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## Conference Paper

# The actually online banking consumer

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# The actually online banking consumer

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**Keywords:** traditional banking, online banking, consumers, survey data, econometric models

## Abstract

This paper carries out an exhaustive analysis of the implementation of e-banking in Spain, the impact of the reduction of bank branches and how both phenomena affect the elderly and the rural world. This allows us to take a picture of the user affected by the digital divide when using e-banking and to get to know them to support them in the digitisation process. The study is conducted by developing a logit model with random effects and a complete descriptive study of the panel data from the survey on equipment and use of information and communication technologies in households between 2017 and 2021, obtaining very important results: the fewer bank branches per thousand inhabitants, the greater the propensity to use e-banking, age and the development of e-skills are a differentiating factor in the adoption of e-banking services, a strong gender gap remains, there is no deep implementation of the other tools provided by digital banking. It is necessary to enhance the financial and online knowledge of individuals to maximise their usefulness in the use of digital banking services.

## 1. Introduction.

Digitalization and the adoption of fintech technologies have led to a major reorganization of the financial sector, reducing physical offices (bank branches) in many areas. Banks and other financial institutions are closing physical branches to reduce operating costs and focus more on digital services (Vives, 2019). This trend is more pronounced in urban areas, where internet penetration is high and customers are more willing to use online services and has been accelerated by the COVID-19 pandemic (Osei, Cherkasova & Oware, 2023). As a result, a

rapid digitalization of operations and services (Baret, Celner, O'Reilly & Shilling, 2020) can be observed, with all banking services and operations being implemented on digital devices (Nguyen, Lan & Dang, 2018). Digitalization allows financial institutions to operate more efficiently, with less need for physical infrastructure but has a negative impact on users, especially the elderly.

But what are fintech and digital banking? All banking transactions are carried out in a virtual environment. FinTech, short for Financial Technology, refers to the innovative use of technology in the design and delivery of financial services and products. FinTech covers a wide range of applications and services, including Digital payments, online banking, personal finance management, lending platforms, investment services, blockchain and cryptocurrencies, InsurTech, etc (Carlin, Olafsson & Pagel, 2017). On the other hand, as part of fintech technologies, the essence of digital banking (a term that goes beyond online banking as it encompasses all forms of banking conducted through digital channels, including online banking) is that both banking and financial services customers can access their bank online (Shah & Clarke, 2009).

The basic difference between online banking and traditional banking services is that in the latter, customers have to visit the branch in person. In contrast, in Internet banking, all transactions can be carried out through electronic devices. Digital banking via phone, internet, and mobile has become an important way of delivering multi-channel services to customers, which is challenging traditional banking models (Cortiñas, Chocarro & Villanueva, 2010; Dootson, Beatson & Drennan, 2016). For all this migration to the digital territory,

techniques corresponding to Artificial Intelligence (AI) or blockchain have been used (Alnaser, Rahi, Alghizzawi & Ngah, 2023).

The 2007-2009 financial crisis catalysed major regulatory and structural changes in the banking sector, pushing it towards greater digitalization and efficiency (Vives, 2019). In its aftermath, the COVID-19 pandemic has again forced the financial sector to further adapt its services to digitalization and the needs of its wide range of users, creating new sources of the digital divide.

The role of e-banking, an online service, in the digital divide should not be overlooked. The digital divide reflects the gap in individuals' connectivity to the internet, either a physical divide, due to lack of equipment, or a usage divide, those benefits that can be obtained from the internet but are not used for various reasons (Lythreitis, Singh & El-Kassar, 2022). This digital divide leads to inequality between users, has been exacerbated after the pandemic, and is not limited to e-banking, but to all e-services, and translates into employment or economic impacts (Stantcheva, 2022). Therefore, beyond the impact of the pandemic, analysis of e-banking can provide data on the digital divide in usage and adoption to improve current policies to reduce inequality.

This paper explores the importance of online banking for the financial sector and how the pandemic has accelerated digital adoption in society. It aims to analyse the factors influencing individuals' willingness to use online banking, focusing on those who did not use it before the pandemic and those who intend to return to traditional banking. The paper also addresses digital inequality, considering gender and age differences, and suggests that e-banking and other digital services could make financial services more accessible to everyone. This makes it possible to analyse the profile of those who resist innovation and to develop a specific marketing strategy for this sector. In the Spanish case, for example, the abolition of a certain number of branches and the impact on the elderly and their families.

Although the above studies have established

an understanding of e-banking services and the variables affected by and for them, these studies lack details of the digital divide determinants. This study, which analyses the factors conditioning the adaptation of users to this new digital environment, provides knowledge for the development of inclusive public policies, the reduction of the digital divide, and the development of regulations that protect the interests of the most disadvantaged. The current research adds value in e-banking literature as it integrates acceptance of technology with individuals' connectivity gap and hence enhances the body of knowledge on inequality components.

