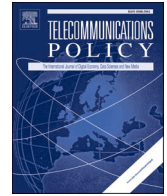




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E-commerce in Spain: Determining factors and the importance of the e-trust

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ABSTRACT

This paper identifies and estimates the determinants for participating in e-commerce and developing e-trust, as well as the importance of e-trust for e-commerce in Spain. For its analysis, a national survey from 2014 to 2019 is used and the logit model is implemented. It is concluded that the e-trust is a determining factor in e-commerce, and the improvement of equality education helps the growth of online commerce and e-trust. In turn, e-trust encourages the use of all digital resources.

1. Introduction

The aim of this paper is to find out the individual profiles and the factors associated with e-commerce and e-trust. This could help companies in the performance of their corporate strategies, their market positioning, marketing, cost savings, profit maximisation, efficiency, and customers loyalty.

Data provided by the [CNMC \(2020\)](#) estimated that the annual growth of e-commerce between 2014 and 2019 would be more than 20% in Spain. This five-year growth is shown in [Fig. 1](#). [Galeano \(2019\)](#) also adds that the market sectors with the highest volume of profits would be those related to tourism and clothing.

The digital divide between Spain and other EU countries has been reduced or overcome, as 90% of the Spanish population has access to the Internet at home, according to the report published by the [BBVA Foundation \(2018\)](#). Likewise, the digital divide has been reduced by 11% between Autonomous Communities. Regional differences in Spain are caused by unemployment, income distribution and population density. This could be related to [Gijón, Whalley, and Anderson \(2016\)](#) which highlights the importance of broadband connectivity.

But recent European studies published by [Eurostat \(2021\)](#) confirm that 70% of the total population has participated in e-commerce. Around 71% of the population say that the purchase was satisfactory. This participation in e-commerce across Europe and its

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impressive growth is shown in Fig. 2.

E-commerce has changed the way of doing business, brought more competitive prices to the table due to a wider offer, a wider variety of products, more marketing strategies and has made customers more demanding as suggested by Valarezo, Pérez-Amaral, Garín-Muñoz, Herguera-García and López (2018). This competitiveness put utility and profit maximisation as the main objective in markets. But, even with this optimistic view, it is important to note that the rise of online markets might have been detrimental to SMEs, unable to adapt to new media on an equal terms with large companies, as Chitura, Mupemhi, Dube, and Bolongkikit (2008) conclude.

This paper identifies the socioeconomic, demographic and digital skills factors that explain the adoption of online shopping by the individual and the trust required for it, it would also be useful to discuss how public administration, businesses and ordinary citizens could promote the adoption of such decisions (Valarezo, López, & Pérez-Amaral, 2019), solving the questions: What factors estimate e-commerce and e-trust? How can these variables be estimated? Is e-trust relevant in the estimation of e-commerce? Could interaction variables be useful in the estimation of e-commerce? What can be done to achieve a more digital society?

It also analyses and compares the differences in user characteristics in the use of e-commerce and the development of e-trust during the five years prior to the pandemic, looking at trends and the impact of different skills and barriers.

To achieve this objective, the INE survey on the use of ICT by households and individuals, a cross-sectional data study, which collects information on Information and Communication Technologies equipment in Spanish households, is used. It has been consulted for 2014 and 2019 to see if there is a change between the two years in the influence of variables on e-commerce and e-trust (INE, 2014, 2019).

This paper is divided into six sections. The next section deals with the literature review on e-commerce, e-trust, and ICT use. Section 3 deals with the data used. The next section explains the methodology of binary dependent variable models, such as linear probability, logit and probit models. The results are shown in section 5. The last section concludes and includes the policy recommendations and limitations of the paper.

2. Literature review

E-commerce (electronic commerce) could be defined as Garín-Muñoz and Pérez-Amaral (2011) said as “the use of the internet to buy, sell or support products and services, not only as an economic exchange, it also includes the exchange of information and post-sale support”. On the other hand, Peštek, Resić, and Nožica (2011) defined e-trust as: “the consumer’s commitment to trust that an offeror will successfully fulfil your online deal, understanding successfully as in accordance to establish terms”.

Once the main concepts that are going to be studied have been defined, the literature review is divided in three parts, the first one related to the use of ICT and the online market, since before people can buy or trust on the Internet, they have to be able to participate in the web, and have businesses on it; secondly, a literature review of e-commerce and finally, the literature review of e-trust.

2.1. Literature related to ITC-usage

Billon, Lera-Lopez, and Marco (2016) divide Europe into three clusters, according to the level of innovation present in the countries. C1 of innovation leaders, C3 of less developed peripheral areas and C2. C2, in which Spain is located, with high levels of ICT use, but little innovation. Billon, Marco, and Lera-Lopez (2017) deduce that the internal characteristics of countries determine the level of innovation. The level of innovation of firms determines how they adapt to changes, such as e-commerce. Hackl, Kummer, Winter-Ebmer, and Zulehner (2014) analyse the association between firm competence and firm profits, with firms that adapt first to an innovation earning the highest profits.

Garrido-Lora, Duran, and Ramos (2016) study the use of ICT in Spain by adults and children at home and at school, finding that there is a generational digital divide, with adults using ICT for work purposes and young people using ICT for an informal use such as social networks. Meanwhile, Bayo-Moriones and Lera-López (2007), for a case study of Spain, analyse the use of ICT in companies,

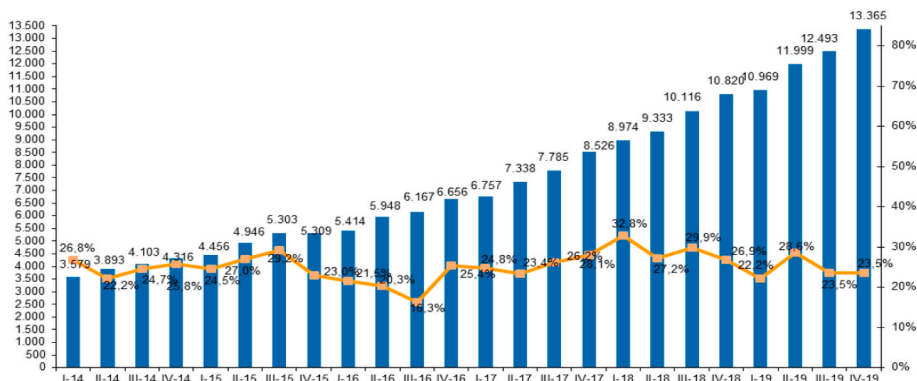


Fig. 1. Quarterly evolution of e-commerce turnover and year-on-year variation (million euros and percentage).

