirements for documents to be produced in writing and for a contract to be signed manually without having certainty as to the validity and enforceability of electronic documents, messages or signatures, thereby placing legal obstacles to electronic communications. ICT laws have the potential to address such issues regarding legal recognition of electronic messages and formation and validation of electronic contracts, and create a more encouraging environment for electronic commerce [19]. Third, businesses and the government would be able to acquire trust of their end-users and partners by providing secure online platforms (e.g., electronic commerce and electronic government) for communication and transaction, which would again lead to a greater diffusion of ICTs among citizens, businesses, and government organizations. Taken together, we propose:

**H1:** *ICT laws in a country is positively associated with the diffusion of ICTs among its citizens (H1a), among businesses (H1b), and among government organizations (H1c).*



**Fig. 1.** Research Model

## 2.2 Moderating Influence of the Cultural Dimension of Uncertainty Avoidance

The concept of culture is defined in various ways in the literature [40], yet a commonly held view is that the cultural environment shapes the values shared by the members of the society. In this study, we rely on Hofstede's definition of culture, and draw on Hofstede's cultural dimensions theory, which is arguably the most widely used theory of national culture in the literature [41]. According to Hofstede, national culture is "the collective programming of the mind which distinguishes the members of one human group from another" [26, p. 260]. Hofstede identified four dimensions of na-

tional culture namely, (1) power distance (large vs. small); (2) individualism vs. collectivism; (3) masculinity vs. femininity; and (4) uncertainty avoidance (strong vs. weak) [26, 27].

The concept of national culture has been used to study different cross-country phenomena across disciplines. In Information Systems (IS) literature, prior research attributed the significant variation in ICT adoption, diffusion, and implementation between countries to national culture [23, 24, 25]. Specifically, the research linking IS and culture has broadly been classified into six themes: (1) culture and IS development; (2) culture, ICT adoption and diffusion; (3) culture, ICT use and outcomes; (4) culture, ICT management and strategy; (5) the influence of ICT on culture; and (6) information technology (IT) culture [15]. While it is important to build understanding on all the above themes, only a few studies have focused on the influence of culture on ICT adoption and diffusion [42], with many studies considering a particular region or a group of countries [22, 43]. For instance, Straub compared the effect of the cultural dimension of uncertainty avoidance on the firm-level ICT diffusion in Japan and the U.S. [22]. In another study, Dotan and Zaphiris performed a cross-cultural analysis of Flickr users of 5 countries—Iran, Israel, Peru, Taiwan, and the United Kingdom [43]. Further, little research is done to have a combined understanding of the cross-cultural ICT diffusion among three stakeholders—citizens, businesses, and government organizations in a country. Hence, motivated by the lack and the need of macro-level studies, this research analyses the moderating effect of uncertainty avoidance on the relationship of ICT laws in a country with its ICT diffusion.

Uncertainty avoidance is defined as “the degree to which members of a society feel uncomfortable with uncertainty and ambiguity” [27, p. 83]. To elaborate, while strong uncertainty avoidance cultures are less comfortable in unstructured situations characterized by ambiguity and uncertainty, weak uncertainty avoidance cultures are more comfortable with ambiguity, chaos, and novelty [45]. Furthermore, individuals in strong uncertainty avoidance cultures would tend to take familiar risks and avoid the risk induced by the unknown, i.e. unstructured situation, whereas individuals in weak uncertainty avoidance cultures would tend to take unknown risks [44, 45]. The current research focuses on uncertainty avoidance for two reasons. First, ICTs may lead to an uncertain situation by causing concerns over electronic contracting, electronic transactions, and privacy, to name a few. As uncertainty avoidance is more related to such uncertain situations, this cultural dimension can be conceived to be more relevant in this study. Second, among four of Hofstede’s cultural dimensions—power distance, individualism, masculinity, and uncertainty avoidance [26, 27], uncertainty avoidance may have the most direct influence on the preference for and use of an electronic medium [22]. This is further supported by Leidner and Kayworth who argued uncertainty avoidance to have a lasting influence on the ICT diffusion in a country [15]. Therefore, it is the cultural dimension that is related to environmental factor, in this study, to analyze their joint influence on ICT diffusion.