Therefore, the following research questions are postulated, is the consumer entering online banking after the pandemic an occasional consumer, or has he or she become loyal to online banking? Resistance to innovation or lack of e-trust? Is there a disadvantaged group being excluded from this service?

The rest of the paper is structured as follows: Section 2 provides the main theoretical background on which the research hypotheses are formulated. The methodology, the research design, and the description of the data used in the study are described in Section 3. The results are in Section 4. Section 5 discusses the results, putting them in the context of related work, and concludes the paper by outlining limitations, future research directions, and practical implications of the current research.

## **2. Literature review**

Over the past few decades, the banking sector has experienced substantial changes due to technological advancements, regulatory shifts, and evolving consumer behaviours. The emergence of digital banking and financial technology (FinTech) has transformed consumer interactions with financial institutions. Online banking platforms and mobile apps have simplified access to and management of financial information, enhancing financial literacy and enabling better financial decision-making (Carlin, Olafsson & Pagel, 2017). E-banking adoption in the financial sector is driven by the need for convenience, cost reduction, changing consumer

preferences, technological advancements, enhanced customer experience, improved security, and market competitiveness. The COVID-19 pandemic, due to the crisis faced by economies worldwide, acted as an accelerator for the digital revolution (Gavrila Gavrila & de Lucas Ancillo, 2021; Nagel, 2020), making the transformation essential for the future of banking (Kitsios, Giatsidis & Kamariotou, 2021).

The use of information and communication technology in banking services is relatively advanced, e-banking can be in the forms of Automated Teller Machines (ATMs), Electronic Wallets (e-wallets), debit cards with chips, Mobile Banking, Internet Banking, and Bizum transfers, among others (Malaquias & Hwang, 2019). Therefore, face-to-face interaction as a process of consumption activities for customers and banking employees is replaced by customer interactions with technology. The patterns of consumer behaviour also change over time with the increasing use of technology in banking services (Najib, Ermawat., Fahma, Endri & Suhartanto, 2021). The most important elements required in the electronic environment are trust and loyalty (Van Esterik-Plasmeijer & Van Raaij, 2017).

The digitalization of the banking sector has been generated by the adaptation of the sector to the changing external (pandemic) and internal contexts of its competition in the market (technological adaptation for cost efficiency, among others) and, as a consequence, there has been a digital disruption that has affected those users who are less prepared for the change (Weber, Mittwoch, Herbet-Homenda & Stefaniuk, 2024). These disruptions impact the daily lives of individuals and their study through the digital divide has been studied for decades, the evolution of the changing environment of technology is producing new negative effects that need to be addressed by academia. The following is a review of the main elements of analysis for the digital divide created by e-banking and how this paper is proposed to advance in its study.

#### *E-Banking, digital divide and inequality.*

The digital divide, defined as the gap

between those with sufficient access to ICTs and those without, can exacerbate inequalities and affect individuals' material and working conditions (Lythreatis, Singh & El-Kassar, 2022; Scheerder, Van Deursen & Van Dijk, 2017; Van Dijk, 2020). This divide can manifest itself in different ways.

The first level of the digital divide relates to the lack of electronic devices and connectivity, such as computers, reliable Internet connection packages and mobile phones (Levente, Csaba, Ott, Zsolt & Harris, 2022; Scheerder, Van Deursen & Van Dijk, 2017). The second level relates to the use of online services, which depends on individual digital literacy (Garín-Muñoz, López, Pérez-Amaral, Herguera & Valarezo, 2019). In addition, there is a third level (Van Deursen & Helsper, 2015), known as the digital achievement divide, where inadequate Internet use hinders individuals' attempts to use online services, thereby reducing job opportunities and income (Stantcheva, 2022; Grošelj, Reisdorf, Dolničar & Petrovčič, 2022).

Digital inequality, which results from differences in material conditions due to users' online activities, is primarily associated with the second and third levels of the digital divide (Lythreatis, Singh & El-Kassar, 2022). These divides are often correlated with individual characteristics, online skills and beliefs about internet use (Foroughi, Iranmanesh & Hyun, 2019). As a result, those most affected are older people who are not ICT literate, adults who are not integrated into ICT, and those who choose not to participate in the digital revolution. In addition, living in rural areas poses further constraints (Pérez-Amaral, Valarezo, López & Garín-Muñoz, 2021).

Developing the skills to use digital services involves meeting personal social and self-esteem needs and trusting the service provider, which are critical to user satisfaction and continued use (Bauer, Hammerschmidt & Falk, 2005; Wang, Shi & Yuen, 2022). The financial crisis has not narrowed the digital divide, and the pandemic has widened it; households unable to upgrade their equipment face fewer educational and employment opportunities and poorer mental health (Stantcheva, 2022). Moreover, even if they do have devices, poor

broadband infrastructure and connectivity are major problems (Pérez-Amaral, Valarezo, López & Garín-Muñoz, 2021). Thus, digital literacy and the digital divide have a significant impact on individual opportunities and experiences, making the study of digital inequality essential.

