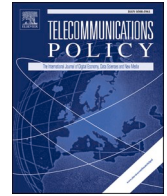




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# Telecommunications Policy

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## Drivers of and barriers to e-commerce adoption in Indonesia: Individuals' perspectives and the implications

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### ABSTRACT

This study aims to investigate the underlying factors affecting Indonesian individuals' decision to make online purchases. Primary data were collected through a nationwide survey in 2019 covering all 34 Indonesian provinces. Secondary data regarding Indonesian villages' potential (PODES) are utilized to provide information about the availability of infrastructure at the village level. The standard utility/net gain maximization framework is adopted, and a binary logistic regression model is employed. A total of 8854 useable samples are analyzed. The results suggest that the probability of using e-commerce to make online purchases increases if an individual is male, young, married, highly educated, and an entrepreneur, as well as has access to the Internet, can easily find logistic and financial services, has sufficient digital skills, and has not been exposed to harmful content. These results produce several findings: the relative advantages of e-commerce over traditional commerce and the compatibility of e-commerce with individuals' needs and values can drive its adoption; digital skills and the ubiquitous related infrastructures are an essential requirements to expand e-commerce diffusion; exposure to harmful content is empirically discovered to be a barrier to e-commerce adoption. These findings lead the authors to provide recommendations to promote more inclusive e-commerce adoption and optimize the e-commerce sector's contribution to the national economy.

### 1. Introduction

Digital technology continues to evolve at an accelerated pace as it permeates broader areas of the economy and society. It recasts the relationship between buyers and sellers, workers and employers, governments and citizens, and among people in their social life. In a broader context, digital technology is also believed to be an important catalyst for sustainable national and global economic growth. Countries must be on a fast learning curve to sustainably keep up with this technological development and reap the potential benefits. Developing countries, in particular, face more challenges because they lag behind developed countries in almost all of the fundamental

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attributes required to stimulate digital economic development (Gonzalez et al., 2017; Hanna, 2016). Although these countries could learn from more developed countries that have made a successful digital transformation, it is essential to discover their own national best practices. One of the challenges to overcome in unlocking the digital economy potential is advocating the acceptance and adoption of digital innovation (Gonzalez et al., 2017; Mühleisen, 2018). Thus, understanding the driving and inhibiting factors in the decision to embrace digital innovation is crucial to drafting a more targeted adoption policy. Against this background, this study seeks to shed light on the underlying factors affecting digital innovation adoption, particularly individuals' adoption of e-commerce, the sector estimated to contribute the most to the digital economy.

This study focuses on Indonesia, a developing country located in Southeast Asia. Indonesia is expected to become the largest digital economy market in this region (Google, Temasek, Bain and Company, 2020b). In 2019, Indonesia's digital economy was estimated to have grown five-fold since 2015 and was expected to continue its rapid growth, reaching 124 billion USD by 2025 (Google, Temasek, Bain and Company, 2020a). Among sectors included in the estimation, electronic-based commerce (e-commerce) is the most significant sector, accounting for about 50% of Indonesia's 2019 digital economy. This sector's contribution is expected to grow to more than 60% by 2025 (Google et al., 2020b). Unfortunately, Indonesia's e-commerce transaction value in 2019 was only 3% of Indonesia's retail transactions, much lower than the average in Asia-Pacific countries (PPRO, 2020). These conditions make Indonesia a very interesting country to focus on in this study.

This study aims to examine the underlying factors of individuals' e-commerce adoption to make online purchases. It is widely recognized that buyers utilize e-commerce to save money and time (Punj, 2012). In traditional commerce, buyers must spend a considerable amount of time and effort checking prices at various physical stores to find the lowest price, but this is not the case in e-commerce. With e-commerce, buyers can easily find the lowest price for a product because they have access to freely available product and price information. E-commerce also enables buyers to make purchases anywhere at any time. Garín-Muñoz et al. (2019), Guzzo et al. (2016), (Pérez-Amaral et al. (2020)), and (Valarezo et al. (2018)) examined e-commerce adoption from individual buyers' perspectives, but in developed countries. As Gonzalez et al. (2017) claim, there are inequalities between developed and developing countries in nearly all-the important attributes required to stimulate digital economic development. Thus, it is worth validating previous studies' findings in the context of a developing country. Furthermore, this study is expected to complement previous research, which has primarily used the technology acceptance model (TAM), its extension, and other similar models (Ardiansah et al., 2020; Datta, 2011; Mainardes et al., 2020; Md Johar and Awalluddin, 2011; Peng & Ku-Ho, 2019; Tarhini et al., 2019). According to Baaren et al. (2011), the TAM has limited scope, as it cannot be used to understand the complete process of technology adoption. Furthermore, Li (2014) suggests that diffusion or econometric model is more suitable for examining the adoption of innovation if the adoption is voluntary, such as in e-commerce adoption. In the Indonesian context, this study expands previous studies by Lestari (2019) and Piarna and Fathurohman (2020), which only captured e-commerce adoption among a specific age range of respondents in a limited geographic area, limiting the extrapolation of their findings to the whole population. This present study seeks to fill these gaps by applying a diffusion or econometric model to investigate individuals' adoption of e-commerce and utilizing nationwide survey data collected from respondents with a broader range of characteristics.

The remainder of this paper is organized as follows. The next section provides an overview of e-commerce in Indonesia, followed by a description of the theoretical framework and previous relevant empirical research. Subsequent sections describe the research method used in this study, present the results, and discuss the findings and implications, as well as the conclusions.

## 2. An overview of e-commerce in Indonesia

### 2.1. Population and economy

Indonesia is the largest archipelago in the world, consisting of more than 17,000 islands stretching between the Indian and Pacific

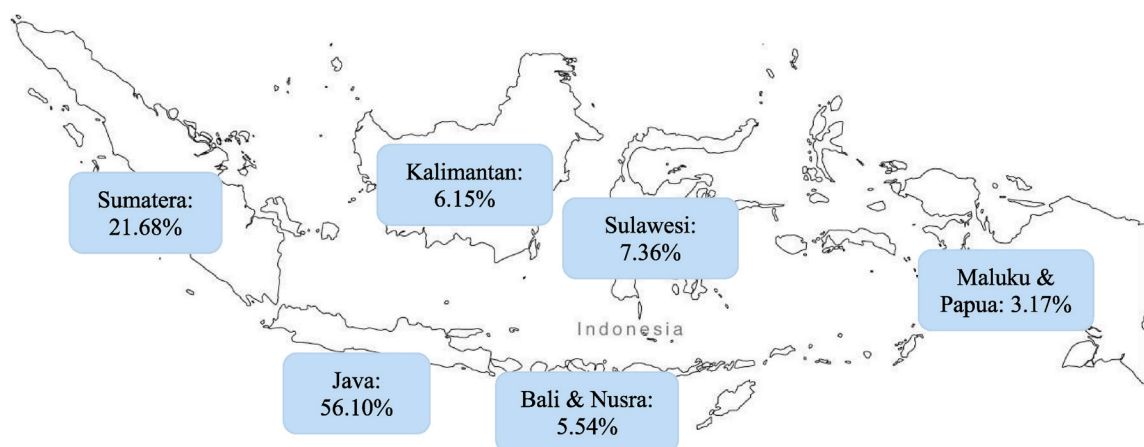


Fig. 1. Indonesian population distribution based on the 2020 population census (BPS, 2021).