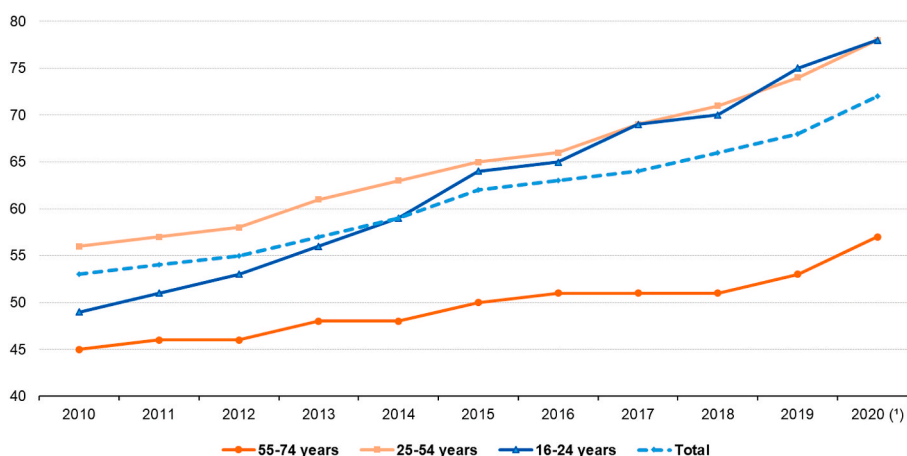


Fig. 2. Internet users who bought or ordered goods or services for private use by age.

Source: EUROSTAT (2021a, 2021b).

concluding that it is important to implement ICTs in industries and to have them as a strategy focus, especially to develop activities such as e-commerce.

2.2. Literature related to e-commerce

On e-commerce it is possible to find many references, such as [Laudon and Guercio-Traver \(2008\)](#) with their first publication on business, technology and society around e-commerce, now presenting the latest edition for 2020–2021 ([Laudon & Guercio-Traver, 2020](#)). An introduction to e-commerce could be found in [Qin \(2009\)](#). [Qin \(2009\)](#) and [Laudon and Guercio-Traver \(2008, 2020\)](#) relate the importance of e-commerce for society and economies. New studies on e-commerce focus on its trends during COVID-19 ([Bhatti et al., 2020](#)), but the focus of this paper is on what has happened before the pandemic.

[Garín-Muñoz and Pérez-Amaral \(2011\)](#) suggested the use of the Theory and Technology Acceptance Model (TAM) for the estimation. The TAM combines the consumer's Perceived Utility (PU) towards online shopping and Perceived Utility Facility (PUF), which is related to the simplicity of the exchange. The explanatory variables proposed by the TAM are demographic and socio-economic factors such as age, gender, education, income, marital status, and nationality. [Garín-Muñoz and Pérez-Amaral \(2011\)](#) proposed a multinomial logit model to estimate the propensity to buy online for each type of consumer. [Vega \(2015\)](#), on the other hand, obtained results that deny the impact of socio-demographic variables such as marital status, gender or age on online commerce.

[Molinillo, Liébana-Cabanillas, and Anaya-Sánchez \(2018\)](#) use a self-developed survey to analyse, with partial least squares, traditional e-commerce sites and the requirements for including social commerce models in these sites in Spain. [Molinillo et al. \(2018\)](#) conclude that it is important for e-commerce success to try to innovate and include social networking tools.

[Valarezo, Pérez-Amaral, Garín-Muñoz, Herguera-García and López \(2018\)](#) focused on the individual decision process that leads individuals to engage in electronic commerce with foreigners, especially with the EU. The proposed models showed the importance of being foreign and ICT familiarity factors. E-commerce reduces market power, increases competition and fosters competitive prices, but also presents barriers: lack of infrastructure, online illiteracy, fears and lack of confidence. [Valarezo, Pérez-Amaral, Garín-Muñoz, HergueraGarcía, and López \(2018\)](#) recommend policy campaigns in defence of consumers and against trade barriers. Specifically, they propose a Standard Neoclassical Utility Model, and a regression of several logit models ([Valarezo et al., 2018](#)).

This essay highlights the importance that computer literacy, e-trust, and computer and Internet skills have in e-commerce. [Valarezo et al. \(2018\)](#) also found a gender bias in Spain: being male encourages shopping. However, age and being a foreigner, limit online shopping.

[Garín-Muñoz, López, Pérez-Amaral, Herguera, and Valarezo \(2019\)](#) perform an economic model similar to [Valarezo et al. \(2018\)](#). [Garín-Muñoz et al. \(2019\)](#) are critical of the evident socio-demographic gap in online activities and encourage policies, not only to increase e-commerce, but also to reduce biases and educate people with their Internet skills, which will help citizens to make good use of the Internet. Therefore, [Garín-Muñoz et al. \(2019\)](#) assert that e-banking, e-government and e-commerce are value added services. Moreover, e-banking and e-government stimulate the use of e-commerce.

To analyse the e-commerce penetration in Spain, [Pérez-Amaral, Valarezo, López, Garín-Muñoz, and Herguera \(2020\)](#) use panel data. They propose "low-cost" measures such as training programmes related to digital skills and reducing digital divide. [Pérez-Amaral et al. \(2020\)](#) also supports the digitalization of public services by boosting e-government by making ICT a kind of necessity, they also encourage companies to train their employees in the use of ICT. [Valarezo et al. \(2019\)](#) propose a similar model than [Pérez-Amaral et al. \(2020\)](#) but this one with pooled panel data, suggesting some policy recommendations as boosting digital skills variables for and from the demand side; developing a strong e-government; and, firms making things easier for customers.