Researchers argue that the inclination of members of a culture to avoid uncertainty and ambiguity profoundly affects the diffusion of ICTs [22, 46]. Countries with strong uncertainty avoidance would experience a slow rate of ICT diffusion. Consistent with this logic, we argue that ICTs attributed by numerous mobile applications,

multimedia, transactional online media, and continuously evolving technological features would create inherent risks including privacy and security issues for citizens to use ICTs for the communication and exchange of information. As a result, despite the presence of sound ICT laws, citizens in strong uncertainty avoidance cultures will be more hesitant towards using ICTs than those in weak uncertainty avoidance cultures, leading to a lower diffusion of ICTs among citizens in strong uncertainty avoidance cultures. Similarly, with respect to organizational communication behavior, uncertainty and ambiguity are conceived as principal factors in predicting media use [22]. For instance, electronic mode of contracting for businesses and governments may raise uncertainties whether a contract formed by the interaction of an automated electronic message and a natural person can be accepted as valid, or whether electronic message or records can be submitted as evidence in courts. Although well-developed ICT laws attempt to answer these uncertainties, in a strong uncertainty avoidance culture, stakeholders' natural tendency to avoid uncertainties (ICT-induced uncertainties in this context) may prevent them to use ICT at its full potential. Hence, despite that the sound ICT laws may decrease the legal and regulatory concerns associated with ICT use, it can be expected that businesses and the government in strong uncertainty avoidance cultures would be more sluggish in the usage of ICTs than those in weak uncertainty avoidance cultures. Taken together, we propose:

**H2:** *Uncertainty avoidance moderates the relationship of ICT laws in a country with ICT diffusion among its citizens (H2a), businesses (H2b), and government organizations (H2c), such that the effect of ICT laws on ICT diffusion among citizens (H2a), businesses (H2b), and government organizations (H2c) would be less in a strong uncertainty avoidance culture than that in a weak uncertainty avoidance culture.*

### 3 Research Design

To test the hypotheses, we collected archival data from multiple publicly available sources, in line with Jarvenpaa [47], and Srivastava and Teo [9]. Further, as many studies suggest that the effects of an independent variable may not be instantaneous [36], we maintain 1-year lag between the independent and dependent variables. Hence, we collected data for the dependent variable for year 2016, which was 1-year ahead of the 2015 data for independent variables.

Hypotheses were tested through a cross-sectional analysis of 90 countries (after omitting missing values). The dependent variables in this study are (1) ICT diffusion among citizens; (2) ICT diffusion among businesses; and (3) ICT diffusion among government organizations. ICT diffusion among citizens refers to the extent to which ICTs spread to general use by citizens in a country, and it was measured using a composite of three indicators: (i) percentage of individuals using the Internet; (ii) fixed (wired)-broadband Internet subscriptions per 100 inhabitants; and (iii) active mobile-broadband subscriptions per 100 inhabitants. The indicators were sourced from the International Telecommunication Union report [48]. The second dependent variable, ICT diffusion among businesses refers to the extent to which ICT use spreads through

businesses in a country, and it was measured using a composite formed by computing the statistical mean of four indicators, obtained from the Global Information Technology report [8]. The four indicators represent (i) the extent to which businesses in a country adopt new technology; (ii) the extent to which companies in a country have the capacity to innovate; (iii) the extent to which businesses in a country use ICTs for transactions with other businesses; and (iv) the extent to which businesses in a country use ICTs for selling goods and services to consumers. All four indicators were anchored on 1-to-7 scale with “1” representing “not at all”, and 7 representing “to a great extent”. The third dependent variable, ICT diffusion among government organizations, refers to the extent to which ICTs spread to general use by government organizations in a country, and it was measured using the Online Service Index, which indicates the extent to which the government in a country has an online presence. The values for this index were within 0 and 1, with the higher values indicating the higher level of online presence characterized by the higher level of ICT use by the government, and the scores were obtained from the United Nations (UN) e-government survey report [49].