Oceans (World Bank, 2019). It is the fourth most populous country, home to more than 270 million people (BPS, 2021). Fig. 1 shows the population distribution based on the 2020 population census in six island clusters: Java, Bali & Nusra, Sumatera, Kalimantan, Sulawesi, and Maluku & Papua. Java is the most densely populated and the most developed island in Indonesia. It is also where Indonesia's capital city, DKI Jakarta, is located.

Furthermore, Indonesia is the largest economy among the Association of Southeast Asian Nations (ASEAN) member countries (World Bank, 2020a). Except for 2020, it has experienced annual economic growth rates of at least 5% over the past five years (World Bank, 2020b). The Indonesian people are well recognized for their enthusiasm for embracing digital technology. According to a report by We Are Social and Hootsuite (2020), at the beginning of 2020, Indonesia had 175.4 million Internet users, representing 64% of the total Indonesian population. However, this adoption rate is 2% lower than the average adoption rate in Southeast Asia (SEA). The report also states that in 2020, Indonesia had approximately 160 million social media users and about 338.2 million mobile-connected devices. Additionally, Indonesia's population is characterized as having middle level education attainment, and the country has a low level of technological innovation. Thus, it is unsurprising that Indonesia tends to be a market for technologically advanced countries (Suryanegara, 2020). However, the advantages and convenience of e-commerce are expected to drive more Indonesian to engage in e-commerce for both shopping and earning an income.

## 2.2. Online marketplace development

The establishment of Dyviacom Intrabumi (D-Net) in 1996 was a milestone in Indonesia's e-commerce development. A few years later, several online marketplaces were launched, such as Bhinneka ([bhinneka.com](http://bhinneka.com)), Jakartanotebook ([jakartanotebook.com](http://jakartanotebook.com)), Tokopedia ([Tokopedia.com](http://Tokopedia.com)), Bukalapak ([bukalapak.com](http://bukalapak.com)), Blibli ([blibli.com](http://blibli.com)), Lazada ([lazada.co.id](http://lazada.co.id)), Orami ([orami.go.id](http://orami.go.id)), Ralali ([ralali.com](http://ralali.com)), JD ID ([jd.id](http://jd.id)), and Shopee ([shopee.co.id](http://shopee.co.id)). Most of these online marketplaces have adopted business-to-customer (B2C) and customer-to-customer (C2C) business models. Fig. 2 shows the timeline for these online marketplace introductions.

Fig. 3 shows the monthly average number of visits to these Indonesian online marketplaces' websites in 2020. It appears that during 2020, Shopee was the most visited marketplace, followed by Tokopedia ([iprice, 2020](http://iprice, 2020)).

## 2.3. Economic potential of Indonesian e-commerce

The emergence and rapid development of online marketplaces have stimulated e-commerce transactions in Indonesia. Das et al. (2018) predicted that the online commerce market in Indonesia will grow from 8 billion USD in 2017 to 55–65 billion USD by 2022. During the same period, annual individual spending is also expected to grow 2.38-fold, from 260 USD to 620 USD. Furthermore, Das et al. (2018) reported that the growth of e-commerce was also projected to impact the job market significantly. In Indonesia, 26 million jobs are expected to be supported by online commerce in 2022, which is a more than six-fold increase compared to 2018 figures. This increase is driven by buyers' increased trust in the security of online transactions, the wider variety of online products available, and more competitive prices as the number of online sellers grow. A more recent report by Google et al. (2020b) also provides insight into e-commerce development in Indonesia. According to the report, the gross merchandise value (GMV) of Indonesian e-commerce will increase exponentially from 2 billion USD in 2015 to 83 billion USD in 2025.

Fig. 4 presents a comparison of the e-commerce GMV in six countries in SEA. In early 2020, these countries had a total population of 583 million, and approximately 271 million of them lived in Indonesia. The figure shows that Indonesia's e-commerce GMV is projected to grow faster than that of the other five countries.

## 2.4. E-commerce-related regulations

The Indonesian government has long recognized the economic potential of e-commerce and enacted several regulations to

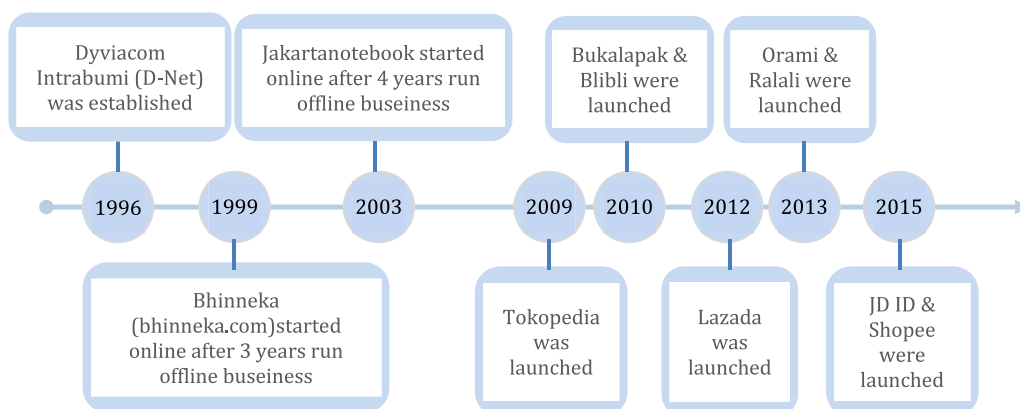


Fig. 2. Non-exhaustive online marketplaces introduction in Indonesia.

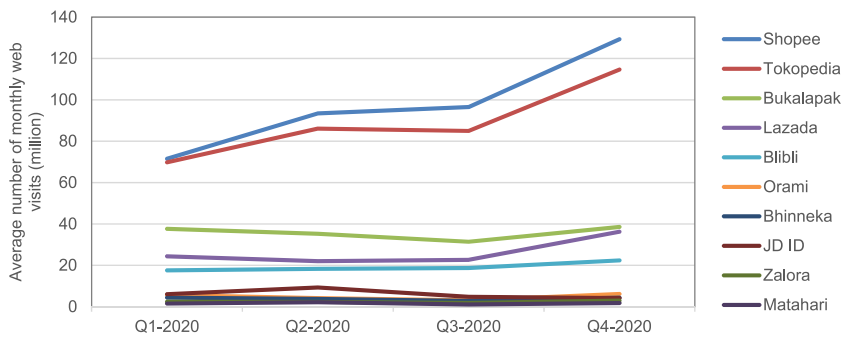


Fig. 3. Average number of visits to ten Indonesian online marketplaces' websites in 2020 (iprice, 2020).