[Pérez-Amaral et al. \(2020\)](#) and [Valarezo et al. \(2019\)](#) state that, even with absolute numbers like the rest of the EU, Spain lags behind the rest of Western Europe in terms of accessibility. This demonstrates the importance of Internet access and frequency of use

and why they should be included in the study.

2.3. Literature related to e-trust

Hackers who might steal your personal information or the unknown seller are reasons not to buy online (McKnight, Choudhury, & Kacmar, 2002). Peštek et al. (2011) state that the factors that most influence e-trust are: website accessibility, privacy, quality, and post-sale treatment.

Corritore, Kracher, and Wiedenbeck (2003) concluded that “trust will be one of the keys to e-commerce, if the internet user does not trust the security of a website, he will not use it”. It is important to educate consumers to use security software, take care of passwords, etc. because online commerce and services are an important key for government, consumers and businesses (Butler, 2014).

Gefen, Karahanna, and Straub (2003) use the TAM to investigate the importance of e-trust, finding that it is important that the consumer trusts in the seller and that there is no cheating in the transaction, that the website is secure and easy to use. Ribadu and Wan (2019) write about the importance of e-trust in the Muslim community. There is a propensity to shop online if people trust the transactions, the quality of the website, and the security of third-party (Ribadu & Wan, 2019).

In Spain, Martínez de Ibarreta and Gijón (2015) explain why consumers act in a risky way while browsing and carrying out online transactions, with risky behaviour being related to higher levels of e-trust. The individual variables that explain this risky behaviour would be e-trust, education, computer protection and online experience.

Another way of estimating trust would be based on the personal information that people give. Potoglou, Patil, Gijón, Palacios, and Feijóo (2013) look for the economic value to the personal information that people post on the Internet, and the conclusions they reached coincide with the “privacy paradox”: individuals are particularly concerned about the use of their personal information by companies on the Internet, however, they would not be willing to pay for a more efficient use of it.

Gijón, Garín-Muñoz, Pérez-Amaral, and López-Zorzano (2013) attach great importance to after-sales treatment in the development of customer loyalty and, therefore, trust. A satisfied customer is more likely to be loyal and develop trust than a dissatisfied one. They may stop trusting the company and stop buying from them.

Having established all the guidelines and concepts related to the state of the art of e-commerce and e-trust, the focus and contribution will be on the econometric analysis of e-trust and on a comprehensive work that tries to establish the impact of e-trust on e-commerce in a proper way. The aim is to analyse the impact of e-trust at a time of exponential growth in e-commerce. In addition, the five-year comparison will provide two snapshots and two different profiles of individuals, a relatively long period to observe the barriers that prevent individuals from developing their economic activity on the Internet. This is discussed in section 5 and further explored in section 6, which are the novelties of this paper.

Table 1
Demographic profile.

		2014		2019	
		Frequency	Percent	Frequency	Percent
GENDER	Male	1215	48.9	3066	48.6
	Female	1272	51.1	3242	51.4
AGE	18–24	210	8.4	511	8.1
	25–34	403	16.2	899	14.2
	35–44	509	20.5	1295	20.5
	45–54	456	18.3	1192	18.9
	55–64	369	14.8	971	15.4
	65–74	302	12.1	851	13.5
	>75	238	9.6	590	9.3
WAGE	Very low	981	15,04	1435	14,73
	Low	2238	34,31	3404	34,93
	Medium	1786	27,38	2636	27,05
	High	714	10,95	947	9,72
	Very high	803	12,31	1322	13,57
LEVEL OF STUDIES	Primary	87	3.5	395	6.3
	High School	492	19.8	1028	16.3
	College	1353	54.4	3425	54.4
	PhD	555	22.3	1452	23.0
CITIZENSHIP	Spanish	2291	92.1	5673	90.0
	Dual (Spanish + Other)	78	3.1	242	3.8
	Foreign	118	4.7	386	6.1
E- TRUST	Low	1929	29,58	2965	30,43
	Medium	3727	57,15	6086	62,46
	High	866	13,28	693	7,11
BROADBAND	Yes	4638	71,11	8451	86,73
	No	1884	28,89	1293	13,27

3. Data

The data was gathered using a survey by the Spanish National Statistical Institute (Instituto Nacional de Estadística, INE) conducted yearly. The survey is about ICT equipment and use by households (Encuesta sobre Equipamiento y Uso de Tecnologías de Información y Comunicación en los hogares).

For this paper, the data used was collected from January to May 2014; and from February to May 2019. For 2014, the sample consists of 2487 respondents (INE, 2014) and, for 2019, 6308 respondents (INE, 2019). This annual survey collects information on the ICT equipment of Spanish households with individuals over 10 years old, with special emphasis on those aged between 16 and 74. Both samples are representative nationwide and by gender, age, and education level. The demographic profile of the respondents is show in Table 1.

The dependent variable is a dummy that takes value 1 if the individual uses e-commerce, 0 otherwise. The independent variables used are the socio-demographic ones (male, age, education level ...), wage, ICT ability and e-trust.

About ICT ability variables, there are variables about computer use and Internet use. The variables which treat the ability with the computer use oscillate between: “low”, use of word processing programs; “medium”, all of the tasks that involve using spreadsheets, presentations or the use of links; “high”, encompassing tasks like, for example, using spreadsheets at a very advance level or using a video, picture or file edition programs, and “very high”, if know how to programming. The ones about Internet use, a low ability if it is only used for social media and the mail; if it is used as digital media and general information, giving opinions and reviews ..., it is considered medium ability; and finally, high ability if it is used to manage their money, purchases, or use e-banking or e-government.

Interaction variables will also be added to the study, these would be “Middle class single”, single individual with normal salary, “High class single”, single individual and with high salary, “High education and high e-trust”, individual with studies and who trusts on the Internet, “Low PC skills and Low e-trust”, individual who does not know how to use computers and does not trust the Internet and “Low PC skills and High e-trust”, individual who despite not knowing how to use computers trusts the Internet.