The independent variable is a technology-oriented environment factor and measures the overall sophistication of laws relating to ICTs in a country [50]. This variable was measured by a single indicator evaluating whether ICT-related laws that govern the understanding and use of IT (i.e., electronic commerce, digital signatures, consumer protection, etc.) were either non-existent or well-developed and enforced. It was measured asking the respondents, “How developed are your country’s laws relating to the use of ICTs (e.g., e-commerce, digital signatures, consumer protection)?”, and anchored on a 1-to-7 scale with “1” representing “not developed at all”, and 7 representing “extremely well developed”. The cultural dimension of uncertainty avoidance was used as the moderating variable. Uncertainty avoidance refers to the extent to which members of a society feel comfortable with ambiguity and uncertainty, and its measure was obtained from Hofstede’s multinational study of cultural values [46].

Most prior macro-level studies demonstrated the direct influence of financial indicators on ICT use [14]. Accordingly, we controlled for a country’s financial stability that was measured by the macroeconomic environment index obtained from the Global Competitiveness report [51]. This index was composed of five financial sub-indices: government budget balance, gross national savings, inflation, government debt, and country credit rating. Apart from this financial indicator, three Hofstede’s cultural dimensions, namely, power distance, individualism, and masculinity were also opted as control variables in this study for their potential influence on ICT diffusion. Measures for these national cultural dimensions were taken from Hofstede’s multinational research on cultural values [46].

## 4 Analysis and Results

### 4.1 Descriptive Statistics and Correlations

Table 2 presents the descriptive statistics and correlations for all variables. As shown, most of the correlations were significant at  $p < 0.05$ . Further, correlations between the explanatory variables were below the threshold value of 0.8, indicating minimal concern for multicollinearity [52]. This is also supported by the results of the collinearity tests measuring variance inflation factor (VIF), in which VIFs were found to range from 1.07 to 2.15 with all tolerance levels above 0.47. Having VIFs  $< 4.0$  and tolerance levels  $> 0.25$  [53], we can confirm that our research model is not largely affected by the multicollinearity concern.

**Table 2.** Descriptive Statistics and Correlations

Variables	M	SD	MEC	PDI	IDV	MAS	UAI	ITL	IDC	IDB
MEC	4.83	1.05	-							
PDI	63.13	21.55	-0.25*	-						
IDV	40.96	22.23	0.27*	-0.68**	-					
MAS	47.63	18.94	-0.13	0.11	0.05	-				
UAI	65.01	21.95	-0.14	0.17	-0.19	0.01	-			
ITL	4.21	0.86	0.59**	-0.45**	0.49**	-0.12	-0.06	-		
IDC	46.32	24.85	0.48**	-0.52**	0.65**	-0.03	0.08	0.73**	-	
IDB	4.76	0.68	0.59**	-0.51**	0.56**	-0.09	-0.12	0.89**	0.77**	-
IDG	0.65	0.20	0.39**	-0.42**	0.50**	-0.02	0.14	0.65**	0.73**	0.62**

Note. N=90; M: Mean; SD: Standard deviation; MEC: Macroeconomic conditions; PDI: Power distance; IDV: Individualism; MAS: Masculinity; UAI: Uncertainty avoidance; ITL: ICT laws; IDC: ICT diffusion among citizens; IDB: ICT diffusion among businesses; IDG: ICT diffusion among government organizations; \* $p < 0.05$  \*\* $p < 0.001$  (2-tailed).

### 4.2 Hypotheses Testing

The research hypotheses were tested by jointly estimating a system of equations through the seemingly unrelated regression (SUR) approach [54]. We preferred SUR approach over ordinary least squares (OLS) regression to account for contemporaneous correlations. To elaborate, our research model had a system of multiple dependent variables. As they were correlated (see, Table 2), the error terms were likely to be correlated, which could lead to biased estimates if OLS regression were used. SUR models are able to accommodate such autocorrelation in the unobserved error terms, and tend to generate more efficient estimates than OLS [21].