Geographical perspectives help to explain the spatial distribution of the digital divide through user-generated data and the resulting spatial inequalities (Ferreira, Vale, Carmo, Encalada-Abarca & Marcolin, 2021; Graham, 2011; Yang et al., 2016). Inequalities arise when frequent and extensive use of ICTs does not lead to beneficial socio-economic outcomes (Baller, Dutta & Lanvin, 2016; Van Deursen et al., 2015).

Financially, inequalities are treated as financial inclusion, which enables access to affordable and useful financial products (World Bank, 2018). The adoption of e-banking and fintech significantly improves women's employment and reduces gender inequality, especially in businesses that lack traditional financial access. Fintech not only increases the number and proportion of female employees, but also alleviates financial constraints for women-owned businesses (Loko & Yang, 2022). It uses digital financial tools to increase access to and use of financial services for populations that are disproportionately excluded from the traditional financial system (Sahay & Cihak, 2018).

In addition, other groups significantly affected by the current developments in the banking sector and thus by the development of e-banking are older people (Weber, Mittwoch, Herbet-Homenda & Stefaniuk, 2024). There are few studies on the adoption of e-banking by older people, and most research comes from institutional or policy perspectives rather than empirical domains (G20/GPFI, 2019; OECD, 2020). We discuss these constraints in more depth below.

#### *Sociodemographic conditions for e-banking*

Sociodemographic factors play a crucial role in influencing individuals' interactions with the digital environment, with a particular impact on online banking (Van Dijk, 2020; Garín-Muñoz et al.,

2019).

According to Lips, Eppel, Craig and Struthers (2020), age and gender are among the most influential factors in overall Internet use, with significant differences in Internet use between age groups. For example, Internet use drops from 82% of adults aged 65-69 to 44% of those aged 80+. Furthermore, while 70% of adults aged 65-79 have a high-speed Internet connection at home, this figure drops to 47% among those aged 80+. Older adults are less likely to use mobile devices to access the internet and generally rate their internet literacy lower than younger adults. Confidence in managing personal data online is also lower among older adults, with only 47% of those aged 75+ feeling confident, compared to 85% of those aged 16-24. These differences highlight the need for targeted interventions to increase older adults' digital inclusion by improving their skills, confidence and access to technology. White and Selwyn (2013) already reported significant differences affecting the over-65s in their study of the English population and concluded that for elderly people, particularly those aged 65 and over, there are significant disparities in Internet access and use. Respondents under 65 years old were found to be between 5.31 and 8.21 times more likely to report having Internet access compared to those aged 65 or over. The authors suggested that age is a critical factor in digital inclusion, with older adults being less likely to engage with the Internet. Despite efforts to promote digital inclusion, these age-related inequalities persist, highlighting the challenges in addressing digital exclusion among the elderly.

The digital divide also reveals significant differences in access to and use of technology between men and women. Women, particularly in developing countries, face greater barriers due to socio-economic factors, educational disparities and cultural norms (Hafkin & Huyer, 2007). This gap extends to digital literacy, limiting women's ability to benefit from online services such as e-banking, digital education and remote working opportunities. In addition, habitat plays a key role in understanding the digital divide in e-banking. In rural areas, limited

access to high-speed internet and digital infrastructure exacerbates the digital divide and hinders residents' ability to use online banking services (Whitacre, Gallardo & Strover, 2014).

Bridging this gap will require significant investments in digital infrastructure, targeted education initiatives and policies that promote equitable access to technology. Therefore, a deeper analysis of socio-demographic determinants is essential to address the gender digital divide and improve the digital inclusion of older adults and rural populations, as highlighted by Van Dijk (2017) and Garín-Muñoz et al. (2019) in their study on Spain.

In summary, the digital divide primarily involves social and economic factors, while also considering geographical factors (Warf, 2018). Although the digital divide in terms of coverage and access to technologies has been extensively studied, the second and third levels of the digital divide, which are smaller from a geographical perspective, have not been addressed as comprehensively. Additionally, while there is research on the usage gap and its real-world consequences, the relationship between these levels is rarely considered and inadequately discussed. To fill this research gap, this study demonstrates the emerging need to triangulate the three broad sets of factors to understand the digital divide due to their impact on access to the resources or services provided by technology. Although e-banking is not the only online service, it effectively illustrates the relationship between individuals and e-services. Therefore, it serves as an initial approximation that can be extrapolated to understand the digital divide in Spain.

### **3. Methodology**

#### *Data Sources*

Data on e-banking adoption and respondents' personal features are sourced from the INE survey (Survey on ICT equipment in Spanish households). This survey has an unbalanced panel structure, covering the years 2017 to 2021, with each wave containing between 15,000 and 18,000 observations (INE, 2021a).