And, finally, there are variables related with e-trust, such as “security”, being positive if the individual feels safe on the web and has a security software. Then, “frequency”, between low, medium, and high, depending on how many times a week the individual connects to the Internet, and the “frequency of online shopping”. Also, linking trust with purchases and adding that buying online frequently implies greater confidence, if it is divided into frequencies (low, medium or high), depends on how much the individual buys in a year, and his/her propensity to “online storage”, understanding the use of the cloud to upload his/her information to the Internet.

4. Methodology

The Technology Acceptance Models (TAM) are the ones used by almost all studies to empirically describe the behaviour of online consumers. TAM models were developed by Davis (1989) and the extended model by Venkatesh and Davis (2000). TAM models bring together both Perceived Utility (PU) and Perceived Utility Facility (PUF), regarding online purchasing. As suggested by Gefen et al. (2003) and Pavlou (2003), different levels of e-trust, and also with socio-demographic variables interaction, are included in the model.

The dependent variable used is a dummy variable that takes value 1 if the individual buys online, and 0 otherwise. For this kind of dependent variable and with cross-section data, this model cannot be estimated using the Ordinary Least Squares method (OLS). The models that could be used are linear probability model (LPM), logit and probit models. The most obvious problem in LPM is that the estimated probability values fall outside the range of “0” and “1”. Those problems associated to linear probability models are explained, among others, by Wooldridge (2010).

Different tests are done like the Cronbach’s alpha test (Cronbach, 1951) to see the reliability of the models, if the variables included are suitable; and a Wald’s test to see the significance variables and show their true relevance in the estimation (Wooldridge, 2010).

In the next subsections, it could be found the explanation of the estimation models that are used.

4.1. Linear probability model

The LPM was estimated only for comparison with the other two binary regression models. It is known that this probability model has limitations as the results could be bigger than one or less than zero, that it is not possible in a probability (Wooldridge, 2010).

Equation (1) shows the general estimated model, where X_{ji} are the independent variables used, u_i is the error term, β_0 is the constant term and β_j are regression coefficients.

$$e - commerce_i = \beta_0 + \beta_j X_{ji} + u_i \tag{1}$$

4.2. Logit model

The logit model it is not a linear model, it is a logistic probabilistic model that gives a result between 0 and 1, that is consistent with a probability result. Equation (2) shows the theoretical logit model.

$$\Pr(y_i = 1 | x_i; \beta) = \Lambda(x_i' \beta) = \frac{e^{(x_i' \beta)}}{1 + e^{(x_i' \beta)}} \tag{2}$$

The logit model is tested with the “chi-square test” and the existence of each independent variable in the model is tested by “Wald

test statistics". However, in cases where there is a classification and assignment process and where normal distribution assumption and continuity assumption are not prerequisite, data should be analysed with logit model.

4.3. Probit model

This model assumes that the basic dependent variable is normally distributed, whereas in logit model is assumed that the variable is based on the logistic curve. Equation (3) shows the theoretical probit model.

$$\Pr(y_i = 1|x_i; \beta) = \varphi(x_i'\beta) \tag{3}$$

So, the linear probability model that would consist of subjecting the expression to OLS directly, may be adequate to see how the independent variables act with respect the probability of success of dependent variable, but it will not be able to estimate its exact influence since it does not intend to approximate the prediction to values 0 and 1 and may give values outside these which would not be valid. Between probit and logit the decision is different, both approximate their results to 0 and 1, but the probit uses normal distribution function and logit uses the accumulated logistic function, both models use the Maximum Likelihood Estimator (MLE), which guarantees that the estimators of the parameters are consistent and asymptotically normal (Wooldridge, 2010). The parameters do not have individual interpretation, but the slopes can be found that indicate their influence on the decision. Odds ratios (the ratio of the probabilities, this indicates the positive or negative influence of the variables to facilitate the successful decision) are included in the results too.

Seven empirical models are estimated using the methodology that was explained in section 4. The models are:

- Model 1: Linear Probability Model for e-commerce in 2019
- Model 2: Probit model for e-commerce in 2019
- Model 3: Logit model for e-commerce in 2019
- Model 4: Extended logit model for e-commerce in 2019
- Model 5: Extended logit model for e-commerce in 2014
- Model 6: Logit model for e-commerce and high confidence in 2014
- Model 7: Logit model for e-commerce and high confidence in 2019

5. Results

This section presents the results of the seven estimated models specified in section 4, which will be divided into five parts. First, the comparison with the LPM, logit and probit models for 2019 is given in the next subsection. Then, the extension of the logit models for 2014 and 2019 is explained. This is followed by Cronbach's alpha, a reliability test for the appropriateness of the e-commerce estimation models. This is followed by the Wald test, and finally, the models on e-commerce and high confidence are shown.

Table 2
Estimation results for e-commerce 2019.

