Master's Degree Dissertation

Uncertainty avoidance and its effect on diffusion of electronic commerce - a cross-country study

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Academic Year 2019 – 2020

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Project performed within the framework of the **Master of Science in Management** program taught by Barcelona School of Management, a centre associated with Pompeu Fabra University

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Abstract

The diffusion of e-commerce has seen a significant surge in recent years. Economic, political, and technological factors are considered as the main determinants of technology diffusion. However, these findings appear inconclusive as diffusion rates of e-commerce diverge considerably across countries, even with similar economic and political situations. There is evidence that socio-cultural factors can be relevant in explaining cross-country discrepancies in technology diffusion; nevertheless, its effect on internet retailing has rarely been explored. Furthermore, the highest barrier to the success of e-commerce is the perceived risks in that mode of retailing. This makes us wonder whether the risk perception across countries can help explain disparities in e-commerce growth rates across nations. This study focuses on uncertainty avoidance, a measure of the extent that people in a given culture feel threatened by the unknown to explain cross-country e-commerce diffusion. This study further explores the role of technology infrastructure in e-commerce diffusion, intending to explain the moderating effect of technology infrastructure on the relationship between uncertainty avoidance and e-commerce diffusion. The results reveal that uncertainty avoidance has a significant negative impact on the diffusion of internet retailing. However, with a reliable technological infrastructure, this negative effect is weakened.

Keywords:
Technology Diffusion, E-commerce Diffusion, Internet Retailing, Risk, Uncertainty Avoidance

Acknowledgments

First and foremost, I wish to express my sincere appreciation to my supervisor, Professor Timo Sohl, whose guidance and encouragement were guiding me throughout this journey. Whose sincerity, support, and devotion have been invaluable on both academic and personal levels.

Above all, I would like to extend my deepest gratitude to my parents for their unwavering love and support throughout my life. For believing in me when no one else did. For having my back through it all and for endlessly encouraging me to believe that anything I set my mind to I can accomplish. I also wish to express special gratitude to my beloved friend Helen for her support, patience, and unflinching faith in me. I am lucky to call you my friend and have you by my side throughout this master and beyond.

And finally, I wish to show special gratitude to my father, whose patience cannot be overvalued. Whose helpful advice and contributions have guided me not just through my personal, but throughout all my academic life.

TABLE OF CONTENTS

INTRODUCTION

The adoption and diffusion of electronic commerce (e-commerce) has reshaped the way business is conducted. On the one hand, firms are driven to the adoption of e-commerce by global competitive forces, while on the other, firms are also guided by social environment and policy aspects. (Kraemer, *et al.,* 2002). Overall, the success of e-commerce in a market is dependent on a series of factors, some of which are fundamentally controllable, while others are not (Yeniyurt and Townsend, 2003).

The internet and e-commerce have witnessed phenomenal growth around the world, and the rate of e-commerce adoption is considered a significant force in influencing the pace of economic growth. Nevertheless, despite the global boom of internet retailing, the growth of e-commerce has not occurred at the same rate for all nations. Existing research has highlighted the main drivers of adoption and diffusion of technologies and contributed divergence in diffusion rates to causes such as the growth of the economy, level of income, and degree of openness to trade. Overall, the outcome derived from these studies lies in the premise that the adoption of technology and its diffusion are economic phenomena. However, there is evidence that adoption rates differ considerably, even across countries with similar economic situations. Hence it can be posited that cross-country variations in e-commerce diffusion may not only be due to economic factors but also to prevailing social conditions or national culture. (Erumban and Jong, 2006).

National culture has long been recognized as a vital force in the success of new technologies, and considerable disparities have been found in how different cultures react to technological innovations (Gong, 2009). The cultural framework of Hofstede (2001) has widely been used to describe the role of culture on technology adoption, and the dimension of uncertainty avoidance is found to play a substantial part (Nath and Murthy, 2004). While the role of cultural dimensions in the diffusion of the internet and other ICTs (information and communications technology) has been studied, the effect of socio-cultural factors on the diffusion of e-commerce across countries remains fairy unexplored in literature.

Uncertainty avoidance is a society's tolerance for ambiguity, and research has emphasized its negative influence on the diffusion of technology (Gong, 2009). The notion of uncertainty avoidance is especially relevant in e-commerce as perceived risks are the most significant inhibitors to e-commerce growth. While existing literature has focused on risk from the

consumer's perspective and found perceived risks to profoundly hinder the use of e-commerce, few studies have focused on the concept of perceived risk in a global cross-country context. (Doolin, *et al.,* 2005; Jarvenpaa, *et al.,* 2000; Cheng, *et al*., 2013).

Thus, following this line of reasoning, this study aims to enrich our understanding of e-commerce adoption and diffusion by providing an empirical investigation into the relationship between uncertainty avoidance and e-commerce diffusion. The dimension of uncertainty avoidance will be studied explicitly, and used as a macro cross-country variable of risk, contributing to the findings of perceived risks as the most significant facilitator of e-commerce diffusion. Technology infrastructure, one of the essential enablers of internet retailing, is considered as a moderator of this relationship, allowing us to draw concrete policy implications and provide additional evidence to the enabling and inhibiting factors of e-commerce diffusion. This study expects that low uncertainty avoidance cultures, thus more trusting, and less fearful of the unknown, are more likely to overcome the risks associated with e-commerce usage, suggesting a negative effect of uncertainty avoidance on e-commerce diffusion. As socio-cultural factors have a substantial influence on a country's ability to participate in internet retailing, and because culture changes slower over time than technology, societal values may be a better predictor of adoption than other factors. Moreover, this study suggests that in the case of strong technological infrastructure, the effect of uncertainty avoidance on diffusion is diminished. Whereas in the case of low technological infrastructure, the role will be attenuated. Based on this objective, the following research question is posed:

"What is the effect of uncertainty avoidance on e-commerce diffusion, and what is the moderating role of technology infrastructure in the relationship between uncertainty avoidance and e-commerce diffusion?"

The paper is divided as follows. The first chapter presents the theoretical framework. Technology and e-commerce diffusion, the role of risks in the e-commerce environment, and uncertainty avoidance as a dimension of national culture are addressed, and the conceptual model is proposed. In the second chapter, the methodology is illustrated. Finally, in the third chapter, the data analysis is conducted, and the findings are summarized. To conclude, the limitations of the research are discussed, and recommendations for future research are made.

1. THEORETICAL DEVELOPMENT

This chapter provides an overview of both technology and e-commerce adoption and diffusion and its determinants. The first section describes the enablers and inhibitors of e-commerce diffusion and portrays the relevance of technology infrastructure concerning e-commerce diffusion. The second section addresses risks as the primary inhibitor to the adoption of e-commerce. The third section defines the national culture and its effect on e-commerce diffusion and demonstrates the role of uncertainty avoidance as a macro variable of risk. The literature review concludes with a proposed conceptual model and developed hypotheses.

1.1. Technology and Electronic Commerce Adoption and Diffusion

The diffusion of technology innovation refers to the dynamic consequence of adoption. It portrays the aggregation of technology adopters over time, mounting from individual adoption decisions. Comin and Mestieri (2014) examine the measurements and drivers of technology diffusion. They cover two approaches to technology diffusion measurement. They argue that the extensive measure of technology diffusion consists of merely tracking the presence of a technology in a given country in a moment, and it is informative of the overall technology adoption in a given country if significant cross-country variations in adoption are present. Traditional measures of technology diffusion consider the number of potential adopters relative to the current adopters in various industries or countries. They propose an S-shaped diffusion curve that measures diffusion in three parameters: the speed of adoption, long-run outcome, and a constant of integration. (Comin and Mestieri, 2014).