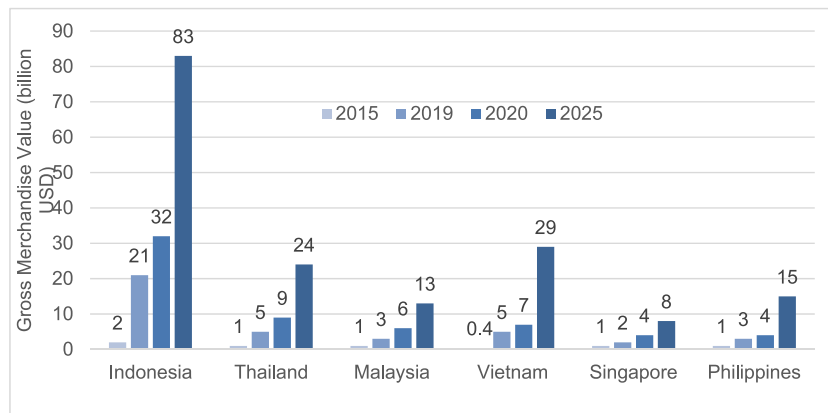


Fig. 4. Gross Merchandise Value (GMV) of e-commerce in six SEA countries (Google et al., 2020b).

stimulate e-commerce adoption and transactions. The first regulation was a law focused on electronic information and transactions. This law was enacted to provide legal certainty and protection for all actors in the e-commerce sector by determining the obligations of all parties involved in electronic-based transactions. The second regulation was a law focused on commerce; one of its articles requires e-commerce business actors to provide complete and correct data and sets fines for violators. More detailed rules are contained in their derivative regulations. The next related regulation was a presidential regulation on e-commerce roadmap for 2017–2019. The regulation established many programs to support the development of e-commerce in Indonesia, such as funding, taxation, consumer protection, education, human resources, communication infrastructure, logistics, and cybersecurity, as well as implemented mechanisms to manage the e-commerce roadmap. The broad nature of these programs indicates the need for synergy among government agencies, such as the Coordinating Ministry for Economic Affairs, the Ministry of BUMN, the Ministry of Communication and Information Technology, the Ministry of Finance, the Ministry of Trade, Bank Indonesia (i.e., Indonesia’s central bank), the Creative Economy Agency, the Ministry of Education, and the Coordinating Ministry for Politics, Law, and Security. Furthermore, the Indonesian government also stipulated a national e-commerce policy framework. This regulation is expected to encourage the growth of e-commerce by creating a reliable and sustainable e-commerce ecosystem. On the supply side, this regulation provides business certainty and an equal playing field to ensure fair business competition, eliminating discrimination between foreign and local e-commerce actors, as well as between offline and online actors. On the demand side, this regulation is expected to build consumer trust and confidence by stressing the obligation of consumer protection.

### 3. Theoretical framework and the empirical literature

This study focuses on the diffusion of e-commerce in a developing country. Rogers (2003) defined diffusion of innovation as a process of communicating an innovation through a communication channel over time in a social system. Diffusion of innovation theory concerns on how innovation is introduced, evaluated, accepted, or rejected, and then reevaluated by society in a social system (Rogers, 2003). Throughout this diffusion process, an individual will find several factors that shape his or her final decision to adopt the innovation. This section will discuss the theoretical framework, along with related empirical studies, as a basis for determining which factors affect e-commerce diffusion in society.

Diverse final decisions among individuals on whether to adopt e-commerce is a common practice in a social system, creating the so-called advanced digital divide. van Dijk (2006) used the term digital divide to describe not only inequality in physical access, which has been the focus of most studies on the topic, but also inequality in other aspects, including motivation, skills, and the use of digital

technology. Furthermore, van Dijk (2006) explained that prior to using a digital innovation, an individual must have motivation, physical access, and relevant digital skills. Discrepancies in these three aspects lead to diversity in actual use. The motivational aspect reflects an individual’s interest in adopting an innovation and is affected by social and mental factors. For instance, a study conducted by the University of Texas in poor communities of Austin indicated that male students had lower interest in computers because they presumed that computers are closely related to women’s work (Rojas et al., 2004). Another study performed by Katz and Rice (2002) found that people’s assumptions about the Internet only being suitable for higher income and educated people were a potential social explanation for the digital divide on the Internet.

The next important aspect of digital innovation adoption is material or physical access (van Dijk, 2006). In e-commerce, this aspect is related to the availability and the sufficiency of Internet access and other related infrastructure, such as financial and logistic infrastructure. Some empirical studies support the notion that access to infrastructure is a mandatory requirement for Internet and broadband adoption (Andrés et al., 2010; Chinn & Fairlie, 2007; Moutafides & Economides, 2011; Rohman & Bohlin, 2011; Srinuan & Bohlin, 2013; Sujarwoto & Tampubolon, 2016). Unavailable or limited Internet infrastructure further dissuades potential users. This study uses FBB subscription, mobile internet coverage, and the availability of logistic and financial services to understand the impact of infrastructure on e-commerce adoption. Additionally, since infrastructure development varies by region, several studies have used geographical factors to reflect the importance of infrastructure on broadband adoption (Rohman & Bohlin, 2011; Srinuan & Bohlin, 2013). In Indonesia, infrastructure development has concentrated on the island of Java. Thus, this study also uses Java as an explanatory variable to confirm the importance of infrastructure in e-commerce adoption.

Another important aspect of digital innovation adoption is digital skills. van Dijk (2006) argued that once an individual is motivated to use a digital innovation and has physical or material access, he or she must acquire the necessary digital skills to utilize digital devices. Empirical research by Valarezo et al. (2018) and Garín-Muñoz et al. (2019) confirmed the notion that as an individual’s digital skills (i.e., personal computer and Internet skills) improve, his or her probability of becoming an online buyer increases. However, as van Dijk (2006) stated, motivation, having the necessary physical access and digital skills do not guarantee the use of an innovation. Thus, it is necessary to include other predictors in the investigation, as described below.

The e-commerce transaction method is different from conventional ones. Although this method is more sophisticated and offers many benefits over traditional commerce, it creates new risks (Ariffin et al., 2018). Laroche et al. (2005) note that compared to offline transactions, online transactions incur more risks and hamper trust since it is more challenging to assess the product and security issues associated with the transaction process. These risks influence individuals’ attitudes toward online transactions (Ariffin et al., 2018). Exposure to negative content on the Internet can also be a source of perceived risk.

Additionally, Rogers (2003) classifies individuals into five categories based on how quickly they adopt an innovation, beginning with the quickest adopters: innovators, early adopters, early majority, late majority, and laggards. Hence, in e-commerce, some people adopt it at an early stage, while others adopt it later. Furthermore, Rogers (2003) provides several generalizations regarding how demographic factors can differentiate earlier and later adopters. Many empirical studies have reported mixed findings when examining the relationship between demographic characteristics and innovation adoption. For instance, Garín-Muñoz et al. (2019) and (Pérez-Amaral et al. (2020)) found that online buyers were typically young, male, and relatively well educated. Srinuan and Bohlin (2013) study confirmed that fixed broadband adopters can be characterized as young, male, and well educated, as well as having higher earnings. However, their findings on the demographic factors varied, as they investigated the use of five broadband internet-based service.