	LPM	Probit		Logit		Odds ratio
	Coefficient	Coefficient	Slope	Coefficient	Slope	
Male	0,024*** (0,009)	0,163*** (0,060)	0,022	0334*** (0,121)	0,022	1397
Age	0,011*** (0,002)	0,056*** (0,011)	0,007	0099*** (0,022)	0,0065	1,1043
Age ²	-0,0001*** (0,000)	-0,0007*** (0,000)	-0,0001	-0,001*** (0,000)	-8,8569e-05	0,9986
Foreigner	-0,136 (0,027)	-0,068 (0,167)	-0,009	-0,140 (0,327)	-0,009	0868
Single	-0,020* (0,01)	-0,157** (0,074)	-0,0222	-0,342** (0,145)	-0,023	0,7103
High School	0,208*** (0,054)	0,694*** (0,169)	0,1004	1211*** (0,302)	0,0842	3357
College	0,232*** (0,055)	0,889*** (0,175)	0,117938	1605*** (0,315)	0,1029	4979
PhD	0,255*** (0,058)	1103*** (0,326)	0,0704503	2136*** (0,675)	0,0642	8,4711
Wage 900–1600€	0,026 (0,020)	0,131 (0,101)	0,0386828	0,228 (0,192)	0,0143	1256
Wage 1600–2500€	0,052*** (0,020)	0,304*** (0,103)	0,0369727	0,547*** (0,198)	0,0328	1728
Wage 2500–3000€	0,0518** (0,021)	0,316*** (0,122)	0,0469807	0,559** (0,238)	0,0309	1749
Wage over 3000€	0,062*** (0,020)	0,401*** (0,118)	0,0130464	0,727*** (0,232)	0,0402	2069
Medium PC skills	0,031 (0,031)	0,088 (0,139)	0,0605578	0,173 (0,250)	0,0121	1188
High PC skills	0,064*** (0,010)	-0,388*** (0,062)	-0,0167739	0,753*** (0,119)	0,057	2124
Low Internet Skills	-0,005 (0,138)	-0,133 (0,555)	0,532767	-0,389 (1049)	-0,0216	0,677
Medium Internet Skills	0,546*** (0,059)	1737*** (0,205)	0,0174271	3041*** (0,355)	0,535	20,91
Medium e-trust	0,075*** (0,013)	0,4*** (0,066)	0,0624819	0,757*** (0,126)	0,0573	2,13
High e-trust	0,091*** (0,015)	0,657*** (0,131)	0,0622	1,29*** (0,281)	0,0565	3636
Broadband	0,066*** (0,021)	0,332*** (0,097)	0,0563	0,622*** (0,178)	0,0514	1,8632
Constant	-0,268* (0,156)	-3079*** (0,655)		-5342*** (1215)		
Pseudo-R ²	0,137	0147		0,146		
Wald χ^2		423,09		419,31		
PCPC		90,8%		90,9%		

Notes: Standard deviation in parenthesis. * Significant at 10%, ** significant at 5% and *** significant at 1%.

5.1. LPM, logit and probit models: e-commerce and its determinants for 2019

Table 2 shows three estimation models for the dependent variable e-commerce: the LPM, the probit and the logit model, without interaction variables. Most of the variables included are significant at 1% level in all models, so they are assumed to be relevant in this decision making.

Among these three models, the one used in this paper is the logit model. This is because LPM does not estimate values between 0 and 1, which prevents it from proving to be a good decision model in a binary choice case. Deciding between logit and probit is more complex because both approximate their results to 0 and 1. However, the logit model allows us to see the impact of each variable on the dependent variable (odd ratios) and the percentage of correctly predicted cases in the logit model is slightly higher than in the probit. Valarezo et al. (2018) used the logit model also for e-commerce research and propose several of them. Therefore, the logit model is chosen.

The variables with the highest impact on the dependent variable for the logit model, both with the highest coefficient and the highest odd ratio, are those related to a higher salary, higher education level, and higher digital skills (see Table 2). But despite being significant for most salaries and education levels, the impact is increasing with the level of these socio-demographic variables, meaning that the higher the salary or the career-level, the more it influences the online purchase decision. These results reflect the impact of socio-demographic variables that are consistent with the results of Garín-Muñoz et al. (2019).

Among digital skills, the higher the digital skills, the higher the propensity to purchase. Therefore, e-trust presents itself as a useful variable in the estimation, having the second highest coefficient and odd ratio after Internet skills. The importance of the digital skills variables in the TAM model and the positive relationship with e-commerce coincides with the results of Garín-Muñoz et al. (2019) as well as those found by Gefen et al. (2003), also highlighting the importance of e-trust.

The only variable that shows a negative relationship with e-commerce is “single”. Thus, singles are less likely to shop online than non-singles.

There seems to be a gender gap in e-commerce participation. It could be explained as a greater inclination of men to participate in e-commerce. This gender gap is consistent with Yang and Lester (2005) and Valarezo et al. (2018).

Another special mention goes to the variable “broadband”, which is significant at 1%. Although it may seem obvious, it is important because, although having broadband is common among people who shop online, not everyone who has broadband shops online. This is explained by factors of trust and lack of digital skills, so having it in the model is necessary. The relevance of this variable is hypothesised by Gijón et al. (2016), but in the present study the hypothesis holds.

The goodness-of-fit criteria for this model would be the pseudo-R² and the Percentage of Correctly Predicted Cases (PCPC), which gave contradictory values of 0,14 and 90,9%, respectively. Subsequent reliability will be assessed by another estimator, Cronbach’s Alpha, which estimates whether the model is made with the right variables. But having a PCPC above 90% is a clear sign of reliability.

Table 3
Estimation results e-commerce 2014 and 2019.

	Logit 2014			Logit 2019		
	Coefficient	Slope	Odds ratio	Coefficient	Slope	Odds ratio
Male	0,414*** (0,076)	0,080	1,5129	0,1622*** (0,557)	0,0304	1176
Age	0,061*** (0,016)	0,011	1,06	0,068*** (0,0131)	0,0128	1,0706
Age ²	-0,0009*** (0,0002)	-0,0001	0,999	-0,001*** (0,0001)	-0,0001	0,999
Foreigner	-0,173 (0,155)	-0,034	0,8407	-0,101 (0,146)	0,01863	1,1
Single	0,294*** (0,109)	0,0563	1343	-0,0738 (0,085)	-0,0139	0,928
High School	0,133 (0,171)	0,0260	1,1431	0,538*** (0,108)	0,1037	1125
College	0,755*** (0,189)	0,137	2128	0,966*** (0,1266)	0,1625	2,62
PhD	1433*** (0,549)	0,186	4192	1016*** (0,311)	0,143	2,76
wage 900–1600€	0,272** (0,110)	0,0515	1,3126	0,118 (0,084)	0,0220	1,1259
wage 1600–2500€	0,715*** (0,143)	0,127	2045	0,393 *** (0,102)	0,0704	1,4817
wage 2500–3000€	0,905*** (0,158)	0,1455	2473	0,5328 *** (0,12)	0,0891	1,7037
wage over 3000€	1215*** (0,194)	0,183	3,37245	0,664 *** (0,131)	0,109	1,9442
Medium PC skills	0,682*** (0,105)	0,144	1978	0,8249 *** (0,068)	0,161	2,2817
High PC skills	0,403*** (0,151)	0,0842	1497	0,772 *** (0,069)	0,140	2,1650
High Internet Skills	1767*** (0,102)	0,399	5,85	-	-	-
Medium Internet Skills	-	-	-	1,91 *** (0,136)	0,438	6,8134
Medium e-trust	1671** (0,846)	0,336	5317	2464*** (0,418)	0,492	11,7630
High e-trust	2103** (0,852)	0,273	8193	2086*** (1628)	0,261	14,6625
Broadband	0,2582*** (0,0856)	0,0515	1,29	0,363*** (0,0828)	0,0725	1,4377
Middle class single	-0,221 (0,1779)	-0,0446	0,801	-0,067 (0,1422)	-0,0129	0,9344
High class single	-0,619** (0,289)	-0,134	0538	-0,115 (0,231)	-0,0223	0,8907
H. Ed. level and high e-trust	0,710** (0,310)	0,1163	2034	0,764 ** (0,331)	0,117	2,1482
low e-trust and low Pc	0,450* (0,238)	0,0819	1569	0,521*** (0,106)	0,0887	1,6844
High e-trust and low PC skills	0,717 (0,840)	0,1270	2,0346	1,4944*** (0,422)	0,2363	4,4568
Pseudo-R ²	0,219			0,319		
Wald χ^2	1324,68			3858,38		
PCPC	78%			91,1%		