Existing literature has also examined the determinants of technology diffusion and categorized the findings into four categories: socioeconomic (e.g., GDP per capita), technological (e.g., network infrastructure), cultural (e.g., uncertainty avoidance), and political (e.g., government regulations) (Feng, 2015). Comin and Mestieri (2014) differentiate between two categories of drivers of cross-country technology diffusion - supply and demand side. On the one hand, knowledge and policies affect the diffusion of technology from the supply side. Prior knowledge allows for reduced costs of technology adoption. They argue that it can take a form of human capital or be collectively embodied in organizations or sectors. Additionally, policies can constrain the adoption of technology by setting conditions that deter the incentives for adoption.

On the other hand, demand is also considered an important driver of technology diffusion. Demand is considered a pull-side driver of technology diffusion as it allows for increased returns, and adopters' ability to cover sunk costs of adoption in conditions of high demand. (Comin and Mestieri, 2014).

However, innovations are not adopted simultaneously in a social system; instead, it is a process. In 1962, Rogers developed a theory to explain how ideas or products gain momentum and diffuse in a social system. (LaMorte, 2019). The theory of diffusion of innovations (DOI) is now the foundation for a considerable body of information technology research. (Pearson and Grandon, 2005). It is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p.11). The diffusion of innovation theory sheds light on how adoption occurs in a social system and explains how and at what rate new technologies diffuse through cultures. According to DOI, the rate of adoption is influenced by four key features: characteristics of the innovation itself, the time since the introduction of the innovation, the communication channel used to transfer the benefits of the innovation, and lastly the social system in which the innovation is to be diffused. The innovation-decision process is described as having several stages of processing when evaluating whether to adopt technology - the progression from initial knowledge to the adoption decision. (Weigel, *et al*., 2014). According to Rogers (2003), the five main factors that influence the adoption of an innovation are relative advantage, complexity, trialability, compatibility, and observability. In a more recent study, Al-Jabri and Sohail (2012) also considered perceived risks as one of the main factors, as they found strong evidence for perceived risks to hinder adoption. Based on DOI theory, diffusion and adoption rates of different innovations can be analyzed at two levels: individual or the system level (Gong, 2009).

E-business is regarded as an important area of information technology (IT) innovation, as it allows us to integrate internet-based technologies with the core business (Lin and Lin, 2008). The global spread of the internet has allowed electronic markets to gain a competitive advantage over the traditional markets, linking businesses and people with little regard for national boundaries. Electronic commerce (e-commerce), the sale of goods and services over computer networks, has changed how economic transactions are carried out, and an increasing number of businesses are taking advantage of the benefits that e-commerce has to offer. (Merhi and

Arhuwalia, 2017). In this paper, the terms electronic commerce (e-commerce) and internet retailing are used interchangeably.

Concerning the adoption and diffusion of internet retailing, Pavlou (2003) argues that the adoption of e-commerce depends not just on consumers' acceptance of internet technologies as viable channels of interaction, but also their perception of online retailers as reliable vendors. He defines e-commerce adoption as consumers' engagement in electronic exchange relationships with online vendors. Several models have been tested and found support in users' adoption and acceptance of information technologies. (Pavlou, 2003). The technology acceptance model (TAM) by Davis (1989), the most extensively tested and applied of the models, describes the process of user acceptance of technologies. TAM and DOI are complementary in that they provide antecedents to innovation adoption (Weigel, *et al*., 2014). TAM highlights the importance of perceived usefulness and ease-of-use, as well as external variables in determining the users' attitude and subsequent intention to adopt a technology. (Pearson and Grandon, 2005). Pavlou (2003) further developed an e-commerce acceptance model, drawing from the theory of TAM and incorporating the concepts of trust and risk. He argues that trust and perceived risks are significant components of the model and essential factors in predicting e-commerce adoption, given the inherent uncertainty in the online environment. Thus, the model demonstrates the key drivers for consumers' acceptance of e-commerce, integrating perceived risks and trust, along with TAM variables of perceived usefulness and ease of use, highlighting the prominence of perceived risks on consumers' adoption intentions and subsequent behavior.

1.1.1. Enablers and Inhibitors of Electronic Commerce

Kraemer, *et al*., (2002) argue that the adoption of e-commerce is affected by global environmental forces, national environment, and national policy factors. They found that the diffusion of business to consumer (B2C) e-commerce is primarily dictated by country-specific factors such as national and local environment, retail structure, and cultural factors. The adoption of B2C e-commerce at a country level is described as an evolutionary diffusion process, which is affected by several inhibiting and enabling socioeconomic and environmental factors. (Kraemer, *et al*., 2002). Research has categorized the main enabling and inhibiting factors into four categories: macroeconomic, demographic, socio-cultural, and ICT infrastructure. Specifically, they found internet user penetration, GDP, credit card penetration, and mobile penetration to be the main enabling factors for e-commerce diffusion. In contrast, no equal

distribution of income and development of traditional retailing networks were found as inhibitors. (Mangiaracina, *et al.,* 2012).

Several researchers have explored the consumers' perspective of e-commerce adoption and the different factors affecting adoption from the consumers' perspective. A great variety of products, lower prices, accessibility, and convenience all constitute as enablers for consumers to engage in internet retailing and help establish the unique characteristics of this retailing method. (Chaparro-Pelaez, *et al.,* 2016). Alqahtani, *et al*., (2012) found that internet and infrastructure, government e-readiness, trust, and perceived usefulness are amongst the factors that enable e-commerce adoption. Concerning the inhibitors, existing studies have found the lack of trust stemming from a lack of privacy and security to be one of the main obstacles to e-commerce adoption. The lack of face-to-face interaction between shoppers and retailers, inability to see and feel products, and having to share personal information increase the perception of risk and increase distrust in that shopping mode. (Alqahtani, *et al*., 2012).

1.1.2. ICT Infrastructure and Electronic Commerce

Several researches have explored ICT infrastructure effects on e-commerce diffusion. Widely available and affordable telecommunication infrastructure is found as one of the essential factors for a large-scale diffusion of internet retailing. In recent years, digital technologies have grown rapidly, and digital economies have become significant contributors to overall economic growth. (Merhi and Ahluwalia, 2017). Mangiaracina, *et al*., (2012) identified the main factors of ICT infrastructure as the amount of IT investments, internet user penetration, mobile penetration, and the presence of secure servers. They found internet usage and mobile penetration to positively affect internet retailing diffusion. Furthermore, Kraemer, *et al*., (2002) discovered that the accessibility of ICTs is likely higher in wealthy, small, and densely populated nations. Besides, the patterns of e-commerce diffusion can further be predicted and explored by looking at patterns of internet diffusion. Specifically, Feng (2015) found the effect of infrastructure - precisely the number of secure internet servers - to be a highly significant predictor of internet penetration in the world.