#### 4. Methodology

##### 4.1. Data

The primary data in this study were collected through a nationwide survey on the use of information and communication

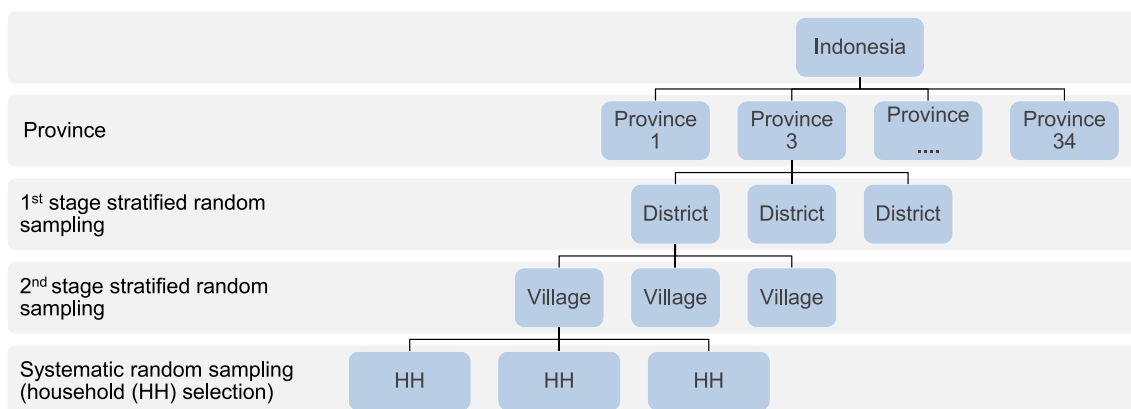


Fig. 5. Sample structure.

technology (ICT) and its effect on society, culture, and economics. The survey was administered from July to August 2019 and covered all 34 Indonesian provinces. The sampling began at the district level using multistage stratified random sampling combined with systematic random sampling. Stratified random sampling involves dividing the target population into mutually exclusive sub-populations and then randomly drawing samples from each subpopulation (Daniel, 2012). Because e-commerce relies on the internet, the stratification was based on internet coverage, specifically the mobile internet coverage, which varied according to geographical location. This survey applied stratified random sampling in two stages to select district and village samples, while systematic random sampling was used to select household samples. The later sampling technique selects the first household sample randomly, and subsequent samples are selected using a certain interval until the expected sample size is met (Daniel, 2012). Fig. 5 shows the survey's sample structure.

The survey selected one respondent from each household sample. Therefore, the sample size was determined based on the number of households, which was around 68.51 million in 2019 (BPS, 2020). Approximately 9600 households/respondents were required for a 1% margin of error. This number was distributed proportionally based on the subpopulation size. The survey was conducted face-to-face to collect the desired samples covering 34 provinces, 142 districts, 596 villages, and 9623 households/respondents. This present study focuses on the working-age respondents, namely those aged more than 15 years old (BPS, 2016), causing a decrease in useable samples to 8854. This change slightly increases the margin of error from 1% to 1.04% but does not shrink the geographical coverage of the data.

The secondary data, village potential statistics (PODES), were provided by Badan Pusat Statistik (BPS). PODES contains an overview of village-level government administration areas throughout Indonesia, capturing the availability of infrastructures and each village's socio-economic potential (BPS, 2018). However, this study only utilized the most relevant information, such as mobile internet coverage, banking services, and logistic services.

#### 4.2. Variables

This study has one outcome variable, namely e-commerce adoption, which is dichotomous, (i.e., e-commerce adopter and non-adopter). The outcome variable has a set of explanatory variables, including respondents' demographic, access/infrastructure, digital skills, and harmful content exposure.

Demographic variables consist of the respondents' gender, age, highest level of formal education completed, monthly family income, marital status, geographical location, and primary occupation. The survey question asking about the respondents' gender had a binary response choice: male or female. Geographical location data consisted of the respondents' province, district, sub-district, and village of residence. Respondents were also asked to select a predetermined range to indicate their age (i.e., 9–14 years old, 15–24 years old, 25–34 years old, 35–44 years old, 45–54 years old, or 55–65 years old), their highest level of formal education completed (i.e., none, elementary school, Junior high school, senior high school, diploma, undergraduate, master's, or Ph.D.), monthly family income (i.e., up to 2 million rupiahs [up to about 138 USD], more than 2 to 4 million rupiahs [about 139–276 USD], more than 4 to 6 million rupiahs [about 277–414 USD], more than 6 to 8 million rupiahs [about 415–552 USD], or more than 8 million rupiahs [more than 552 USD]), marital status (i.e., single, married, or divorce/widowed), and primary occupation (i.e., no occupation, entrepreneur/trader, student, housewife, retired, state employee, private employee, farmer, fisherman, craftsman, or freelance worker).

To simplify the analysis, several variables are regrouped as follows: Geographical location is simplified into Java and outside Java. Highest level of formal education is regrouped into none/elementary school, junior/senior high school, diploma/undergraduate, and master/Ph.D. Monthly family income is regrouped into up to 4 million rupiahs, more than 4 to 8 million rupiahs, and more than 8 million rupiahs; primary occupation is reclassified into entrepreneur/trader, non-labour force (i.e., student, no occupation, housewife, or retired), formal worker (i.e., state employee or private employee), and informal worker (i.e., farmer, fisherman, craftsman, or freelance worker). As described in the previous subsection, this study only focuses on the working-age respondents. Consequently, this study excludes the respondents aged 9–14 years from the analysis.

Access/infrastructure was comprised of four variables: fixed broadband (FBB) subscription, mobile internet coverage, logistics services, and financial services. While FBB subscription data were collected at the individual level from the survey, the other three were collected at the village level and taken from PODES data. FBB subscription data provide information about whether the respondent has access to FBB service at home. Mobile internet coverage indicates whether mobile internet signals cover the village where the respondents live. Logistics service availability indicates whether at least one logistics service is available in the vicinity of the respondent's home. Financial service availability indicates the distance to the nearest banking service from the village where the respondents live. The first three variables are dummy variables, while the fourth is the actual distance in kilometers.

Digital skills are the skills required to utilize digital devices, digital applications, and networks to access and manage information (UNESCO, 2018). In this study, digital skills are differentiated into personal computer (PC) skills and Internet skills. Nine basic PC skills were incorporated into the survey questionnaire: copying or moving text within a document, copying or moving text between documents, creating a basic formula in an Excel spreadsheet, connecting peripherals to a PC, installing software, using PowerPoint software, copying or moving a file or a folder on a PC, copying or moving a file or a folder between a PC and another device, and understanding at least one programming language. However, to simplify the analysis, this study categorizes PC skills into three levels according to the number of PC skills the respondents reported: low (up to 3 PC skills), medium (4–6 PC skills), and high (7–9 PC skills). The respondents' internet skills are measured by their responses to whether they used social media, instant messaging (IM), e-mail, and Internet surfing. This study assumes that internet-based service use by an individual reflected the individual had the necessary internet skills to utilize the service. All the internet skills are dummy variables.