Information on bank branches was sourced

from the Banco de España, which maintains a registry of supervised entities. To minimize potential endogeneity issues with the survey variables, we used figures from January of each year. Among the various categories of entities, we selected those classified as “bancos” [banks], “cajas de ahorro” [saving banks] and “cooperativas de crédito” [credit cooperatives]. These categories were chosen because they represent institutions where the average individual is likely to deposit savings and conduct financial or banking operations, thereby providing a reasonable proxy for typical banking activity locations (Banco de España, 2024).

Integration of these data sources has been carried out using province and habitat classifications, which categorize municipalities based on their population size, this has been extracted from the INE population census (INE, 2021b).

#### *Variables*

##### Dependent Variable

In our models, the dependent variable is the use of e-banking services, represented as a dummy variable (1: yes, 0: no). This corresponds to the item in the survey that specifically asked: “have you used online banking in the past year”.

Additionally, we investigate more specific banking operations, such as the buying and selling of stocks or other financial assets, applying for loans, and purchasing insurance. These specific banking activities are also measured as binary response variables (yes/no).

##### Explanatory Variables

The explanatory variables in our models, which we consider as drivers of e-banking use, can be classified into four categories:

##### a) Personal Features

- Age: We hypothesize a non-linear relationship between e-banking adoption and age, expecting an inverted U-shape with a peak around the age of 40. Consequently, we include both age and age squared in our models to capture this effect.

- Gender: There are no prior expectations regarding gender differences in the likelihood of

adopting e-banking services.

- Years of Education: We anticipate that higher levels of education will be associated with increased e-banking adoption.

- Spanish Nationality: This is a dummy variable (1: yes, 0: no). We expect that individuals with Spanish nationality are more likely to use e-banking services.

- Employment Status: This variable distinguishes whether the individual is employed or not. We hypothesize that employed individuals, due to having less leisure time, are more likely to use e-banking services for convenience.

#### b) Features Related to Digital Skills

Adopting e-banking is facilitated when individuals possess the necessary equipment, are familiar with and have basic skills in using the Internet and have confidence in online security. Therefore, we have included the following variables:

- Having a Computer or Laptop: This dummy variable indicates whether the individual owns a computer or laptop.

- Daily Use of Internet: This dummy variable captures whether the individual uses the internet daily.

- Mobile and Computer Use Skills: This dummy variable represents having at least medium-level skills in using mobile devices and computers.

- E-Trust: This construct ranges from 0 to 2, aggregating two survey items related to trust in Internet safety. Higher values indicate greater trust in the safety of online activities. These items had the following wording "How confident you are on the Internet".

#### c) Household Features

- Household Income (in logs): We posit that higher household income is associated with greater use of banking services, which in turn increases the likelihood of using e-banking.

- Household size (in logs). Larger households make have more banking activity, which could increase e-banking. However, in larger households, there may be less need for everyone to use online banking services, as they might delegate these tasks to other members, possibly younger or more digitally

literate. The net effect of these opposing forces is unclear a priori.

#### d) Environmental Features.

These are the features in which this paper is focused.

- Type of Habitat: For anonymity reasons, the survey does not provide information about the specific municipality where each respondent lives. Instead, it indicates the type of habitat based on the size of the municipality, ranging from 0 to 6, where 0 indicates a municipality with a population above 500,000 inhabitants, and 6 indicates a municipality with fewer than 10,000 inhabitants. We reverse-coded and log-transformed this variable to approximate the actual size of the municipality. We believe that e-banking, like many innovations, initially emerged in urban areas before gradually spreading to rural regions. Consequently, we expect that individuals residing in larger municipalities are more likely to have adopted e-banking, all else being equal.

- Density of Bank Branches per 1,000 Inhabitants: We compute this variable at the province level and by year as a proxy for the availability of nearby physical bank branches and ATMs. We hypothesize that, all else being equal, a lower density of bank branches will increase the propensity to adopt e-banking. Given that branch density may vary across different types of habitats within each province, we refine this variable by calculating it for each province-year-type of habitat.

- Proportion of Population Over 65. We calculated the proportion of the population aged 65 or older for each province. Technological innovations are generally more likely to be adopted by younger people. Given that the spread of innovations often occurs through social contagion and interaction, we hypothesize that, all else being equal, individuals living in provinces with a higher proportion of elderly residents (i.e., more aged provinces) will have a lower probability of adopting e-banking, regardless of their own age. By incorporating these diverse explanatory variables, our models aim to provide a comprehensive understanding of the factors influencing the adoption

of e-banking services.

#### *Estimation strategy*

The general equation to be estimated takes this expression

$$ebank_{it} = \sigma(\beta_0 + \beta branch\ density_{it} + \delta X + \alpha_i + Year_t + \varepsilon_{it}) \quad [1]$$

Where  $i=(1,2,3\dots)$  is the subscript indicating the individual,  $t=(2017, \dots, 2021)$  is the time subscript,  $s$  denotes the sigmoid functional form of the logit models, branch density accounts for the density of bank branches per 1,000 inhabitants (at province level or at the province-type of habitat level, depending on the models).  $X$  represents all the rest of explanatory variables, whose effect on the likelihood of using e-banking services is captured by the vector of parameters  $\delta$ .  $\alpha_i$  denote individual fixed effects,  $Year_t$  are the time year fixed effects and  $e$  is the usual error term.