1.2. Risk in Electronic Commerce

The impersonal nature of the e-commerce environment and the inherent ambiguity of using it for transactions has made risk an inevitable element of e-commerce (Pavlou, 2003). In the literature, risk is defined as ‘’the trustor’s belief about the likelihood of gains or losses’’ (Sharma and Kurien, 2017, p.32). Cases (2002) explains that the most critical part regarding the acceptance of e-commerce is not the objective transaction security of the online channel but the subjective risk perception of consumers. Perceived risk is the feeling of uncertainty about engaging in a behavior. Existing literature has found perceived risks to constitute the highest barrier to the adoption and engagement in e-commerce activities (Chu and Li, 2008; Ariffin, *et al.,* 2018; Jarvenpaa and Tractinsky, 1999). Pavlou (2003) suggests that two forms of uncertainty are consistently present in the online environment: behavioral uncertainty and environmental uncertainty. He argues that the perceived risk associated with e-commerce transactions increases the perception of behavioral and environmental uncertainty, which is likely to hinder the use of e-commerce. Environmental risks are technology-driven, derived from the underlying infrastructure. Environmental risks mainly involve economic risk arising from the possibility of monetary loss and privacy risk, such as theft of credit card information and infringement of private information. Behavioral risks, on the other hand, arise from vendors behaving opportunistically by taking advantage of the impersonal online environment. Examples of behavioral risks include product misinterpretation, private information leaks, and product falsification. (Pavlou, 2003).

1.3. National Culture and Electronic Commerce Diffusion

Culture is defined as internalized beliefs, values, logic, and decision rules shared across members of society. Arising from these essential components, peoples’ behavior is a reflection of the culture in which it is embedded. (Gong, 2009). The effects of socio-cultural factors have been explored in various literature regarding the adoption of new technologies, ICTs, and the internet (Nath and Murthy, 2004; Steers, *et al.,* 2008; Erumban and Jong, 2006; Ferle, *et al*., 2002). However, the relationship between socio-cultural factors and e-commerce diffusion is rather unexplored in literature. Hofstede (2001) argues that the differences in values and attitudes affect how people interact and make use of their environment. Thus, as national culture is expected to influence the inhabitants of a country and it is a constant that rarely changes over time, cultural

dimensions might be a better predictor of cross-country variations in adoption and diffusion rates than other factors (Erumban and Jong, 2006).

Despite the global boom of e-commerce, growth has not followed the same pattern for all nations (Gong, 2009). Existing literature has found the adoption rates of ICTs across countries to diverge considerably. Technological, political, and economic factors behind these differences, such as the roles of adoption costs, level of income, and growth of the economy, have been the subject of several previous research. There is, however, evidence that diffusion rates differ significantly across countries with similar economic situations. (Erumban and Jong, 2006). Research has found a considerable disparity in adoption rates, even for developed countries (Merhi and Arhuwalia, 2017). For example, in Europe, the people aged between 16 and 74, those who purchase online range from 23% in Italy to 78% in the United Kingdom in 2017 (Statista, 2018). This disparity may be a crucial indicator, as most developed countries share similar structural and institutional characteristics and better infrastructure facilities, which inherently support e-commerce adoption. Thus, the discrepancy may lie in the meaning attributed to technologies among people based on their socio-cultural attitudes. The shared values, institutions, and political atmosphere may influence the perception of the individuals in a given culture, impacting the adoption and diffusion of e-commerce across countries. (Erumban and Jong, 2006). There is evidence that even when non-cultural factors remain stable, technology acceptance rates differ considerably across societies due to socio-cultural differences. (Nath and Murthy 2004).

An influential cultural framework that has received a great deal of recognition from scholars is that of Hofstede (2001). He defines culture as “the collective programming of the mind which distinguishes the members of one group or category of people from another’’ (Hofstede 2001, p.9). He claims that people in a given culture share a national character that shapes their mental programming. He identifies five dimensions on which cultures vary: power distance, individualism vs. collectivism, femininity vs. masculinity, long term vs. short term orientation, and uncertainty avoidance. (Hofstede 2001). The dimension at the focus of the current study is uncertainty avoidance. The relevance of uncertainty avoidance in the e-commerce context is compelling, as the current research findings show a significant effect of perceived risks on e-commerce adoption. Nath and Murthy (2004) found uncertainty avoidance to significantly affect internet diffusion. Besides, Yaveroglu and Donthu (2002) found technological innovation to be high in countries with low uncertainty avoidance. Whereas Steers, *et al*., (2008) argue that

national efforts to develop advanced technologies are related to the country's future orientation and need to avoid uncertainty.

1.3.1. Uncertainty Avoidance as a Measure of Risk

Uncertainty avoidance has been defined in the literature as "the degree to which members of a society feel uncomfortable with uncertainty and ambiguity" (Erumban and Jong, 2006, p.305). Countries high in uncertainty avoidance are characterized by high risk aversion, stricter rules, and less tolerance for opinions and behaviors different from theirs. Cultures high in uncertainty avoidance are found to be less innovative and less accepting of new things. (Nath and Murthy, 2004). Hofstede (2001) argues that people in countries high in uncertainty avoidance are generally less willing to accept personal risk than those in countries that are low in uncertainty avoidance and are likely to avoid any risky behavior. Research suggests that those in societies high in uncertainty are generally more resistant to change from existing patterns, and they tend to focus on risk avoidance and reduction. (Gong 2009). Merhi and Ahluwalia (2017) further argue that risk-taking behavior is inversely related to uncertainty avoidance.

1.3.2. Uncertainty Avoidance and Electronic Commerce

Existing literature has heavily focused on perceived risks and its effect on consumers' intentions to engage in e-commerce and found perceived risks to profoundly hinder the use of e-commerce (Pavlou, 2003; Chu and Li, 2008; Ariffin, *et al*., 2018; Jarvenpaa, *et al*., 2000). Jarvenpaa and Tractisnky (1999) noted that the unique nature of the impersonal e-commerce environment, combined with the inability to physically examine the goods, delivers few assurances for online consumers. According to existing literature, cultures high in uncertainty avoidance have higher levels of fear for the unknown and are more likely to have non-trusting, risk-averse attitudes towards e-commerce transactions given the lack of face-to-face contact. Yildrim *et al.,* (2016) suggest that uncertainty avoidance, which can be associated with risk tolerance, has an impact on e-commerce. Unknown situations, such as the identity of the seller/buyer, privacy concerns about theft or leak of personal information, and reliability of the system, all hinder e-commerce usage. The nature of the e-commerce environment and the lack of face-to-face interactions amplify the perception of risk. The risk of not receiving the correct product and breach of personal and financial information are few examples apparent in the e-commerce environment that place the buyer in a weaker position relative to the seller, therefore increasing their

perception of risks (Merhi and Ahluwalia, 2017). Yildrim *et al.,* (2016) argue that cultures that are low in uncertainty avoidance, more trusting, and less fearful of the unknown, are more likely to overcome the risks associated with e-commerce usage. These cultures are also more likely to trust online transactions, which is essential for transactions to occur.

1.4. Conceptual Model

Existing literature has found cross-country variations in the adoption and diffusion rates of technologies, assuming that this discrepancy can be attributed to socio-cultural factors. There is evidence that uncertainty avoidance, a socio-cultural dimension of risk, can contribute to this disparity. Thus, this study aims to quantify the effects of uncertainty avoidance on e-commerce diffusion and to portray the moderating effects of technology infrastructure on this relation. The following graph illustrates this relationship.