Harmful content exposure only had one variable, a dummy variable that captured whether the respondent had been exposed to

**Table 1**  
Description and summary of the outcome and explanatory variables.

Variables	Description	Mean	Std. Dev.
<b>Outcome variable</b>			
e-Commerce adopter	= 1 if respondent is an e-commerce adopter = 0 otherwise	0.2879	0.4528
<b>Explanatory variables</b>			
<b>DEMOGRAPHICS</b>			
<b>Gender</b>			
Male	= 1 if respondent is male = 0 if female	0.4929	0.5000
<b>Age in years</b>			
15–24	= 1 if respondent is age 15–24 = 0 otherwise	0.2532	0.4349
25–34	= 1 if respondent is age 25–34 = 0 otherwise	0.2453	0.4303
35–44	= 1 if respondent is age 35–44 = 0 otherwise	0.2301	0.4209
45–54	= 1 if respondent is age 45–54 = 0 otherwise	0.1721	0.3775
55–65	= 1 if respondent is age 55–65 = 0 otherwise	0.0993	0.2991
<b>Education</b>			
None or primary school	= 1 if respondent achieved up to primary school level = 0 otherwise	0.2423	0.4285
Junior or senior high school	= 1 if respondent achieved junior or senior high school level = 0 otherwise	0.6363	0.4811
Diploma or bachelor's	= 1 if respondent achieved diploma or bachelor level = 0 otherwise	0.1184	0.3231
Master's or Ph.D.	= 1 if respondent achieved master or PhD level = 0 otherwise	0.0030	0.0551
<b>Family income (in rupiah)</b>			
Up to 4 million	= 1 if respondent's family income is up to 4 million = 0 otherwise	0.9201	0.2711
>4 to 8 million	= 1 if respondent's family income is > 4 to 8 million = 0 otherwise	0.0749	0.2632
>8 million	= 1 if respondent's family income is > 8 million = 0 otherwise	0.0050	0.0703
<b>Marital status</b>			
Single	= 1 if respondent's marital status is single = 0 otherwise	0.2790	0.4485
Married	= 1 if respondent's marital status is married = 0 otherwise	0.6744	0.4686
Divorced/widowed	= 1 if respondent's marital status is divorced/widowed = 0 otherwise	0.0466	0.2109
<b>Primary occupation</b>			
Unemployed/non-labor force	= 1 if respondent is unemployed or non-labor force = 0 otherwise	0.4475	0.4973
Formal worker	= 1 if respondent is a formal worker = 0 otherwise	0.1770	0.3817
Informal worker	= 1 if respondent is an informal worker = 0 otherwise	0.2424	0.4285
Entrepreneur/trader	= 1 if respondent is an entrepreneur/trader = 0 otherwise	0.1332	0.3398
<b>Location</b>			
Java	= 1 if respondent lives on Java Island = 0 if outside Java	0.3342	0.4717
<b>ACCESS</b>			
FBB subscription	= 1 if respondent has access to FBB service at home = 0 otherwise	0.0573	0.2324
Mobile internet coverage	= 1 if respondent's location is covered by mobile internet signal = 0 otherwise	0.9141	0.2803
Logistic service	= 1 if respondent's location is covered by at least one logistic service = 0 otherwise	0.3047	0.4603
Financial service	= The distance (km) of a nearest bank from the village where the respondents live	10.1747	15.0751
<b>INTERNET-BASED SERVICE</b>			
Social media user	= 1 if respondent is a social media user = 0 otherwise	0.5386	0.4985
IM user	= 1 if respondent is an instant messaging user = 0 otherwise	0.5472	0.4978
Email user	= 1 if respondent is an email user	0.0961	0.2948

(continued on next page)

**Table 1** (continued)

Variables	Description	Mean	Std. Dev.
Internet-surfing user	= 0 otherwise = 1 if respondent is an Internet surfer = 0 otherwise	0.3675	0.4822
PC SKILLS			
Low	= 1 if respondent's level of PC skills is low = 0 otherwise	0.8180	0.3858
Medium	= 1 if respondent's level of PC skills is medium = 0 otherwise	0.1010	0.3013
High	= 1 if respondent's level of PC skills is high = 0 otherwise	0.0810	0.2728
EXPOSED TO NEGATIVE/HARMFUL CONTENT ON THE INTERNET			
Exposed	= 1 if respondent has experiences of being exposed to negative/harmful content when accessing the Internet = 0 otherwise	0.1066	0.3086

negative or harmful content when accessing the Internet.

#### 4.3. Empirical model

This study uses an approach similar to the ones used by Ariansyah and Yuniarti (2021), Garín-Muñoz et al. (2019), Srinuan and Bohlin (2013), Pérez-Amaral et al. (2020), and Valarezo et al. (2018) to deal with individuals' decisions to use e-commerce. According to the standard neo-classical utility maximization framework, an individual will choose an option among the available alternatives that offers the highest utility. In this case, an individual would have used e-commerce only if e-commerce provided a higher utility over not using it. Suppose that  $U_i$  and  $y_i$  denote the utility obtained by an  $i$ th individual from either using or not using e-commerce, and the  $i$ th individual dichotomous choice to adopt ( $y_i = 1$ ) or not to adopt ( $y_i = 0$ ) e-commerce. The  $i$ th individual's decision to use e-commerce can be expressed as follows (Valarezo et al., 2018):

**Table 2**  
Respondents' demographic and e-commerce penetration rates.

	Respondents	e-commerce adopter	
	N	n	Penetration (n/N in %)
All respondents	8854	2549	28.79
Gender			
Male	4364	1402	32.13
Female	4490	1147	25.55
Age (years)			
15–24	2242	982	43.80
25–34	2172	885	40.75
35–44	2037	470	23.07
45–54	1524	180	11.81
55–65	879	32	3.64
The last formal education			
None or primary school	2145	105	4.90
Junior or senior high school	5634	1798	31.91
Diploma or bachelor's	1048	628	59.92
Master's or Ph.D.	27	18	66.67
Marital status			
Single	2470	1083	43.85
Married	5971	1417	23.73
Divorced/Widowed	413	49	11.86
Family income (rupiah)			
Up to 4 million	8147	2209	27.11
>4 to 8 million	663	314	47.36
>8 million	44	26	59.09
Primary occupation			
Unemployed/non-labor force	3962	1203	30.36
Formal worker	1567	704	44.93
Informal worker	2146	221	10.30
Entrepreneur/trader	1179	421	35.71
Location			
Outside Java	5895	1391	23.60
Java	2959	1158	39.13



$$y_i = \begin{cases} 1, & U_i(\text{use}) > U_i(\text{not use}) \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