As the dependent variable is of binary nature, we have estimated logit panel models, although we have tried also linear probability models (as robustness checks), giving almost identical results (Wooldridge, 2010).

We have chosen random effects estimation strategy (Hausman, 1978). The random effects estimation strategy is particularly suitable for a large dataset (50,000 individuals over 5 years) as it allows for the inclusion of time-invariant variables, such as gender and nationality that do not vary over time. Additionally, it produces estimates that are more efficient by utilizing both within and between individual variation, making it ideal for a large sample size (Baltagi, 2021).

As e-banking adoption has an increasing trend along time, we have also added yearly time fixed effects to take account of this effects.

To prevent heteroskedasticity issues we make inference based on heteroskedastic robust standard errors, clustered by individual.

In our analysis, we employ hierarchical regression, an incremental modelling approach that involves adding sets of explanatory variables in successive steps. This method allows us to assess the

incremental explanatory power of each set of variables. We begin with a baseline model that includes only the density of bank branches as explanatory variable, and then progressively introduce additional sets of variables, such as personal features, digital skills, household characteristics, and the other environmental factors. To assess the incremental contribution of the newly added variables, we use the Likelihood Ratio Test (LRT) to compare nested models. Furthermore, we examine the coefficients and p-values of the newly added variables to determine their statistical significance. This step-by-step approach allows us to understand how different sets of variables collectively influence the likelihood of adopting e-banking services.

#### **4. Results**

The proportion of e-banking adopters has been increasing steadily from 2017 to 2021, across all age groups. Table 1 presents the adoption rates by year and age decade. The data indicates that the overall adoption rate rose from 0.547 in 2017 to 0.678 in 2021. The highest adoption rates are observed in the 30-40 and 40-50 age groups, while the lowest are found in the 70-80 and 80+ age groups. Notably, the adoption rate among individuals aged 80 and above remained static at around 0.3 throughout the period. Apart from this age segment, there was a marked acceleration in adoption rates during 2020 and 2021, likely driven by the lockdowns and mobility restrictions imposed due to the COVID-19 pandemic. This trend underscores the significant impact of the pandemic on the digital transformation of banking services.

**Table 1. Proportion of e-banking by year and age**

Regarding the number of bank branches per 1,000 inhabitants, there has been a significant decrease from 2017 to 2021. In 2017, there were 28,456 bank branches across Spain, resulting in a ratio of 0.611 branches per 1,000 inhabitants. By 2021, the number of branches had declined to 22,091,



reducing the ratio to 0.466 branches per 1,000 inhabitants, a decrease of 23.7%.

When examining different population habitats, the reduction was more pronounced in larger municipalities with populations exceeding 500,000, where the ratio decreased by 27.8%. In contrast, smaller municipalities experienced a lesser reduction of 19.8%. This steeper decline in larger cities could be partially attributed to the processes of bank consolidation, leading to the closure of branches that were previously part of different banks but became redundant post-merger due to their proximity.

**Table 2. Number of bank branches by 1,000 inhabitants by year and municipality size**

To fully understand the level of e-banking adoption and the density of bank branches, it is essential to analyse their variability across territory, doing analyses at province level. Not all provinces exhibit the same degree of e-banking adoption or bank branch density, nor have these factors evolved uniformly over the analysed period.

In 2017, the province of Teruel, one of Spain's least populated areas, had the highest ratio of bank branches per 1,000 inhabitants at 1.394. Conversely, Cádiz, (excluding the cities of Ceuta and Melilla located in North Africa, with much lower ratios, due to their peculiar location), had the lowest ratio at 0.397. Throughout the analysed period, all provinces experienced a decrease in their bank branch ratios. Teruel saw the smallest decline of just -0.072, whereas Tarragona experienced the largest decrease at -0.361.

Figure 1 illustrates the provincial map of Spain, showing bank branch ratios per 1,000 inhabitants in 2017 and the changes from 2017 to 2021. Figure 2 similarly depicts e-banking adoption levels by province in 2017 and the variations over the same period. These figures highlight significant territorial diversity in these measures, and the necessity of incorporating these elements into models explaining the determinants of individual adoption behaviours.

**Figure 1. Bank Branches density by 1,000 inhabitants (2017) and growth rate 2017-2021**

**Figure 2. Proportion of e-banking 2017 and growth rate 2017-2021**

**Figure 3. Relationship between bank branches density and e-banking proportion by province (2021)**

Additionally, Figure 3 presents a scatterplot at the provincial aggregate data level, showing the relationship between bank branches ratio and e-banking adoption in 2021. An inverse relationship is evident, indicating that provinces with the lowest bank branch ratio also exhibit higher levels of e-banking adoption.