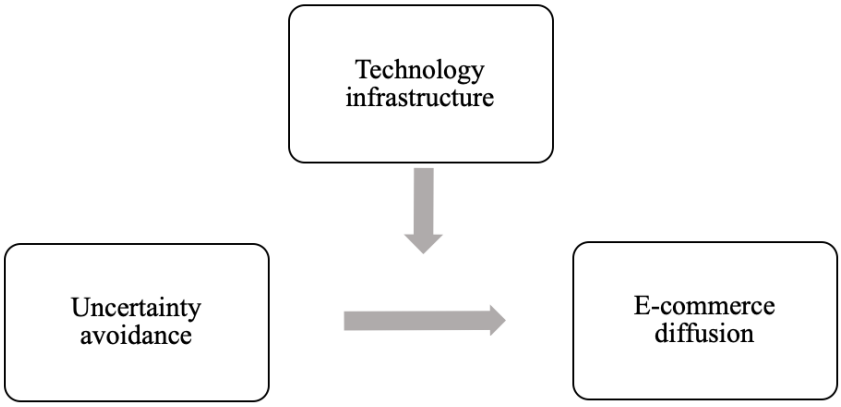

Figure 1. Conceptual Model. The relationship between uncertainty avoidance and the diffusion of e-commerce, with the moderating effect of technological infrastructure.
Source: Own elaboration

Despite the universal surge in e-commerce, global e-commerce adoption rates differ significantly across countries. Even though various technological, economic, and political factors influence the adoption of technologies, there is evidence of increased divergence in diffusion rates of e-commerce across countries with similar economic and political situations. Although the majority of current literature has focused on the adoption of technologies in general, there are indications that the adoption of e-commerce is largely influenced by socio-cultural factors, precisely the dimension of uncertainty avoidance.

The adoption of new technologies entails risk and uncertainty, as it implies adopting and applying new skills. Nevertheless, these risks are further amplified in the impersonal e-commerce environment, where risks such as not receiving the product after purchase or breach of financial and personal information are just a few of the most common perceived threats to the customer. The risks inherent to the online mode of retailing are the main inhibitors to the growth of e-commerce, and the negative effect of these perceived risks on consumer behavior in online retailing has been studied and identified in the literature. This study aims to explore the global dimension of risks. Specifically, we are interested in exploring the effect of tolerance for uncertainty across countries on e-commerce diffusion. As socio-cultural factors are firmly rooted in history and remain stable over time, socio-cultural dimensions may be better in predicting technology's adoption and diffusion rate than many other factors. Thus, we suggest that uncertainty avoidance, a cross-cultural measure of the extent that people in a given culture feel threatened by the new and unknown, has direct implications on the adoption and diffusion of new technologies, specifically e-commerce. People in cultures low in uncertainty avoidance feel more comfortable with uncertain situations and are more willing to take personal risks. Alternatively, in cultures with a high degree of uncertainty avoidance, people are generally more risk-averse, often trying to minimize ambiguity. Thus, we argue that people in cultures with low levels of uncertainty avoidance, thus more trusting and less fearful of the unknown, are more likely to overcome the risks associated with e-commerce usage. Hence, we predict:

H1: Uncertainty avoidance will be negatively associated with e-commerce diffusion.

Technological infrastructure is one of the essential facilitators for the diffusion of internet retailing. ICT infrastructure factors such as internet user penetration, mobile penetration, international internet bandwidth, and availability of secure internet servers positively impact e-commerce diffusion. Unlike the dimension of uncertainty avoidance, which is firmly rooted in history and remains quite stable over time, the degrees of ICT infrastructure vary significantly across countries and can directly be influenced by policymakers. ICT infrastructure provides a foundation for e-commerce, and is the most critical enabler for e-commerce adoption, as found in the literature. Thus, we suggest that the effect of uncertainty avoidance itself on e-commerce diffusion also differs for countries with different levels of ICT infrastructure, namely, secure internet servers. We expect that ICT infrastructure positively moderates the relationship between

uncertainty avoidance and e-commerce diffusion. More specifically, we argue that in the case of strong ICT infrastructure, the role of uncertainty avoidance on e-commerce diffusion is weakened, whereas, in countries with low technological infrastructure, the negative relationship between uncertainty avoidance and e-commerce diffusion will be amplified. Thus, we predict:

H2: Technology infrastructure will attenuate the negative relationship between uncertainty avoidance and e-commerce diffusion.

2. METHODOLOGY

The following chapter describes the data, and the overall methodological approach used to investigate the research question and test the derived hypotheses.

2.1. Data Description

Existing literature has highlighted two main approaches for cross-country analysis - those using primary data and those utilizing secondary data. Early research studies have gathered samples from various countries to perform mean and variance analysis to shed light on socio-cultural similarities and differences across nations. However, this method has received a significant amount of criticism for studying cross-cultural differences since factors other than socio-cultural, such as economic and political, may incite discrepancies in the results. (Yeniyurt and Townsend, 2003). Thus, to overcome the adverse effects of the primary data approach, this study uses secondary data. This study utilizes secondary panel data of internet retailing and uncertainty avoidance in 75 countries in the period of 2000-2009. The reason for this range of years is the unavailability of cross-country data for e-commerce retail sales beyond 2010. The primary data set on internet retailing variables was retrieved from the Euromonitor database, complemented by country-level economic and technological infrastructure variables from the open-access global development data of The World Bank (2020). Country-level data on cultural dimensions of Hofstede (2001), precisely that of uncertainty avoidance, was retrieved from the World Management Survey (2020).

Following the conceptual model, the two main variables at the focus of this study are e-commerce diffusion and uncertainty avoidance. The variable utilized to measure e-commerce diffusion is the percentage of internet retailing sales out of the total retailing sales per country and year. According to Euromonitor (2011), retailing is the sale of new and used goods to the general public for personal or household use. Retailing is the aggregate of store-based retailing and non-store retailing. Non-store retailing is composed of vending, direct selling, home shopping, and internet retailing. Internet retailing, on the other hand, is defined as the sale of goods to the general public via the Internet, with sales data attributed to the country of the purchaser, rather than the country of the retailer. Thus, the percentage of internet retail sales as a share of total retail sales reflect the growth and diffusion of e-commerce technology in a given country in a particular year. The cross-country values for uncertainty avoidance are based on the cultural framework of Hofstede (2001), where he attributed uncertainty avoidance scores for individual countries. The scores are based on a comprehensive study on the influences of culture on values based on data collected from over 100,000 individuals in more than 50 countries. The uncertainty avoidance scores run roughly from 0 to 100, and do not vary over the years, but across countries. The number of secure internet servers is utilized as a technology infrastructure variable, which is found to be a highly significant predictor of internet penetration in the world, as discussed in chapter 1.1.2. As such, it is used in recognition that it may mitigate the effects of uncertainty avoidance on the diffusion of online retailing. To avoid bias due to the emission of other relevant variables identified in the literature, four control variables are included: GDP dollars, GDP growth, urban population, and population.

2.2. Empirical Approach

The overarching aim of the study is to explore the effect of uncertainty avoidance on e-commerce diffusion across countries and to explore the moderating effect of technology infrastructure on this relationship. In order to examine the proposed hypothesis, statistical analysis is performed using a statistical software Stata. The pooled ordinary-least-squares (OLS) regression analysis is implemented. Standard errors (SEs) are clustered at the country level.