An  $i$ th individuals' decision to either adopt ( $y_i = 1$ ) or not to adopt ( $y_i = 0$ ) e-commerce for purchases depends on many factors. Some factors are categorized as observed ( $X_i$ ), while others are unobserved ( $\varepsilon_i$ ). Thus, the individual's utility obtained from either using or not using e-commerce is decomposed into two parts; one part depends on observed variables, while the other depends on unobserved variables. This decomposition can be expressed in a linear equation, as follows:

$$U_i = \beta X_i + \varepsilon_i \quad (2)$$

Thus, the probability of an  $i$ th utility-maximizing individual adopting e-commerce ( $y_i = 1$ ) can be expressed as follows in Equation (3):

$$P(y_i = 1 | X_i) = P\{U_i(\text{use}) > U_i(\text{not use}) | X_i\} \quad (3)$$

**Table 3**  
Estimated results.

Explanatory Variables	dy/dx	Std. Error	z	P > z	[95% Conf. Interval]	
<b>DEMOGRAPHICS</b>						
Gender (Ref: female)						
Male***	0.090	0.008	11.140	0.000	0.075	0.106
Age in years old (Ref: 15 to 24)						
25–34	0.003	0.012	0.290	0.773	–0.020	0.027
35–44***	–0.055	0.014	–3.840	0.000	–0.082	–0.027
45–54***	–0.105	0.017	–6.240	0.000	–0.138	–0.072
55–65***	–0.171	0.027	–6.330	0.000	–0.223	–0.118
Education (Ref: None or Primary School)						
Junior or senior high school***	0.063	0.014	4.380	0.000	0.035	0.091
Diploma or bachelor's***	0.103	0.017	5.960	0.000	0.069	0.136
Master's or Ph.D.*	0.097	0.058	1.670	0.096	–0.017	0.212
Family income in rupiah (Ref: < 4 million)						
4 to 8 million	0.017	0.012	1.380	0.166	–0.007	0.041
>8 million	0.060	0.047	1.260	0.207	–0.033	0.153
Marital status (Ref: Single)						
Married***	0.042	0.011	3.680	0.000	0.020	0.064
Divorce	0.037	0.026	1.390	0.163	–0.015	0.088
Location (Ref: Outside Java)						
Java***	0.045	0.008	5.840	0.000	0.030	0.060
Primary occupation (Ref: Unemployed/non-labor force)						
Formal worker	0.011	0.011	1.020	0.306	–0.010	0.031
Informal worker	–0.005	0.013	–0.400	0.692	–0.030	0.020
Entrepreneur/trader***	0.061	0.012	5.160	0.000	0.038	0.084
<b>ACCESS/INFRASTRUCTURE</b>						
FBB subscription (Ref: Non-subscriber)						
FBB subscriber***	0.036	0.013	2.710	0.007	0.010	0.062
Mobile internet coverage (Ref: Not covered)						
Covered**	0.042	0.017	2.520	0.012	0.009	0.074
Logistic service (Ref: not available)						
Available***	0.022	0.008	2.860	0.004	0.007	0.037
Financial Service (km)***	–0.001	0.000	–2.600	0.009	–0.001	0.000
<b>INTERNET-BASED SERVICE</b>						
Social media (Ref: Non-user)						
Social media user***	0.224	0.019	11.940	0.000	0.187	0.261
Instant messaging (Ref: Non-user)						
IM user***	0.198	0.019	10.350	0.000	0.160	0.235
Email (Ref: Non-user)						
Email user***	0.060	0.011	5.440	0.000	0.038	0.081
Internet surfing (Ref: Non-user)						
Internet-surfing user***	0.065	0.008	8.260	0.000	0.050	0.081
PC SKILLS (Ref: Low)						
Medium***	0.075	0.010	7.610	0.000	0.055	0.094
High***	0.114	0.013	8.970	0.000	0.089	0.139
EXPOSED TO NEGATIVE/HARMFUL CONTENT ON THE INTERNET (Ref: Not exposed)						
Exposed***	–0.074	0.010	–7.610	0.000	–0.094	–0.055
Number of observations	8854					
LR chi2 (25)	4665.34					
Prob > chi2	0.0000					
Pseudo R2	0.4389					

Note: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

2. Ref: Reference. All presented results are relative to each reference.

The probability of an  $i$ th individual using e-commerce can also be expressed as the function of the benefits the  $i$ th individual earns ( $B_i$ ) and costs the  $i$ th individual bears ( $C_i$ ) as a consequence of using e-commerce (Garín-Muñoz et al., 2019). Equation (4) represents this relationship:

$$P(y_i = 1|X_i) = P\{B_i(\text{use}) > C_i(\text{use})|X_i\} \quad (4)$$

Since  $y_i$  is dichotomous, this study employs binary logistic regression analysis to predict the probability of an individual to use e-commerce according to a set of explanatory variables,  $X_i$ . Table 1 provides short descriptions and summaries of all variables included in the analysis. Except for financial service, the mean values of the variables can be multiplied by 100 to show the percentages of respondents in each variable category over the total respondents.

## 5. Results

### 5.1. E-commerce penetration rates based on the respondents' demographics

Of the 8854 survey respondents, only 28.79% had online shopping experience. Table 2 provides more detailed penetration rates based on the respondents' demographic characteristics. In terms of gender, the e-commerce penetration rate is higher for male respondents (32.13% among males and 25.55% among females). This information may indicate a positive association between being male and e-commerce use. As the e-commerce penetration rates are higher in younger respondents than in older respondents, age seems to have a negative relationship with e-commerce adoption. Furthermore, the e-commerce penetration rates seem to increase with educational level. Of the respondents with a master's or Ph.D degree, 66.67% were online buyers, while 59.92% of the respondents with a diploma or undergraduate degree, 31.91% of the respondents with junior or senior high school education, and 4.90% of the respondents with primary or no formal education were online buyers. In terms of marital status, the highest e-commerce penetration rate was among single respondents, followed by married and divorced/widowed respondents. Regarding the respondents' primary occupation, the highest e-commerce penetration rate was among formal workers (44.93%), followed by entrepreneurs (35.71%), unemployed/non-labor forces (30.36%), and informal workers (10.30%). A significant gap in penetration rates was found among geographical locations, in which the rate was higher for respondents living in Java. Hence, a positive association is also expected between respondents living in Java and e-commerce adoption.

### 5.2. Estimated results

The complete estimated results of the binary logistic regression model are presented in Table 3. The results show that the model has a likelihood ratio ( $LR$ ) chi-square value of 4665.34 and a  $p$ -value of 0.0000. These results indicate that the proposed model has at least one relevant predictor. The results also show that the pseudo  $R^2$  of the model is 0.4389, which implies that the model can explain 43.89% of Indonesian individuals' decisions regarding e-commerce adoption.