Notes: Standard deviation in parenthesis. * Significant at 10%, ** significant at 5% and *** significant at 1%.

As the model is reliable, it can be said that e-commerce would be well estimated with the TAM and e-trust variables with a high fit. Then, the results presented in this paper will be in line with the results found in [Garín-Muñoz and Pérez-Amaral \(2011\)](#).

In the following models, the constant in the table results will be omitted because it has no economic impact.

5.2. Logit models: e-commerce and its determinants with interaction variables for 2014 and 2019

This section presents the comparison between two logit models for the years 2014 and 2019. These models estimate e-commerce with the variables TAM, e-trust and some interaction variables (see [Table 3](#)).

Looking at the results in [Table 3](#), there are similarities between the two years. First, most of the explanatory variables are significant for both logit models. Secondly, variables related to doctoral level (PhD), high salaries and high digital skills have the strongest influence on the dependent variable.

The impact that explanatory variables have on the probability of e-commerce differs within years. [INE, 2014](#), socio-demographic variables had higher coefficients and odd ratios on decision making. [INE, 2019](#), digital skills and e-trust were the most influential variables. Therefore, in 2019, ICT skills had more weight in the decision than any other variable. Another difference is the higher adaptation of the goodness-of-fit criterion in 2019, from a PCPC of 78% in 2014 to 91.1% in 2019.

As can be seen in [Table 3](#), socio-demographic variables such as “university”, “PhD” and salaries above €1600 have a positive relationship with the dependent variable and an odd ratio that makes them noteworthy. However, their impact is reduced in 2019 compared to 2014, with generally lower slopes and odd ratios. Moreover, although the proportion of males and females is the same across sample sizes, the impact of the dummy variable is less significant in 2019, decreasing the gender gap. As for the broadband variable, it remains relevant in the model in both years, has a positive impact on the decision and is significant at 1%. Although the impact of the aforementioned socio-demographic variables is decreasing, it is still relevant, as presented by [Garín-Muñoz et al. \(2019\)](#) and [Garín-Muñoz and Pérez-Amaral \(2011\)](#) where the TAM model is used.

[Valarezo et al. \(2018\)](#), are interested in digital skills variables. In these models most of these variables are positively related and significant at 1% with the e-commerce decision, with higher coefficients and odd ratios than in 2014, indicating a greater relevance in the final decision. In 2019 e-trust reaches slopes of approximately 0.5 and 0.3 and odd ratios higher than 10, showing a very high relevance. These results are common within the literature, such as [Valarezo et al. \(2018\)](#).

[Valarezo et al. \(2019\)](#) also propose interaction variables that are positively related to e-commerce, coinciding with the models in [Table 3](#). Within the interaction group, the variable “High e-Trust and low PC skills” is significant, demonstrating the tendency of e-trust to influence decision-making. All other interaction variables in 2019 are positive and significant.

This is not the case in 2014. There is one significant variable with a negative relationship with the dependent variable which is “single upper class”, maintaining the idea that being single means you are less likely to shop online than those with a partner.

The goodness-of-fit criteria for this model would be the pseudo-R² and the Percentage of Correctly Predicted Cases (PCPC), which give contradictory values. But the PCPC seems to be a good indicator of the reliability of this model, with 91.1%, 23% higher than in 2014. Therefore, it can also be said that 2014 is a worse predictor than 2019. Due to the contradictory values, a Cronbach’s alpha will be performed.

5.3. Cronbach alpha for the suitability of the e-commerce estimation models

Reliability is an aspect of these models that causes considerable controversy. As can be seen from the results in [Table 4](#), the goodness-of-fit criteria give contradictory values. In the face of this opposition, another reliability estimator is used: Cronbach’s alpha, which estimates whether the model is made with adequate variables, i.e. whether the dependent variable is adequately estimated with the chosen explanatory variables. [Peštek et al. \(2011\)](#) indicate that a model is reliable if the alpha exceeds 0.6, and as the result of this model is 0.74, it could be concluded that the models are reliable.

5.4. Wald test of e-trust and broadband

The importance of e-trust is something that has to be dealt with individually. Doing the Wald test of the e-trust variables and all interaction variables with e-trust, the results show p-values closer to 0, indicating that a significance of 1% is obtained (see [Table 5](#)). This confirms their significance in the proposed model, which is in line with expectations and with [Corritore et al. \(2003\)](#) and [Martínez de Ibarreta and Gijón \(2015\)](#). Likewise, the p-value allows us to justify the presence of broadband as an explanatory variable, which demonstrates its importance as assumed by [Gijón et al. \(2016\)](#).

Table 4
Reliability statistics.