The dependent variable, the percentage of internet retailing sales, is represented by '*Internetretailing_perce',* which is the percentage of internet retailing with respect to total retailing of a country in a given year. The primary explanatory variable is

'*UncertaintyAvoidance'.* The moderating variable is '*SecureInternetServers',* representing the number of secure internet servers of a country, per 100,000 people, in a given year. It is of interest to see whether uncertainty avoidance significantly affects the diffusion of internet retailing and if the number of secure internet servers positively moderates this effect. In order to control for the economic differences between countries, the four control variables, namely *'lnGDPdollars', 'GDPgrowth', 'Urbanpopper', 'lnpopulation',* were used. The values for *'GDP growth'* and *'Urbanpopper'* are expressed in percentages. *'Urbanpopper'* is defined as the percentage of the total population in a given country living in areas specified as a city. The natural logarithm was used for the variables *'GDPdollars'* and *'population'*, as for both, the data are very rightly skewed, with the mean exceeding the median. Thus, taking the natural logarithm allows for a more normal distribution of the transformed variables.

A main baseline regression model is used to test our hypothesis. The first specification assesses the effect of our moderating variable, secure internet servers, on the percentage of internet retailing (i.e., internet retailing diffusion) while controlling for GDP dollars, GDP growth, urban population, and population. The second specification additionally includes the explanatory variable uncertainty avoidance. Finally, the full model reported in specification three includes an interaction term, assessing the marginal combined effect of uncertainty avoidance and secure internet servers on internet retailing percentage, while still controlling for the macroeconomic variables. The main model is derived from our hypotheses, suggesting that the availability of secure internet servers moderates the negative relationship between uncertainty avoidance and internet retailing diffusion. The three-specification approach allows to estimate the effect of both the explanatory and moderating variable on the percentage of internet retailing and describe their interaction effect when combined. Two robustness checks complement the analysis. The first one using the natural logarithm of internet retail sales per capita as a dependent variable *(lnInternetRetailing)*, and the second lagging all independent variables by one year, while keeping the dependent variable the same as in the main model.

3. RESULTS

The following chapter highlights the results of the data analysis and demonstrates the descriptive statistics and correlations. The main regression model, along with additional analyses, is exhibited.

3.1. Descriptive Statistics and Correlations

The descriptive statistics in Table 1, and the correlation matrix exhibited in Table 2 provide a summary of all the variables used in the analysis of this study. The mean, standard deviation (Stand.Dev), minimum and maximum give us an overview of the range of all the variables and the level of dispersion of these variables across all the countries in the given time. The correlation matrix exhibits the interrelationship between all the variables. 437 observations were noted for all the variables, for the 75 countries included in this study.

Table 1 demonstrates that the dependent variable '*Internetretailing_perce'* has a minimum of 0 and a maximum of 0.10, with a standard deviation of 0.02 and a mean of 0.01. This reveals that the relative percentage of internet retailing sales out of the total retailing sales were between 0 and 10% for all the considered countries, in the years 2000-2009. The independent variable '*UncertaintyAvoidance'* has a minimum of 0.08 and a maximum of 1.12 with a standard deviation of 0.23. The disparity of this variable can be better seen when transformed into its actual values. Transforming the values to the actual values in hundreds, we find the minimum to be 8 and the maximum to be 112, with a mean of 67.38. This reveals a significant variation in uncertainty avoidance across countries. A high value for '*UncertaintyAvoidance'* means that the people in the given country are generally more fearful of the unknown and less likely to undergo risk. The moderating variable '*SecureInternetServers',* measured as the number of secure internet servers per hundred thousand people in a given country, has a mean of 0.08, standard deviation of 0.36, the minimum is 0 and the maximum is 3.79. This suggests that the number of secure servers varies considerably among countries.

Variables	Observations	Mean	Std.Dev.	Minimum	Maximum
Internetretailing_perce	437	0.01	0.02	0.00	0.10
UncertaintyAvoidance	437	0.67	0.23	0.08	1.12
SecureInternetServers	437	0.08	0.36	0.00	3.79
lnGDPdollars	437	26.23	1.54	22.55	30.32
GDPgrowth	437	3.26	4.08	-17.95	18.29
Urbanpopper	437	72.19	15.52	28.90	100.00
lnpopulation	437	16.79	1.52	14.10	21.01

Table 1. Descriptive Statistics
Source: Own Elaboration

Descriptive statistics for the control variables *'lnGDPdollars', 'GDPgrowth', 'Urbanpopper',* and *'lnpopulation'* are also provided in Table 1. The variables *'lnGDPdollars'* and *'lnpopulation'* are natural logarithms of the variables *'GDPdollars'* and *'population'*. The values for *'GDPgrowth'* and *'Urbanpopper'* are expressed in percentages. We find a very significant standard deviation (15.52) for the variable urban population (*'Urbanpopper'),* with a mean of 72, minimum of 28.9, and maximum of 100. This shows that the share of total population living in cities varies considerably among nations.

Table 2 presents the correlation matrix. The results demonstrate a negative correlation (r=-0.20) between the independent variable '*UncertaintyAvoidance'* and the dependent variable '*Internetretailing_perce'*. This value is also extremely significant *(p<0.001),* which provides considerable evidence that a significant negative relationship exists between these two variables, as hypothesized. It can also be seen that a positive relationship (r=0.26) exists between the moderating variable '*SecureInternetServers'* and the dependent variable '*Internetretailing_perce'*. This value is also very significant *(p<0.001)*, which suggests a positive relationship between these two variables. A positive correlation (r=0.44) also exists between *'lnGDPdollars'* and '*SecureInternetServers'*. This suggests that the number of secure internet servers is higher for nations with higher GDP, as discussed in 1.1.2. It can also be noted that the highest positive correlation coefficient (r=0.72) exists for the variables *'lnGDPdollars'* and *'lnpopulation',* which again is highly significant *(p<0.001).* A high correlation, as such, may indicate issues of multicollinearity. However, as both of the collinear variables are only used as control variables, and such a high correlation does not occur with any of the other variables, the performance of the control variables as controls should not be affected, and multicollinearity

should not be an issue. Nevertheless, a way to ensure that multicollinearity will not negatively affect the regression model is to compute the variance inflation factor (VIF) for each variable. VIF measures how the variance of the regression coefficient is inflated by its correlation with the other variables. As a rule of thumb, if the VIF of an explanatory variable exceeds 10, it is considered to be highly collinear and should be excluded from the regression. In our analysis, none of the variables revealed a VIF that exceeded 3.7. Thus, multicollinearity issues are rejected.

Variables	**Internetretailing _perce**	**Uncertainty Avoidance**	**SecureInternet Servers**	**lnGDP dollars**	**GDP growth**	**Urban popper**	**lnpopulation**
InternetRetailing	1.00						
UncertaintyAvoidance	-0.20***	1.00					
SecureInternetServers	0.26***	-0.13**	1.00				
lnGDPdollars	0.23***	-0.16***	0.44***	1.00			
GDPgrowth	-0.23***	-0.08**	-0.12**	-0.15***	1.00		
Urbanpopper	0.26***	-0.04	0.12***	0.18***	-0.17***	1.00	
lnpopulation	-0.16***	-0.03*	0.28***	0.72***	0.11***	-0.26***	1.00

****p < 0.001, **p < 0.01 *p < 0.05*

Table 2. Correlation Matrix

Source: Own elaboration

3.2. Regression Results

The results of the main regression analysis are demonstrated in Table 3. All three specifications are statistically significant *(p<0.001 for F test)* and include 437 observations from 75 countries. A pooled OLS regression estimator is used as the most appropriate method of analysis, as the independent variable '*UncertaintyAvoidance'* does not vary over time for a given country.