Three SUR equations were formed with three dependent variables—ICT diffusion among citizens, ICT diffusion among businesses, and ICT diffusion among government organizations. These equations were jointly estimated in three steps: in Step 1, control variables were entered; in Step 2, main effects as described in hypotheses

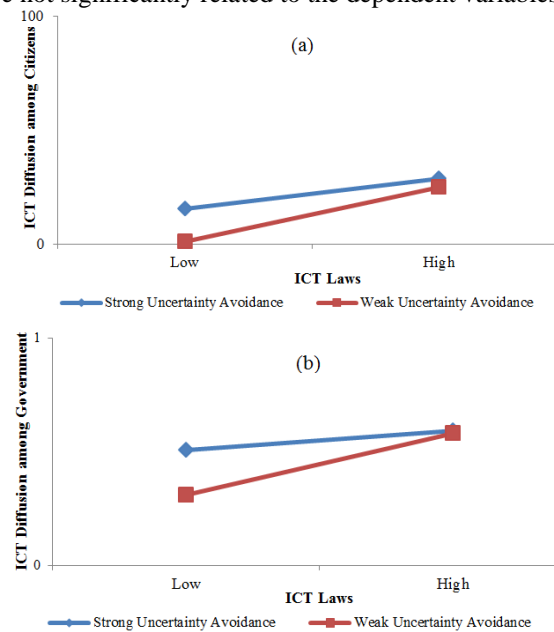
H1a-H1c were tested; and in Step 3, the interaction term was included to test the moderation effects as stated in hypotheses H2a-H2c.

**Table 3.** Seemingly Unrelated Regression Results

Variables and Statistics	B								
	Dependent variable: IDC			Dependent variable: IDB			Dependent variable: IDG		
Step 1: Controls									
MEC	7.623***	2.926	2.992	0.295***	0.059	0.060	0.053**	0.013	0.013
PDI	-0.128	-0.072	-0.064	-0.005	-0.002	-0.002	-0.001	-0.001	0.000
IDV	0.543***	0.436***	0.429***	0.010**	0.003	0.003	0.003**	0.002*	0.002*
MAS	-0.006	0.025	0.040	-0.001	0.001	0.001	0.001	0.000	0.001
Step 2: Main Effects									
ITL		13.040***	25.385***		0.594***	0.643***		0.113***	0.260***
UAI		0.240**	1.116**		-0.001	0.003		0.002**	0.013***
Step 3: Interaction Effects									
ITL* UAI			-0.204**			-0.001			-0.002**
R <sup>2</sup>	0.528	0.693	0.714	0.542	0.833	0.834	0.333	0.525	0.569
R <sup>2</sup> Change	-	0.165	0.021	-	0.291	0.001	-	0.192	0.044
<i>Note.</i> N=90; B: Unstandardized regression coefficients; MEC: Macroeconomic conditions; PDI: Power distance; IDV: Individualism; MAS: Masculinity; ITL: ICT laws; UAI: Uncertainty avoidance; IDC: ICT diffusion among citizens; IDB: ICT diffusion among businesses; IDG: ICT diffusion among government organizations; All models are significant at p<0.001 (2-tailed); *p<0.05 **p<0.01 ***p<0.001 (2-tailed).									

Table 3 summarizes the results of the seemingly unrelated regression. The models were effective in explaining the variance in ICT diffusion among citizens (with R<sup>2</sup>=0.714), among businesses (with R<sup>2</sup>=0.834), and among government organizations (with R<sup>2</sup>=0.569). As shown in Table 3 (Step 3), ICT laws were positively and significantly (p<0.001) related to all three dependent variables, and hence, hypotheses H1a, H1b, and H1c were supported. It thus can be expected that sound ICT laws in a country will lead to a greater diffusion of ICTs among citizens, businesses, and the government within that country. Further, the interaction effects were negative and statistically significant (p<0.01) for ICT diffusion among citizens and the government. Nevertheless, the joint influence was statistically insignificant for ICT diffusion among businesses (p>0.05), implying that hypothesis H2b is not supported. In order to further understand the role of the moderator for hypotheses H2a and H2c for which the interaction effects were found significant, we plotted the interaction effects (see, Figure 2), as suggested by Cohen and Cohen [55]. In addition, slope analysis was performed as recommended by Aiken and West [56]. The analysis showed that the strength of the relation “ICT laws—ICT diffusion among citizens” was less (slope = 7.67, t = 2.48, p<0.05) in a strong uncertainty avoidance culture than that in a weak