Cronbach’s Alpha	Cronbach’s Alpha Based on Standardized Items	N of Items
,743	,707	32

Table 5
Trust model.

VARIABLES	F stat	p-value
Medium Confidence and High Confidence	19,1	1,19e-06
Broadband	18,66	8,01e-09
Training-Confidence, Low Confidence and Low PC Skills and High Confidence and Low PC Skills	15,27	6,48e-10

5.5. Logit models: e-trust and its determinants for 2014 and 2019

Performing the model to estimate e-trust, [Table 6](#) presents two new logit models, pertaining to 2014 and 2019 and using variables related to consumer behaviour on the Internet and TAM variables on digital skills and socio-demographics.

The 2014 model reveals low numbers in the goodness-of-fit criteria, with a small pseudo-R and a PCPC that does not reach 90%, showing no reliability. The PCPC is 82%, almost 10 points lower than the 2019 model. Showing that there is no relationship between the explanatory variable and the dependent variable (see [Table 6](#)).

Only “single”, “Security Software”, “Internet literacy”, “Online storage” and “Recent e-commerce” are significant in the model. Single and Security Software have negative slopes, which results in a reduced probability. And the rest with positive slopes and odds ratios. It is assumed that the digital skills variables related to consumer behaviour on the Internet generate variations in the likelihood of the dependent variable e-trust.

The 2019 model shows more signs of reliability, the goodness-of-fit criteria seem to be more similar to those of e-commerce. The former shows very low values, but the latter exceeds 90% (see [Table 6](#)).

The dummy variable “male” and the variables in the salary group have a positive relationship with the likelihood of trusting the Internet. As for the variables in the digital skills group, it is significant to have high PC skills, with a relatively low influence.

The model contains some new significant variables related to consumer digital skills and Internet behaviour, such as: “Low frequency of Internet use”, which, contrary to what should be believed, denotes positive trust in the Internet. “Recent e-commerce” is significant and consistent with [Gefen et al. \(2003\)](#). Logically, regular online shopping should imply greater trust. “Online storage”, using cloud systems, is positively related to higher e-trust and this is what is reflected here, which is rational too, because putting personal information on the Internet is a sign of trust in the system. This is related to the value consumers place on their personal data, which was studied by [Potoglou et al. \(2013\)](#) and concluded with the “privacy paradox”. People may be paying for better use of their information by using cloud systems, or they are using it for free by accepting the risks.

Having “security software” is significant at 5% and negative, implying that having it means less e-trust. This relationship of security software and e-trust seems different from the one shown in [Martínez de Ibarreta and Gijón \(2015\)](#), which meant that having security software could be a false sense of security for consumers. In this case security software denotes less trust and therefore less risk.

Table 6
Estimation results for High confidence (2014 and 2019).

	2014			2019		
	Coefficient	Slope	Odds ratio	Coefficient	Slope	Odds ratio
Male	0,091 (0,095)	0,0129	1,09	0,289*** (0,089)	0,201	1,33
Age	-0,017 (0,023)	-0,002	0,983	0,014 (0,020)	0,001	1,01
Age ²	5,12e-05 (0,00002)	7,33e-06	1,0001	-0,0002 (0,0002)	-1,959e-05	0,99
Foreigner	0,379 (0,204)	0,060	1,461	0,170 (0,226)	0,014	1,18
Single	-0,124* (0,117)	-0,018	0,883	-0,092 (0,111)	-0,007	0,91
High School	-0,390 (0,117)	-0,057	0,676	-0,388	-0,029	0,67
College	-0,435 (0,294)	-0,061	0,647	-0,253 (0,282)	-0,018	0,77
PhD	-0,088 (0,446)	-0,012	0,916	-0,423 (0,419)	-0,026	0,65
wage 900–1600€	-0,237 (0,164)	-0,033	0,789	0,211 (0,179)	0,016	1,23
wage 1600–2500€	-0,124 (0,169)	-0,018	0,883	0,359** (0,179)	0,028	1,43
wage 2500–3000€	-0,137 (0,196)	-0,019	0,872	0,477** (0,202)	0,040	1,61
Wage over 3000€	0,051 (0,196)	0,007	1,052	0,608*** (0,191)	0,052	1,83
Medium PC skills	0,119 (0,179)	0,017	1,127	0,204 (0,138)	0,014	1,22
High PC skills	-0,401 (0,252)	-0,064	0,669	0,255** (0,105)	0,018	1,28
Medium Internet Skills	0,4883** (0,229)	0,061	1,529	0,255 (0,731)	0,031	1,68
Security Software	-0,3353** (0,164)	-0,053	0,715	-0,209* (0,117)	-0,016	0,81
High frequency using Internet	0,367 (0,232)	0,047	1,444	1,058 (0,301)	0,054	2,88
Low frequency using Internet	0,236 (0,694)	0,036	1,266	0,469*** (0,779)	0,041	1,59
Recent e-Commerce	0,349*** (0,123)	0,048	1,41	0,337** (0,136)	0,023	1,39
Not recent e-commerce	-0,027 (0,197)	-0,004	0,973	-0,221 (0,269)	-0,015	0,8
Online Storage	0,302***	0,044	1,353	0,232** (0,096)	0,0167	1,26
Pseudo R ²	0,021			0,036		
Wald χ^2	68,17			144,26		
PCPC	82%			91,1%		

Notes: Standard deviation in parenthesis. * Significant at 10%, ** significant at 5% and *** significant at 1%.

It can be concluded that the 2019 model shows that e-trust can be estimated with TAM variables and some behavioural variables. This denotes that better Internet browsing resources translate into higher trust that could lead to risk-prone behaviour, as stated by [Martínez de Ibarreta and Gijón \(2015\)](#).

6. Conclusions

The main objective of this paper is to identify and estimate the determinants for participating in e-commerce and developing e-trust, as well as the importance of e-trust for e-commerce in Spain.

Several conclusions can be drawn from the empirical results and the comparison between 2014 and 2019. There are notable changes between the two dates in terms of the impact of the explanatory variables on the final decision. Considering the odd ratios, the weight of variables related to digital skills has increased significantly between the two years, while socio-demographic variables have lost relevance over time. This change suggests an increase in the importance of online literacy and a narrowing of the digital divide. At least in terms of gender, education, and age.