Table 3 shows the descriptive statistics for the whole sample of the variables used in the models. It can be highlighted that the average adoption rate of e-banking stand at 62.3% for the whole time period, illustrating a significant engagement with digital banking services among the surveyed population. Bank branch density per 1,000 inhabitants showed variability, both at the provincial level (average 0.593) and when refined by habitat within provinces (average 0.585). The age distribution of respondents ranged widely from 16 to 105 years, with an average age of approximately 49 years. Key demographic indicators show that 47% of the respondents were male, and 56.2% were employed. Most respondents had access to technology, as evidenced by high rates of computer or laptop ownership (86.5%) and daily internet use (83.1%). Trust in electronic transactions (e-trust level) averages at 0.7, indicating a moderate level of trust. Education levels average around 12 years, and about 46.3% of respondents possess medium skills in mobile and computer use.

**Table 3. Descriptive statistics for the estimation sample of model 4 (N=51,585)**

**Table 4. Panel logit models estimates for e-**

## banking dependent variable

The likelihood ratio tests performed reject the null hypothesis in all cases at 5%, indicating that the approach of successively adding blocks of variables to the model 0 has been correct and that the blocks of variables added in each case are jointly significant. As number of observations differs among models, to carry out these tests we have re-estimated the models using the smallest sample size (51,585 observations in model 4).

The analysis of the coefficients across various models, as presented in Table 4, reveals a notable consistency in their estimates. Most of the variables not only exhibit statistical significance but also align with the anticipated directional hypotheses.

Specifically, the coefficient associated with the number of bank branches per 1,000 inhabitants is consistently negative across all model specifications. This suggests an inverse relationship between the density of physical bank branches and the propensity to adopt electronic banking; as the number of branches decreases, the likelihood of embracing e-banking correspondingly increases.

The relationship between age and the adoption of e-banking appears to follow an inverted U-shaped curve. This pattern is underscored by the significant and negative coefficient for the squared age term. Utilizing basic calculus, the peak of this curve, representing the age at which the likelihood of adopting e-banking is maximized, is calculated as:  $-\beta_{\text{linear}}/(2*\beta_{\text{squared}})$ . In the full model (model 4) this calculation yields an age of approximately 46.6 years.

Additional findings indicate that higher levels of education and employment status significantly enhance the likelihood of adopting e-banking, confirming our expectations. However, the analysis also uncovers a surprising gender disparity: men are more likely than women to use e-banking. This result was unexpected and may reflect historical gender biases in technological engagement within Spain, where men have traditionally been more associated with technology usage. Also being Spanish, is seen to positively influence e-banking adoption, likely due to having proficiency in Spanish

language and improved access and understanding of online banking interfaces in Spanish.

Regarding the features related with technological equipment, skills and attitudes the presence of a computer or laptop at home, increases likelihood of e-banking. Notably, daily internet usage plays a crucial role in enhancing the likelihood of e-banking adoption, highlighting the importance of internet familiarity. Similarly, trust in electronic transactions also correlates positively with e-banking usage, emphasizing the significance of secure and trusted technology. Additionally, possessing medium-level digital skills in mobile and computer use greatly increases the probability of engaging with e-banking services, underscoring the necessity of digital literacy.

Economic factors also play a role, with higher household income being associated with increased e-banking adoption, possibly due to better access to required technologies and internet services.

The results section of our study on the determinants of e-banking adoption reveals insightful trends relating to household size and territorial factors. Notably, larger household sizes appear to negatively influence the likelihood of adopting e-banking. This trend may stem from a diluted focus on technological engagement within these households, economic constraints, or the possibility that digital banking tasks are delegated to other family members.

Turning to territorial-level variables, beyond the previously discussed bank branch density, we find that individuals residing in more populated municipalities are significantly more likely to adopt e-banking, with evidence supporting this assertion at the 5% significance level. Furthermore, there is suggestive evidence (at the 10% level) indicating that provinces with a higher proportion of residents aged 65 and older see a reduced probability of e-banking adoption. These findings align with expectations that technological innovations, including e-banking, are more readily embraced in younger, more urban environments. This highlights the influence of demographic and geographical dynamics on the adoption of new banking

technologies.

Finally, the time fixed effects captured by the year dummies, using 2017 as the base category, show the increasing trend in e-banking adoption, especially in 2020 and 2021, a trend likely accelerated by the effects of mobility restrictions associated with COVID-19.

#### *Further analysis*

##### *Bank branches density measured at province-habitat*

To more precisely analyse the influence of bank branch density on e-banking adoption, we refined our analysis in Model 4 by adopting a more nuanced measure of this density, calculated by habitat and province. Notably, the density of bank branches varies within a province. Furthermore, the dynamics of bank branch distribution may have evolved differently over time. We derived this refined indicator by dividing the total number of bank branches within each province-habitat by the total population (in thousands) of all municipalities included in that province-habitat, with calculations performed annually. This approach allows for a more detailed understanding of how physical banking infrastructure's distribution impacts the adoption of e-banking services.