VARIABLES	(1) Internetretailing_perce	(2) Internetretailing_perce	(3) Internetretailing_perce
UncertaintyAvoidance		-0.007**	-0.011***
		(0.000)	(0.000)
SecureInternetServers	0.007***	0.007***	-0.044*
	(0.001)	(0.001)	(0.023)
UncertaintyAvoidance#Secure InternetServers			0.111*
			(0.000)
lnGDPdollars	0.007***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)
GDPgrowth	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Urbanpopper	-0.000†	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)
lnpopulation	-0.007***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)
Constant	-0.040***	-0.030*	-0.009
	(0.012)	(0.014)	(0.015)
Observations	437	437	437
R-squared	0.298	0.309	0.344

Notes: Analysis is at the country-year level. Robust standard errors in parentheses (clustered at the country level)
*** p<0.001, ** p<0.01, * p<0.05, † p<0.10

Table 3. Pooled OLS regression results for e-commerce diffusion (% of Internet retail sales)
Source: Own elaboration

Specification (1) indicates the effect of the moderating variable '*SecureInternetServers'* on the dependent variable '*Internetretailing_perce'*. The value of the R squared for the first model is 0.30, meaning that 30% of the variation in '*Internetretailing_perce'* is explained by '*SecureInternetServers'* and the four control variables. Consistent with literature findings on secure internet servers as one of the essential enablers for the diffusion of internet retailing, the results indicate a positive relationship between '*SecureInternetServers'* and '*Internetretailing_perce' (β=0.007, p<0.001).* This denotes that a one unit increase in secure internet servers is expected to result in a 0.7% increase in the percentage of internet retailing. Specification (2) estimates a regression model with the independent variable '*UncertaintyAvoidance'* included. Specification (2) reveals that the independent variable '*UncertaintyAvoidance'* is significant and has a negative relationship with '*Internetretailing_perce' (β=-0.007, p<0.01).* Thus, Hypothesis 1 is supported by the results. This finding indicates that a one unit increase in '*UncertaintyAvoidance'* is associated with a

0.7% decrease in '*Internetretailing_perce'*. We find that the positive relationship between '*SecureInternetServers'* and '*Internetretailing_perce'* remains (*β=0.007, p<0.001).*

Finally, the full model is represented in specification (3), and it tests the moderating effect of '*SecureInternetServers'* on the main relationship between '*UncertaintyAvoidance'* and '*Internetretailing_perce',* explained by Hypothesis 2. Specification (3) estimates the following regression equation, x denoting the respective country, y representing the year. (x=1,…,75) and (y=0,…,9).

$$Internetretailing\_perce_{(x,\,y)} = -0.009 - 0.011*UncertaintyAvoidance_{x,y} - 0.044*SecureInternetServers_{x,y} + 0.111*UncertaintyAvoidance*SecureInternetServers_{x,y} + 0.006*lnGDPdollars_{x,y} - 0.000*GDPgrowth_{x,y} - 0.000*Urbanpopper_{x,y} - 0.007*lnpopulation_{x,y}$$

Results of specification (3) reveal that a significant and negative relationship between uncertainty avoidance and the percentage of internet retailing remains *(β=-0.011, p<0.001).* The interaction effect between '*UncertaintyAvoidance'* and '*SecureInternetServers'* reveals to be positive and significant *(β=0.111, p<0.05)*, indicating that '*SecureInternetServers'* attenuate the negative effect between '*UncertaintyAvoidance'* and '*Internetretailing_perce'.* Thus, Hypothesis 2 is supported by the results. This suggests that the effect of uncertainty avoidance on e-commerce diffusion varies for countries with different degrees of secure internet servers. The negative coefficient of the main interaction *(β=-0.011, p<0.001)* indicates that the effect of uncertainty avoidance on e-commerce diffusion is weaker for countries with higher amounts of secure internet servers. The higher the number of secure internet servers, the weaker the negative effect of uncertainty avoidance on e-commerce diffusion. Looking at the control variables, *'lnGDPdollars' and 'lnpopulation'* are highly significant in all three models *(p<0.001),* with *'lnGDPdollars'* having a positive effect on the dependent variable, while *'lnpopulation'* has a negative effect. This indicates that one unit of increase in *'lnGDPdollars'* for a given country in a certain year, results in 0.6% of increase in '*Internetretailing_perce'.*

In conclusion, the regression results provide evidence in support of both of our hypotheses. The second specification provides significant evidence in support of Hypothesis 1. According to our findings, uncertainty avoidance has a significant negative effect on e-commerce diffusion. The findings of the main model (specification 3) provide evidence in support of Hypothesis 2, by

providing significant indication regarding the moderation effects of technological infrastructure on diffusion of technology. The results show that the negative effect of uncertainty avoidance on e-commerce diffusion is attenuated by the technological infrastructure (i.e., secure internet servers). These results indicate that while uncertainty avoidance has a negative effect on e-commerce diffusion, the effect is weaker with strong technological infrastructure in place.

3.3. Additional Analyses

Two alternative specifications are made to the main regression model in order to check the robustness of the findings. The overview of the results of the robustness checks is found in Table 4 and Table 5. In Table 4, we examine the robustness of our findings on a different dependent variable. The traditional measure of technology diffusion, as described in the literature and used in the main model, is the percentage of internet retailing sales as a share of total retailing sales. Consumer spending on ICT per capita has also been used as a measure of technology diffusion in a few studies. (Merhli and Ahluwalia, 2017). Therefore, the natural logarithm of internet retailing sales '*lnInternetRetailing'* is used as an alternative dependent variable. '*lnInternetRetailing'* is defined as the internet retail sales per capita, in a particular country in a given year. It is of interest to examine whether the effect of '*UncertaintyAvoidance'* on e-commerce diffusion remains when changing the measure of e-commerce diffusion.

VARIABLES	(1) lnInternetRetailing	(2) lnInternetRetailing	(3) lnInternetRetailing
UncertaintyAvoidance		-0.494***	-0.729***
		(0.135)	(0.140)
SecureInternetServers	0.371***	0.348***	-2.622***
	(0.071)	(0.071)	(0.588)
UncertaintyAvoidance#SecureInternet Servers			6.435***
			(1.313)
lnGDPdollars	1.478***	1.447***	1.402***
	(0.040)	(0.041)	(0.042)
GDPgrowth	-0.005	-0.010	-0.007
	(0.010)	(0.010)	(0.010)
Urbanpopper	-0.015***	-0.014***	-0.015***
	(0.002)	(0.002)	(0.002)
lnpopulation	-1.495***	-1.469***	-1.464***
	(0.042)	(0.042)	(0.042)
Constant	-9.400***	-8.723***	-7.474***
	(0.728)	(0.786)	(0.833)
Observations	437	437	437
R-squared	0.830	0.833	0.843

Notes: Analysis is at the country-year level. Robust standard errors in parentheses (clustered at the country level)
*** p<0.001, ** p<0.01, * p<0.05, † p<0.10

Table 4. Robustness check: Logged Internet retail sales per capita as dependent variable
Source: Own elaboration

The results of specification (3) in Table 4 indicate a value of R squared of 0.843. This means that 84.3 percent of the variation in '*lnInternetRetailing'* is explained by the other variables, which is significantly higher than the value in our main regressions. Specification (1) in Table 4 shows a highly significant and positive relationship between '*SecureInternetServers'* and '*lnInternetRetailing' (β=0.371, p<0.001),* thus remaining consistent with the results of our main model in Table 3. Additionally, results of specification (2) in Table 4 reveal a highly significant and negative relationship between '*UncertaintyAvoidance'* and '*lnInternetRetailing' (β=-0.494, p<0.001),* further supporting Hypothesis 1, and our present findings in Table 3. This finding indicates that a one unit increase in uncertainty avoidance results in 49% decrease in the per capita internet retail sales. The interaction term '*UncertaintyAvoidance*SecureInternetServers'* in Model (3) Table 4, is positive and highly significant *(β=6.435, p<0.001).* Thus, this result provides support for Hypothesis 2.