Table 3 also provides the estimated results of the binary logistic regression model. Empirically, 21 of the 27 explanatory variables are relevant predictors of e-commerce adoption by Indonesian individuals. The table presents the marginal effects instead of the logistic coefficients. The marginal effect is more intuitively informative than the logit coefficient and the odds ratio (Mood, 2010; Williams, 2012). The marginal effect (ME) is also known as a partial effect because it only measures the changes in a particular explanatory variable against changes in the predicted outcome, provided that the other explanatory variables remain at specific values (Mize et al., 2019). In a linear model, the ME equals the slope or the coefficient of the focal explanatory variable, but this is not the case for a nonlinear model (Cameron & Trivedi, 2009). As Long and Mustillo (2018) noted, the marginal effects of a logistic regression measure the changes in the probability of the predicted outcome for changes in an explanatory variable in focus.

#### 5.2.1. Demographics

The estimated results for demographic factors show that the model is almost perfectly congruent with Rogers' diffusion of innovation theory. The results indicate that respondents who are male, married, and live on Java have a higher probability of using e-commerce than each reference. Concerning respondents' age, those who were 25–34 years old had relatively the same probability of being online buyers as those who were 15–24 years old. Meanwhile, the results of the other three age groups show that the likelihood of adopting e-commerce decreases with age. To summarize, individuals aged 15–34 are more likely to be online buyers than older age groups. Regarding the respondents' primary occupation, the results show that only entrepreneurs/traders have a higher likelihood of being online buyers than unemployed and non-labor force respondents. Thus, entrepreneurs/traders are more likely to adopt e-commerce than non-entrepreneurs/traders. However, family income level does not differentiate e-commerce adopters from non-adopters. Additionally, the results show that the probability of a respondent using e-commerce increases with his or her educational level.

#### 5.2.2. Access/infrastructure

Access to an FBB service, mobile internet service, logistics services, and financial services are relevant predictors for e-commerce adoption. These indicate that respondents who have access to an FBB service in their homes and those who live in a village covered by mobile internet signals and logistics services have a higher probability of being e-commerce adopters. An inverse relationship was found between the distance to the nearest financial service and e-commerce adoption. This finding implies that as the distance to the

nearest financial service increases, the probability of an individual being an e-commerce user decreases.

### 5.2.3. Internet skills

Of the four Internet-based services incorporated into the empirical model, all are found to be relevant predictors of e-commerce adoption. These findings indicate that the use of social media, instant messaging, email, and Internet-surfing services can differentiate e-commerce adopters from non-adopters. Thus, individuals who have Internet skills related to these four Internet-based services are considered to have sufficient skills to use e-commerce services and are more likely to adopt e-commerce.

### 5.2.4. PC skills

PC skills are also significant predictors of e-commerce adoption by individuals in Indonesia. The results show that the marginal effects increase with the respondents' PC skill levels. Hence, as PC skills improve, individuals are more likely to be online buyers.

### 5.2.5. Harmful content exposure

The perceived risk proxied by the respondents' exposure to harmful content has an inverse relationship with e-commerce adoption, indicating that an individual exposed to this content will be less likely to become an online buyer.

## 6. Findings and implications

This present work enhances our understanding of e-commerce adoption by individuals in developing countries by focusing on Indonesia. This study's findings and implications are presented in the following subsections. In some respects, these findings support previous empirical research.

### 6.1. Relative advantage and compatibility of e-commerce motivate its adoption

Relative advantage and compatibility are two of Rogers (2003) innovation attributes. Relative advantage reflects how much a potential adopter perceives that the innovation is better than its predecessors. The advantage can take many forms, such as economic profitability or a higher social status. Meanwhile, compatibility concerns the potential adopter's perception of how much an innovation is consistent with his or her values, needs, or past experiences (Rogers, 2003).

In the context of this study, e-commerce offers several relative advantages over traditional commerce; for example, it allows adopters to save time and money (Punj, 2012). E-commerce enables individuals to have broader access to product and price information. It also facilitates making purchases from any location where there is Internet access, thereby reducing commuting expenses and saving time. Thus, individuals can purchase products at a relatively lower cost and in a more time-efficient manner compared to traditional commerce. The higher likelihood of e-commerce adoption by married individuals and entrepreneurs/traders may suggest that at least these two relative advantages are considered more compatible with married individuals' and entrepreneurs'/traders' needs and values.

For instance, married individuals view time as more valuable, as they must allocate time for their spouse and other family members (Naseri & Elliott, 2011). Hence, the time-saving aspect of e-commerce is compatible with married individuals' needs and values, enhancing their intention to use e-commerce. Furthermore, married individuals' higher financial capacity supports their intention to adopt e-commerce. They have higher disposable income, as they are more likely to be dual-income earners (Naseri & Elliott, 2011). Meanwhile, the finding on the insignificance of monthly family income in differentiating e-commerce adopters from non-adopters may indicate that not all family members have sufficient power to utilize the family income to shop online.

Entrepreneurs/traders attempt to maximize their profits by, for example, minimizing their costs. Because e-commerce can facilitate more efficient transactions and access to competitive prices (e.g., for manufacturers to procure raw materials or for traders to purchase products for resale), it is also perceived as more compatible with the entrepreneurs'/traders' needs or values. They can utilize a variety of e-commerce platforms, including business-to-business (B2B), business-to-consumer (B2C), and consumer-to-consumer (C2C) platforms, to find the best price in a more time-efficient way.

However, Individuals' perspectives on the compatibility or incompatibility of an innovation with either their values, previous ideas, or needs depends on their awareness of the advantages and consequences of the innovation over its predecessors (Rogers, 2003). Thus, to expand e-commerce diffusion, governments and other stakeholders must increase people's awareness of the various advantages of e-commerce so that more people will find that it is compatible with their values, needs, or previous ideas.

### 6.2. Digital skills are prerequisites for e-commerce adoption

The positive associations between individuals' adoption of e-commerce and their Internet skills, PC skills level, and educational level support the findings of Garín-Muñoz et al. (2019) and (Pérez-Amaral et al. (2020)). These findings approximate one of Rogers (2003) innovation attributes, namely complexity, defined as the level of difficulty involved in learning and using an innovation. As the complexity of an innovation increases, the level of skills required to use it also increase. Unfortunately, as reflected in the survey data presented in Table 1, only social media and instant messaging are used by more than half of the respondents (53.86% and 54.72%, respectively). The other two, email and Internet-surfing services, are only utilized by 9.61% and 36.75% of respondents, respectively. Furthermore, the survey data regarding PC-related skills show that most respondents (81.8%) can be categorized as having low skill levels, and more than 80% are only educated up to the secondary school level. Rumata and Sastrosubroto (2020) highlighted this issue

in explaining why Indonesians lag behind citizens of other Southeast Asian countries in digital literacy. Digital skills among Indonesians also vary by socio-economic factors and geographical location, creating the so-called next-level digital divide (Ariansyah et al., 2019).

This study also finds that younger individuals are more likely to adopt e-commerce. The rationale of this result is that younger individuals are digital natives and therefore more familiar with the digital world because they grew up in the digital age. Thus, they are more likely to have more advanced digital skills than those who are older.