The beta coefficient of the model using this refined measure is -0.492, highly significant ( $p < 0.001$ ). All the coefficients of the rest of the explanatory variables are similar in sign, size and significance, except the variable that approximates the size of the municipality, which loses significance because its source of variability is captured by the new bank branch density variable.

##### *Interaction between bank branch density and age.*

Independently that in those territories with less bank branches density e-banking adoption is higher, the density can modify the way in that other factors influence e-banking adoption. We have estimated a model where bank branches density interacts with age and age squared of individuals.

Table 5 and Figure 4 shows the average

predicted probability of e-banking for individuals at different ages at living in provinces with different bank branches density. Notably, the adoption curves shift rightward and the gaps between these curves widen with increasing age, a trend that is distinctly visible in Table 5. For instance, for an individual aged 60, probability increases 7.8 percentual points if he/she lives in a province with bank branches density of 0.3 by 1,000 inhabitants instead living in a province with density of 0.9 bank branches by 1,000 inhabitants. This increase turns to 8.5 percentual points for another individual aged 80. These findings point out that the closure of physical bank branches tends to accelerate e-banking adoption more significantly among older adults than among younger individuals.

**Table 5. Predicted probability of e-banking for several ages and bank branches densities**

**Figure 4. Predicted probability of e-banking for several ages and bank branches densities**

##### *Modelling specific banking activities*

In addition to utilizing electronic banking for routine transactions such as checking account balances and making transfers, digital banking increasingly supports more complex operations like buying and selling stocks, applying for loans, and purchasing insurance. The ICT equipment survey of Spanish households contains data on whether individuals have used online banking for these specific activities. It is important to note that during the period analysed, such activities remain relatively uncommon.

Table 6 outlines the annual proportion of individuals who have engaged in each of these operations. Overall, within the timeframe analysed, only 3.6% of individuals have executed stock transactions online, 2.4% have applied for bank loans online, and 8% have purchased insurance through their banks. Interestingly, these figures do not show a clear increasing trend over time, unlike

the adoption of general e-banking, which has seen consistent growth.

**Table 6. Proportion of specific e-banking operations by year**

To elucidate the factors influencing the adoption of specific online banking activities, panel regression models were constructed using a comprehensive set of explanatory variables for each activity. The findings are detailed in Table 7. In the cases of insurance and loan services, it was observed that nearly all variables aligned in direction and significance with those identified in the general e-banking model. Notably, the results indicate a trend where a lower density of bank branches correlates with an increased likelihood of conducting these activities online. This pattern suggests that operations traditionally performed in physical bank branches are transitioning online, particularly in areas where physical branch access is more limited.

Conversely, for stock transactions, the density of bank branches did not significantly impact online activity. Additionally, age did not exhibit the inverted U-shaped effect seen in other contexts, nor did it show any clear influence on this behaviour. Similarly, whether individuals were Spanish or not had no discernible effect on their engagement in online stock transactions.

**Table 7. Panel logit models estimates for e-banking specific operations.**

## 5. Conclusions

This paper has focused on studying the e-banking user in its different forms by studying the impact of some particularly relevant variables such as age and accessibility to traditional banking on the correct development of their activity. From this analysis, the most important task of this study is to find out which individuals are more likely to suffer from the digital divide with respect to e-banking and how they are more vulnerable to suffer from some kind of inequality.

The picture shown in section 4 depicts a situation in which the proportion of individuals using e-banking is increasing year by year, while the number of bank branches and with them the option of using traditional banking is rapidly decreasing, as described by Vives (2009) and Baret et al. (2020).

According to all the studies in the previous section it can be concluded that the fewer bank branches per thousand inhabitants, the higher the propensity to use e-banking. This affects rural areas and users living in large cities, to the detriment of those individuals who lack the tools to link to this option, in the same way as indicated by Perez-Amaral et al. (2021).

The variables that define the user who does not access e-banking, i.e. who suffers from the digital divide, is above all age, with older people being much more susceptible than younger people, and this inequality is more pronounced in rural areas (White & Selwyn, 2013; Perez-Amaral et al., 2021). It is also interesting to note that the individual most likely to use e-banking according to their age is 46 years old, showing a middle-aged profile, neither young nor old.

In this sense, as seen in Lips et al. (2020), there is a very pronounced and constant gender gap over time, which affects the use of any tool related to e-banking.

On the other hand, people with more years of education, working and Spanish nationality correspond to the socio-demographic profile most associated with the use of e-banking, as in Foroughi, Iranmanesh and Hyun (2019). Other socio-demographic aspects linked to overcoming the digital divide in e-banking are higher incomes in more densely populated areas, the upper classes of cities, as highlighted by Hafkin and Huyer (2007).