Table 5 provides the results for the second robustness test. '*Internetretailing_perce'* is used as a dependent variable as in the main model, but all independent variables are lagged by one year. The R squared for specification (3) in Table 5 is 0.329, and the number of observations is 382, which is lower than in the main model.

VARIABLES	(1) F.Internetretailing_ perce	(2) F.Internetretailing_ perce	(3) F.Internetretailing_ perce
UncertaintyAvoidance		-0.007*	-0.010***
		(0.003)	(0.003)
SecureInternetServers	0.008***	0.007***	-0.034
	(0.001)	(0.001)	(0.024)
UncertaintyAvoidance#SecureInternet Servers			0.089†
			(0.052)
lnGDPdollars	0.008***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)
GDPgrowth	0.000†	0.000	0.000
	(0.000)	(0.000)	(0.000)
Urbanpopper	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
lnpopulation	-0.008***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)
Constant	-0.054***	-0.043**	-0.028
	(0.014)	(0.016)	(0.017)
Observations	382	382	382
R-squared	0.304	0.313	0.329

Notes: Analysis is at the country-year level. Robust standard errors in parentheses (clustered at the country level)
*** p<0.001, ** p<0.01, * p<0.05, † p<0.10

Table 5. Robustness check: Lagging all independent variables by 1 year
Source: Own elaboration

The results in Table 5 specification (1) show a positive and highly significant relationship between our moderating variable '*SecureInternetServers'* and '*Internetretailing_perce'* (*β=0.008, p<0.001).* Results of specification (2) in Table 5 demonstrate a negative and significant relationship between '*UncertaintyAvoidance'* and '*Internetretailing_perce'* (*β=-0.007, p<0.05),* providing support for Hypothesis 1. Thus, by lagging independent variables by one year, we find that a one unit increase in uncertainty avoidance results in a 0.7% decrease in '*Internetretailing_perce'.* The interaction term in specification (3) Table 5 is significant and

positive ($\beta=0.089$, $p<0.10$), suggesting that secure internet servers attenuate the negative effect of uncertainty avoidance on e-commerce diffusion. Thus, the results provide support for Hypothesis 2. Overall, our results remain robust to both of the two specifications made and consistent with those reported in the main model in Table 3. The results of the robustness checks provide support for both of our hypotheses.

CONCLUSION

The last decades have witnessed a surge in internet retailing around the globe, attracting a substantial amount of attention in research as to the determinants and consequences for this phenomenon. Nonetheless, the growth rates of e-commerce throughout the world have been far from uniform. Research has examined the determinants of technology and e-commerce adoption and subsequent diffusion. Political, economic, and national policy factors have been identified as the primary factors driving the diffusion of technologies. However, there is a lack of empirical evidence to support the findings that the diffusion of internet retailing is solely an economic phenomenon, as diffusion rates of e-commerce diverge considerably across nations otherwise similar in economic and political conditions. This suggests that prevailing social conditions may be attributed to the discrepancies in e-commerce growth rates across countries.

The vast amount of e-commerce research has found perceived risks to be the primary inhibitor to the adoption and growth of e-commerce from the consumers' perspective. However, few studies have focused on the concept of perceived risks on a global cross-country dimension. Uncertainty avoidance is society's tolerance for ambiguity, and its negative influence on technology diffusion has been illustrated in the literature. Nevertheless, the effect of uncertainty avoidance on the diffusion of e-commerce, specifically, remains rather unexplored.

In line with this reasoning, the purpose of this study is to understand the effect of perceived risks on e-commerce diffusion across countries, on a macro level. Thus, the dimension of uncertainty avoidance will be studied explicitly, as a global cross-country variable of risk. This study suggests that uncertainty avoidance negatively influences e-commerce diffusion. However, the expectation is that this negative effect is attenuated by technology infrastructure, specifically the availability of secure internet servers.

To test the hypotheses and provide an answer to the research question, what is the effect of uncertainty avoidance on e-commerce diffusion and what role does technology infrastructure play, this study performed a cross-country analysis. Secondary data, in the form of a panel data on internet retailing and uncertainty avoidance in 75 countries over the years 2000-2009 were analyzed. The pooled OLS regressions were implemented as the primary tool for analyses. Four control variables were implemented into the regression analyses in order to control for country-level characteristics. Additionally, in order to test the results of the primary analysis, two robustness checks were carried out.

Both of the hypotheses found strong support in the results. The results indicate a significant negative relationship between uncertainty avoidance and e-commerce diffusion. The results also confirm the positive moderating effect of technology infrastructure (i.e., secure internet servers) on the negative relationship between uncertainty avoidance and e-commerce diffusion. Our analyses indicate that countries with higher uncertainty avoidance levels tend to show lower e-commerce diffusion rates than those with low levels of uncertainty avoidance. The results also demonstrate that the higher the number of secure internet servers, the weaker the negative effect of uncertainty avoidance on the diffusion of online retailing. These results are consistent to a great extent with previous research, where a significant relationship between uncertainty avoidance and diffusion of technologies was found.

This study contributes to and extends prior literature in two main aspects. First, it expands on the findings of existing literature on perceived risks as the highest barrier to the adoption of e-commerce, broadening it to a global cross-country dimension. Second, it extends the findings of prior studies on socio-cultural factors, precisely uncertainty avoidance, and cross-country differences in ICT adoption by focusing on the diffusion of e-commerce, specifically. Overall, the findings of this study complement existing e-commerce research on perceived risks and contribute to the existing literature on the determinants of technology adoption by highlighting the importance of socio-cultural factors in the adoption and diffusion of online retailing.

Our results reiterate that adoption and diffusion of e-commerce are not just economic phenomena, and that socio-cultural differences can be a barrier to e-commerce adoption. The results provide significant practical implications for firms and countries as they develop approaches to promote e-commerce. The introduction of new technologies is a complex decision for managers, and socio-cultural differences add a compelling degree of complexity and perceived uncertainty to

the international business environment. Therefore, managers must consider and understand the relevance of perceived risks and socio-cultural settings of a specific country regarding the acceptance of e-commerce. Knowing that countries higher in uncertainty avoidance will be more reluctant to adopt e-commerce allows managers to estimate the adoption rates of different markets and allow for better forecasts and demand projections. Our results suggest that managers should first target countries with lower levels of uncertainty avoidance and countries with high levels of ICT infrastructure, as high levels of ICT infrastructure allow overcoming the adverse effects even in the case of high uncertainty avoidance.

The findings also offer important implications for policymakers, as their decisions can have an enormous impact on the development of e-commerce in their respective country. For instance, in countries with high uncertainty avoidance levels where people are reluctant to engage in online retailing, focusing on setting up reliable ICT infrastructure can be crucial to the success of online retailing. The growth of e-commerce is expected to increase national online retail sales, and have a subsequent positive impact on economic growth, as online retailing makes up a substantial part of the economy.