E-trust is a relevant variable in the estimation of online commerce, according to the Wald test result. Moreover, it has the highest odd ratios, showing a huge impact on the final decision, as expected according to [Corritore et al. \(2003\)](#). The weight of the variables of digital skills, Internet, and computer skills have also considerably increased its importance in the probability of the final decision, as in [Garín-Muñoz et al. \(2019\)](#).

The growing relationship between digital skills variables and e-commerce shows the increasing importance of developing digital skills and promoting them in public education, as in [Valarezo et al. \(2019\)](#) and [Corritore et al. \(2003\)](#). Moreover, if digital skills, as it turns out, influence e-trust. The impact is twofold. Better education equals growth in online commerce and e-trust. In addition, more e-trust equals more e-commerce. Therefore, Internet use also influences the use of e-commerce and the development of e-trust. A result also found in [Martínez de Ibarreta and Gijón \(2015\)](#).

The importance of a good Internet connection, broadband, is also observed in both years, following the hypothesis put forward by [Gijón et al. \(2016\)](#). E-commerce is not simply a matter of having the Internet at home. It depends on many other factors. That is why the quality of the Internet has to be taken into account.

Another conclusion drawn from the comparison of the two years is the reduction of the gender gap, which is still significant. This importance is noted in the literature by [Garín-Muñoz et al. \(2019\)](#) or specifically the gender-sensitive dummy [Yang and Lester \(2005\)](#). However, the gender gap can be understood in several ways: either women are less interested in e-commerce, are not as confident or are not attracted to the products.

Variables related to the age, salary and education of individuals are also significant. However, they become less relevant over time, indicating an increase in the digital divide. It is also concluded that singles are reluctant to engage in e-commerce, regardless of their income, ignoring the impact of income on e-commerce found in [Garín-Muñoz et al. \(2019\)](#), and contradicting the results of [Vega \(2015\)](#). Another variable with negative impact is security software, in this case, estimating e-trust.

Speaking of the e-trust study. The 2019 estimate also shows the particular importance of online activities in the development of trust. The use of online storage or regular use of the Internet and knowledge of its use stimulate the development of trust. Meanwhile, there is also a gender difference in this estimation, as men tend to develop higher levels of e-trust.

Another non-significant variable, coinciding with the results of [Valarezo et al. \(2018\)](#), is the “foreign” variable, which would be interesting to study specifically for foreign online commerce. [Valarezo et al. \(2018\)](#) found that in foreign e-commerce, “foreign” was significant.

Therefore, the TAM model is useful to estimate both digital activities, as expected by [Garín-Muñoz and Pérez-Amaral \(2011\)](#), [Gefen et al. \(2003\)](#) and others.

Finally, some policy recommendations could be suggested:

From the policy makers’ point of view: they should promote measures to increase ICT literacy and Internet accessibility, boost competitiveness, develop e-trust and maximise citizens’ utility. This reinforcement of these variables was also presented by [Garín-Muñoz and Pérez-Amaral \(2011\)](#). These measures should be promoted by the Autonomous Communities because they are the ones with competences in education. But ideally, a comprehensive plan should be implemented at the national level.

Governments should develop measures to reduce the gender gap, which is one of the barriers to e-commerce, something that was seen, for example, by [Yang and Lester \(2005\)](#), almost 15 years ago, or [Garín-Muñoz et al. \(2019\)](#).

The gender gap barrier and all the other barriers that the digital divide makes e-commerce endure should be addressed by public administrations, as recommended by [Valarezo et al. \(2018\)](#). Improve the security of online shopping and stimulate demand to help this market. The use of online administration should be encouraged because it could help people to develop their ICT skills and boost e-government, [Valarezo et al. \(2019\)](#).

From the point of view of entrepreneurs. If companies want to successfully penetrate online commerce, they should try to attract buyers by innovating, [Molinillo et al. \(2018\)](#). Companies should focus their efforts on data protection measures that guarantee their e-trust, promotions and ensure a good after-sales service, increasing the consumer loyalty index, as pointed out by [Gijón et al. \(2013\)](#), and improve e-trust, recommended by [Martínez de Ibarreta and Gijón \(2015\)](#).

Another policy that entrepreneurs should apply is to focus their marketing campaigns on targeting those market segments that are less likely to shop online. Women and singles, according to the aforementioned results. Something already considered in [Pérez-Amaral et al. \(2020\)](#). Therefore, they also encourage companies to invest in digital skills training for their employees and to make the e-commerce website accessible to all audiences. [Pérez-Amaral et al. \(2020\)](#).

6.1. Limitations

There are some limitations related to the data. As it is a cross-sectional household survey, it is not possible to make a panel data to study the evolution over time. It is not known whether they are the same individuals over time. Another limitation is the absence of data from Covid-19, so it is not possible to measure the impact of the pandemic.

Another limitation is related to the lack of knowledge of the behavioural patterns of single people. They are less likely to participate in online shopping, but it is not known why. This problem is repeated with the security software variable, since when investigating e-trust, having security software installed is detrimental to the development of e-trust.

6.2. Future research

Considering the results presented, the current situation of the pandemic and its expected evolution, new areas of research could emerge:

To address the limitation of the lack of research on the impact of the pandemic on e-commerce, new research on this impact could be conducted, as proposed by Bhatti et al. (2020) and Galeano (2020). This new research could focus not only on the consumers' point of view, but also on the impact on e-business and e-government.

This study provides policy recommendations for business and government. The impact of Covid-19 on business e-commerce and e-government could be explored.

Another issue arising from the pandemic is the impact it is having on perceptions of security and risk on the Internet. Also, how their perception of the value of their personal information has changed, along the lines of Potoglou et al. (2013) and Martínez de Ibarreta and Gijón (2015).

Note. This figure collects the variation in the volume of business of electronic commerce in Spain, in millions of euros (bars) and percentage (line).

Source: CNMC (2020).

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