uncertainty avoidance culture (slope = 16.61,  $t = 208.78$ ,  $p < 0.001$ ), which is also apparent in Figure 2(a). This implies that when uncertainty avoidance is strong, the effect of ICT laws on ICT diffusion among citizens is less than that in a weak uncertainty avoidance culture. Hence, hypothesis H2a is supported. For government organizations, the slope analysis revealed that in a strong uncertainty avoidance culture, the relation “ICT laws—ICT diffusion” was insignificant, and its slope value was less (slope = 0.05,  $t = 1.56$ , n.s.) than that (slope = 0.16,  $t = 195.18$ ,  $p < 0.001$ ) in a weak uncertainty avoidance culture. This is also in line with Figure 2(b), which implies that ICT laws may not necessarily lead to a greater diffusion of ICTs among government organizations in a strong uncertainty avoidance culture, whereas ICT laws could be more effective in a weak uncertainty avoidance culture. Hence, hypothesis H2c is supported. Amongst the control variables, only the cultural dimension of individualism was found to be significantly related to ICT diffusion among citizens ( $p < 0.001$ ) and ICT diffusion among government organizations ( $p < 0.05$ ), indicating that a country scoring high on individualism may experience a higher level of ICT diffusion. Other control variables such as macroeconomic environment, power distance, and masculinity were not significantly related to the dependent variables.



**Fig. 2.** Moderating effect of uncertainty avoidance on (a) ICT laws and ICT diffusion among citizens; and (b) ICT laws and ICT diffusion among government organizations.

## 5 Discussion

The diffusion of ICTs largely contributes to the economic growth of a country [11, 12], yet the degree of ICT diffusion differs significantly across countries [5, 13]. In an

effort to understand the phenomenon of the cross-country variation in ICT diffusion, this study investigates the role of ICT laws and uncertainty avoidance in influencing ICT diffusion among three key stakeholders—citizens, businesses, and the government across countries. Analyzing archival data from 90 countries, we contend that ICT laws, if developed well in a country, may lead to a greater diffusion of ICTs among the stakeholders. Further, our findings suggest that the effect of ICT laws in a country on the ICT diffusion might be contingent on the cultural dimension of uncertainty avoidance. In a strong uncertainty avoidance culture, the effect of ICT laws on ICT diffusion among citizens and government organizations would be less than that in a weak uncertainty avoidance culture. However, for businesses, our analysis did not find statistically significant support for such influence of uncertainty avoidance culture, which could be due to the limitation in our cross-sectional dataset. Interestingly, the joint effect was in the desired direction (i.e., negative), thereby partly supporting our line of argument that the influence of ICT laws on ICT diffusion among businesses could be less in strong uncertainty avoidance culture than that in a weak uncertainty avoidance culture.

Our study offers several implications for research and practice. First, given the dearth of macro-level studies simultaneously examining technology diffusion among different stakeholders, this study is one of the first few studies that capture and jointly estimate ICT diffusion among three key stakeholders (i.e., citizens, businesses, and government) in a single model. Second, drawing on the literature on ICT diffusion, this study underscores the importance of an under-explored environmental factor, namely, technology-oriented legal framework characterized by ICT laws. The study thus extends the literature on technology diffusion by investigating the linkage between ICT laws and ICT diffusion across countries. Third, the current study also acknowledges the significance of national cultural values embedded in a country. Hence, this study examines the joint influence of ICT laws and uncertainty avoidance, and shows that the relation of ICT laws in a country with the technology diffusion becomes weaker for its citizens and the government in a strong uncertainty avoidance culture. Taken together, this study explores a potential relationship among technology-related legal framework, national culture, and technology diffusion across three stakeholders in a country, and we believe that our theoretically driven empirical research would be instrumental in encouraging future research on this phenomenon.