While this research expands existing research, there are a few limitations to our study. First, the main limitation lies in data availability. Due to data availability constraints for online retailing sales, only the years 2000-2009 were analyzed for this study, with 75 countries used in the sample. Usage of more recent years and a more extensive data set would allow for more robust and up-to-date findings. Second, although the focus of the study was only on one socio-cultural dimension, namely uncertainty avoidance, we acknowledge that more dimensions exist, with potential influence in e-commerce diffusion. That being said, future research should consider the evolution of online retailing beyond the years 2010. Additional research should also shed light on the broader examination of socio-cultural dimensions on e-commerce diffusion, taking into account other dimensions besides uncertainty avoidance. Another suggestion would be to develop a more comprehensive model of determinants of cross-country e-commerce diffusion, including political, economic, and demographic factors, together with socio-cultural dimensions, to further differentiate the effect and significance of specific variables.

REFERENCES

Al-Jabri, I.M. and Sohail, M.S. (2012). Mobile Banking Adoption: Application of Diffusion of Innovation Theory. *Journal of Electronic Commerce Research*, 13 (4), pp. 379-391.

Alqahtani, M.M., Al-Badi, A.H., Mayhew, P. (2012). The enablers and disablers of e-commerce: consumers' perspective. The Journal of Information Systems in Developing Countries, 54 (1), pp. 1-25.

Ariffin, S.K., Mohan, T., Goh, Y.N. (2018). Influence of Consumers' Perceived Risk on Consumers' Online Purchase Intention. *Journal of Research in Interactive Marketing*, 12 (3), pp. 309-327.

Cases, A.S. (2002). Perceived Risk and Risk-Reduction Strategies in Internet Shopping. *The International Review of Retail, Distribution, and Consumer Research,* 12 (4), pp. 375-394.

Chaparro-Pelaez, J., Agudo-Peregrina, A.F., Pascual-Miguel, F.J. (2016). Conjoint analysis of drivers and inhibitors of e-commerce adoption. *Journal of Business Research*, 69 (4), pp. 1277-1282.

Cheng, F.F., Liu, T.Y., Wu, C.S. (2013). Perceived Risks and Risk Reduction Strategies in Online Group Buying. *Diversity, Technology, and Innovation for Operational Competitiveness: Proceedings of the 2013 International Conference on Technology Innovation and Industrial Management,* pp. 18-25.

Chu, K.K. and Li, C.H. (2008). A Study of the Effect of Risk-Reduction Strategies on Purchase Intentions in Online Shopping. *International Journal of Electronic Business Management,* 6 (4), pp. 213-226.

Comin, D. and Mestieri, M. (2014). Chapter 2 – Technology Diffusion: Measurement, Causes and Consequences. *Handbook of Economic Growth,* 2, pp. 565-622.

Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *Management Information Systems Research Center,* 13 (3), pp. 319-340.

Doolin, B., Dillon, S., Thompson, F., Corner, J.L. (2005). Perceived Risk, the Internet Shopping Experience and Online Purchasing Behavior: A New Zealand Perspective. *Journal of Global Information Management,* 13 (2), pp. 66-88.

Erumban, A.A., Jong, S.B. (2006). Cross-country differences in ICT adoption: A consequence of Culture? *Journal of World Business*, 41 (4), pp. 302-314.

Euromonitor, 2011. Euromonitor International. [Online] Available at: http://www.euromonitor.com/

Statista. (2018). Share of e-commerce users in the European Union from 2009 to 2017, by country. *Statista*. Available at: https://www-statista-com.sare.upf.edu/statistics/435893/e-commerce-usage-rate-by-country-eu/ [Accessed: 14 April. 2020]

Feng, G.C. (2015). Determinants of Internet diffusion: A focus on China. *Technological Forecasting and Social Change*, 100, pp. 176-185.

Ferle, C., Edwards, S.M., Mizuno, Y. (2002). Internet diffusion in Japan. Cultural Considerations. *Journal of Advertising Research*, 42 (2), pp. 65-79.

Gong, W. (2009). National culture and global diffusion of business-to-consumer e-commerce. *Cross Cultural Management: An International Journal*, 16 (1), pp. 83-101.

Hofstede, G. (2001). Culture's consequences: comparing values, behaviors, institutions and organizations across nations. 2nd ed. Thousand Oaks, CA: Sage.

Jarvenpaa, S.L., Tractinsky, N., Saarinen, L. (1999). Consumer Trust in an Internet Store: A Cross-Cultural Validation. *Journal of Computer-Mediated Communication*, 5 (2).

Jarvenpaa, S.L., Tractinsky, N., Vitale, M. (2000). Consumer trust in an Internet store. *Information Technology and Management*, 1 (1-2), pp. 45-71.

Kraemer, K., Gibbs, J., Dedrick, J. (2002). Environment and Policy Factors Shaping E-Commerce Diffusion: A Cross- Country Comparison. *ICIS Proceedings*, 30, pp. 325-335.

LaMorte, W.W. (2019). Diffusion of Innovation Theory. [online] p. 4. Available at: http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html [Accessed 1 Apr. 2020].

Lin, H.F. and Lin, S.M. (2008). Determinants of e-business diffusion: A test of the technology diffusion perspective. *Technovation*, 28 (3), pp. 135-145

Mangiaracina, R., Perego, A., Campari, F. (2012). Factors Influencing B2C eCommerce Diffusion. *International Journal of Economics and Management Engineering*, 6 (5), pp. 844-852.

Merhi, M. and Ahluwalia, P. (2017). Influence of Safety Nets, Uncertainty Avoidance, and Governments on E-commerce Adoption: A Country-Level Analysis. *International Journal of Applied Business and Economic Research,* 15 (2), pp. 397-408.

Nath, R. and Murthy, N.R.V. (2004). A study on the relationship between internet diffusion and culture. *Journal of International Technology and Information Management*, 13 (1), pp. 123-132.

Pavlou, P.A. (2003). Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model. *International Journal of Electronic Commerce,* 7 (3), pp. 101-134.

Pearson, J.M. and Grandon, E.E. (2005). An Empirical Study of Factors that Influence E-commerce Adoption/Non-Adoption in Small and Medium Sized Businesses. *Journal of Internet Commerce*, 4 (4), pp. 2-25.

Rogers, E.M. (2003). Diffusion of innovations. 5th ed. New York: Free Press.

Sharma, J.K. and Kurien, D. (2017). Perceived Risk in E-commerce: A Demographic Perspective. *NMIMS Management Review*, 34 (1), pp. 31-57.

Steers, R., Meyer, A.D., Sanchez-Runde, C. (2008). National culture and the adoption of new technologies. *Journal of World Business*, 43 (3), pp. 255-260.

The World Bank, 2020. World Bank Open Data. [Online] Available at: https://data.worldbank.org

Weigel, F.K., Haze, B.T., Cegielski, C.G., Hall, D.J. (2014). Diffusion of Innovations and the Theory of Planned Behavior in Information Systems Research: A Metaanalysis. *Communications of the Association for the Information Systems,* 34 (31), pp. 619-635.

World Management Survey, 2020. [Online] Available at: https://worldmanagementsurvey.org.

Yaveroglu, I.S. and Donthu, N. (2002). Cultural Influences on the Diffusion of New Products. *Journal of International Consumer Marketing,* 14 (4), pp. 49-63.

Yeniyurt, S. and Townsend, J.D. (2003). Does culture explain acceptance of new products in a country? An empirical investigation. *International Marketing Review*, 20 (4), pp. 377-396.

Yildrim, E., Arslan, Y., Barutcu, M.T. (2016). The role of uncertainty avoidance and indulgence as cultural dimensions on online shopping expenditure. *Eurasian Business & Economics Journal,* 4, pp. 42-51.

List of Figures

List of Tables