These findings imply that the Indonesian government should facilitate the acquisition of digital skills among its citizens. Since 2018, the Ministry of Communications and Informatics (MCI) has been administering the digital talent scholarship (DTS) program, aiming to improve the capabilities, skills, and competitiveness of the country's human resources in information technology. However, this program has a limited capacity, and most of the provided training programs are intermediate-level digital skills training for IT professionals. Another program called Indonesia's National Movement for Digital Literacy or Siberkreasi was established in 2017 with a similar objective. Likewise, this program has a limited capacity. Hence, there is a need to increase training capacity and offer more training programs in basic digital skills that target individuals with very limited or no digital skills. The programs must teach basic digital skills and vary depending on the targeted demographics (Ariansyah et al., 2019). To create more training capacity, the central government should encourage and work alongside local governments to provide basic digital skills training for their citizens.

### 6.3. Internet, logistics, and financial infrastructure are essential factors in e-commerce adoption

The positives and significant factors of FBB subscription, mobile internet coverage, and logistics services indicate the importance of the Internet and logistic infrastructure availability for e-commerce use. Likewise, the inverse relationship between e-commerce adoption and the distance to the nearest banking service empirically proves the need for a ubiquitous financial infrastructure to facilitate e-commerce adoption. These indications are supported by the positive association between e-commerce use and geographical location (Java), implying that more advanced and more ubiquitous infrastructure in Java enables a higher probability of Java's inhabitants adopting e-commerce. The relevance of geographical location in explaining ICT adoption was also found in previous studies (Rohman & Bohlin, 2011; Srinuan & Bohlin, 2013), highlighting the importance of infrastructure for broadband service adoption.

Unfortunately, the Palapa Ring network, intended to provide a fiber optic backbone for internet access in all districts in Indonesia, leaves a challenge of delivering last-mile networks to connect the backbone network with end-users. Indonesia also faces challenges in providing financial services nationwide. A survey conducted by the Indonesian Financial Services Authority (OJK) showed that even though Indonesia's financial inclusion index increased by 8.39% between 2016 and 2019 (OJK, 2019), the index was low when compared to that of neighboring countries, such as Singapore, Malaysia, and Thailand. Apart from financial literacy, Indonesia's geographically uneven financial infrastructure is suspected of causing this less than optimum index. Meanwhile, the last report on the logistics performance index (LPI) in 2018 showed Indonesia's logistics infrastructure score was 2.89 out of 5, lagging behind several other countries in the Asian region (Arvis et al., 2018). All these infrastructure problems are allegedly due to the high cost of deploying infrastructure, especially outside the region of Java.

The study findings imply that facilitating wider e-commerce adoption will require the Indonesian government to encourage the country's internet, logistic, and financial service providers to expand their infrastructure ubiquitously throughout Indonesia. To deal with the high cost of infrastructure deployment, the government should facilitate infrastructure sharing wherever possible. Likewise, local governments should ease and fully support providers in deploying infrastructure in their areas.

### 6.4. Perceived risk discourages individuals from using e-commerce

This study reveals that exposure to harmful content on the Internet discourages people from becoming online buyers. Individuals exposed to harmful content perceive e-commerce as less trustworthy, especially because it involves financial transactions. This finding is in line with previous studies' conclusions that Internet trust, which may reflect lower risk perception regarding the Internet, is vital to promoting Internet-based transactions (Garín-Muñoz et al., 2019; Mainardes et al., 2020; Valarezo et al., 2018).

The finding that males are more likely to adopt e-commerce than females may indirectly support the inverse relationship between perceived risk and e-commerce adoption. First, females' lower likelihood of e-commerce adoption may result from the gender gap in internet access, which favors males (ITU-D, 2020, 2021). Next, the lower internet penetration rate among females can be linked to females' presumption that using information technology is risky (Venkatesh et al., 2003). Likewise, Anandhita and Ariansyah (2018) found that the perception of internet insecurity is one of the most cited reasons hindering Indonesian females from using the Internet.

Since 2008, Indonesia has had a law on electronic information and transactions. According to the law, information technology and electronic transaction usages have to provide a sense of security, justice, and legal certainty for users and providers of information technology (Law on Electronic Information and Transactions, 2008). Unfortunately, the study findings may indicate that this objective has not been fully achieved, particularly from e-commerce users' perspectives. The causes could, for example, be a lack of ability of information technology users to manage the harmful content or a lack of law enforcement against violators. Therefore, the Indonesian government needs to continuously improve its efforts to minimize the perceived risk of e-commerce users, such as by educating individuals about ways to manage harmful content and its adverse effects, enacting strategies to prevent the dissemination and use of prohibited content, and enforcing the law against harmful and false content creators and spreaders.

## 7. Conclusions

E-commerce is the largest and fastest-growing pillar of the Indonesian digital economy, and several projections regarding the future of Indonesian e-commerce are encouraging. However, the groundwork must be laid to achieve the projected results, such as encouraging more people to adopt and participate in e-commerce transactions. Thus, it is important to know the drivers of and barriers to e-commerce adoption so that more targeted policies can be proposed accordingly.

By focusing on the individual level, this study aims to investigate the factors shaping the decisions to utilize e-commerce. A binary logistic regression model is proposed to accomplish the study objective. The estimated results show that the probability of adopting e-commerce increases if an individual is male, young, married, more educated, and an entrepreneur, as well as has access to the Internet, can easily find logistics and financial services, has a sufficient ability to use a digital device and service, and has not been exposed to harmful content on the Internet.

These results lead the authors to several conclusions. First, the main drivers of e-commerce adoption by individuals are the perceived relative advantages of e-commerce over traditional commerce and the compatibility of e-commerce with the individuals' needs, values, and previous ideas. Second, digital skills proficiency, Internet access, and the availability of logistics and financial services are also essential requirements for e-commerce adoption. Third, the availability of harmful content on the Internet empirically discourages individuals from using e-commerce. From a policy viewpoint, these findings imply that the Indonesian government is responsible for increasing individuals' awareness about the advantages and conveniences offered by e-commerce to enhance the compatibility of e-commerce with each individual's needs. The government also needs to facilitate the acquisition of digital skills among its citizens. It is also imperative to expand infrastructure nationwide, educate individuals on ways to manage harmful content to avoid detrimental impacts, and enforce the law against harmful content creators and spreaders of false data and information.

This study has several limitations. First, it utilizes cross-sectional survey data to investigate e-commerce adoption, which does not allow for causal interpretations of the relationships among variables. Additionally, as the diffusion of innovation increases over time, a longitudinal study may provide more conclusive findings. Second, this study is primarily based on the respondents' self-reported information to capture the underlying factors affecting e-commerce adoption. Although this technique is commonly used in innovation adoption studies and the survey team has attempted to ensure questions clarity, the respondents' misunderstanding and distraction may be unavoidable under certain circumstances, leading to the inability of analysis results to optimally reflect the actual conditions. Therefore, future studies could replicate this study with several improvements, as proposed above, to validate the findings.

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