From a practical standpoint, the study indicates that ICT laws are useful for ICT diffusion among all three users. ICT laws may help define the legal structure and standards for gathering, sharing, and storing digital information [21], and could enable citizens, businesses, and the government to electronically communicate and transact with other parties by minimizing legal and regulatory issues [19]. For instance, Information Technology Act 2000 of India states that “Where any law provides that information or any other matter shall be in writing or in the typewritten or printed form, then, notwithstanding anything contained in such law, such requirement shall be deemed to have been satisfied if such information or matter is—(a) rendered or made available in an electronic form; and (b) accessible so as to be usable for a subsequent reference” [58]. It essentially provides legal recognition of electronic records that would encourage businesses to make contracts through electronic means, which

would not only help electronic commerce in a country to thrive but also lead to a greater level of ICT diffusion in the country. Henceforth, it becomes crucial that a country invests in building sound ICT laws and regulations to facilitate its law enforcement that would further enable increased diffusion of ICTs among citizens, businesses, and governmental organizations. Second, the moderating effect of uncertainty avoidance culture would help practitioners understand its significance in explaining the differences in “ICT laws—ICT diffusion” relationship across countries. We suggest that policymakers in a country have to be mindful about the potential effect of the cultural value of uncertainty avoidance. A country not only needs to develop and reform ICT laws but also has to ensure that the laws benefit the users without creating further problems. Sometimes piecemeal law reform may lead to more problems than it solves [19]. Hence, it becomes important to decide upon the approach of developing ICT laws within the broader context of a country’s ICT development and diffusion. Further, as sophisticated laws could be intricate, countries may consider educating and making ICT users aware of the effectiveness and application of ICT laws for creating an encouraging environment for ICT use.

The study has two key limitations. First, this study uses secondary data compiled from multiple third-party sources to undertake a large scale cross-country analysis. The use of secondary data was mainly motivated by the infeasibility of collecting primary data at the country-level. Nevertheless, as these reputable agencies use stringent guidelines for their data collection, the choice of secondary sources can be perceived as productive for conducting a large scale study. Second, data is used from countries that are common to all the primary sources, and countries such as, Algeria, North Korea, Oman and others became excluded from the sample. As a result, data from 90 countries were examined, which appears to be adequate considering that 50 is the minimum number necessary to avert the concerns over degrees of freedom and efficiency [57]. Future studies can focus on various directions. First, our findings can be limited by the cross-sectional nature of the study. Thus, future research may consider analyzing a panel data set to build more rigorous understanding of the phenomenon. Second, this study employs the cultural dimension of uncertainty avoidance to empirically examine its moderating effects on the relation of ICT laws with technology diffusion. Future study may investigate the moderating effects of other Hofstede’s [27] cultural dimensions to have a holistic understanding of ICT diffusion based on the influence of environmental determinants and cultural values. Third, ICT laws may affect the ICT diffusion of countries differently depending on the basic economic conditions of the countries. Future research may categorize countries into developing and developed countries, and compare the effect of ICT laws on ICT diffusion.

## **6 Concluding Remarks**

Despite the increased use of ICTs within and across countries, limited research is carried out to understand the role of the technology-related environmental factor in shaping the ICT diffusion across countries. This study, as an initial step towards building such understanding, underlines the importance of ICT laws in a country, and

proposes a conceptual model, by drawing on the literature on ICT diffusion and Hofstede's national culture dimensions, to (1) investigate the impact of ICT laws in a country on ICT diffusion among the key stakeholders (citizens, business, and the government) within that country, and (2) examine the moderating effect of uncertainty avoidance on the relationships of ICT laws in a country with its ICT diffusion. The research model is empirically validated using publicly accessible archival data. The findings suggest that ICT laws in a country can increase the level of ICT diffusion among the stakeholders. Nevertheless, such relationship is dependent on the cultural value of uncertainty avoidance, specifically for citizens and the government in a country. We believe that the study brings a different perspective to the phenomenon of ICT diffusion by emphasizing ICT-related regulatory frameworks and would encourage future research in that direction.

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