However, as repeated in the analysis of e-services, people with a higher frequency of Internet use and knowledge of how to use it are the ones who are more likely to use e-services, these are also the ones with a higher e-trust, these variables are highlighted in the literature and also play this role in the Spanish case (Foroughi, Iranmanesh & Hyun, 2019; Van-Esteril-Plasmeijer & Van Raaij, 2017).

This analysis responds to the questions posed by providing the individual closest to not suffering from this gap, as well as confirming the presence of some groups that have it more complicated, in this case the elderly who lack e-skills and live in rural areas.

The study also highlights the scarce implementation of other tools of interest to FinTech and e-banking, tools that make banks more competitive and that can bring benefits to users of digital banking: online stock transactions, online applications for bank loans and taking out insurance through their banks. It can be seen from the values in the trend that the peak in the use of these tools corresponds to the year 2019, decreases in the pandemic and recovers, but not completely, in 2021. The variables that explain the type of people using this type of service are the same as those that explain the use of e-banking.

With all this in mind, public and private policies can be derived that could potentially improve the Spanish banking system, as well as the prospects of individuals' utility in using e-banking. From the public sector, it would be relevant to focus on training and communication.

The variables that most influence the adoption of these e-services are the years of education of individuals, their online skills and their confidence in surfing the Internet, and it is essential to strengthen these skills to guarantee the correct development of individuals in their use of e-banking and other e-services. For e-banking in particular, financial literacy training is essential to avoid barriers for users, reduce their susceptibility to fraud and enhance their skills in using e-banking, a commitment to digital and financial literacy together.

It is therefore essential not to leave behind the most vulnerable, in this case the elderly and those living in rural areas, by guaranteeing them a service and supporting banking institutions so that these groups are not left without the possibility of using traditional banking.

As far as the institutions are concerned, it is not only necessary to guarantee the service, but also to prioritise user satisfaction, both in terms of

developing their e-banking experience and reducing their stress by enabling them to use digital banking.

Training will also be key, not only internally, so that all employees are fully familiar with and integrated into the e-banking tools, but also externally, through training and communication campaigns to ensure that individuals are aware of and know how to use the different options offered by e-services.

One of the main limitations of this study is the lack of precise information on the bank where the data were held, or at least the specific type of bank. This lack of information prevents a detailed understanding of the effects of bank concentration. In addition, the available data are not up to date, which means that trends from 2021 onwards cannot be identified.

These issues also point to the most appropriate lines of research to pursue. It is crucial to study the impact of bank concentration on both users and e-banking. Bank concentration is likely to continue to reduce the number of branches, with significant implications for customers and access to financial services.

Updating this study with more recent data would be essential to understand how this situation has consolidated in the aftermath of the pandemic and in a context of increasing digitalisation. With up-to-date data, it would be possible to better assess the recent dynamics and long-term effects of bank concentration in today's financial environment.

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Table 1. Proportion of e-banking by year and age

year	All	<30	30-40	40-50	50-60	60-70	70-80	>80
2017	0.547	0.446	0.684	0.626	0.520	0.435	0.373	0.303
2018	0.560	0.447	0.688	0.664	0.550	0.450	0.376	0.262
2019	0.586	0.538	0.748	0.717	0.600	0.452	0.312	0.242
2020	0.637	0.592	0.810	0.761	0.669	0.539	0.371	0.245
2021	0.678	0.601	0.824	0.812	0.705	0.603	0.434	0.291
All years	0.601	0.520	0.741	0.713	0.608	0.502	0.374	0.266

Table 2. Number of bank branches by 1,000 inhabitants by year and municipality size

year	no. of bank branches	Spain	<10k	10-20k	20-50k	50-100k	100-500k	province capitals	500k+
2017	28456	0.611	0.851	0.559	0.482	0.471	0.475	0.650	0.604
2018	27144	0.581	0.823	0.523	0.458	0.467	0.449	0.617	0.557
2019	25838	0.549	0.791	0.520	0.430	0.428	0.417	0.581	0.518
2020	23685	0.499	0.725	0.470	0.386	0.393	0.381	0.529	0.468
2021	22091	0.466	0.683	0.443	0.361	0.360	0.350	0.491	0.436
change rate 2017-2021	-22.4%	-23.7%	-19.8%	-20.9%	-25.1%	-23.6%	-26.4%	-24.4%	-27.8%

Table 3. Descriptive statistics for the estimation sample of model 4 (N=51,585)

Variable	Average/ proportion	Standar d deviation	Min.	Max.
e-banking (Yes:1, No:0)	0.623	0.485	0	1
Bank branches by 1,000 inhabitants (Province)	0.593	0.176	0.174	1.394
Bank branches by 1,000 inhabitants (Habitat- province)	0.585	0.236	0.174	1.833
Age	49.041	15.310	16	105
Male (Yes:1, No:0)	0.470	0.499	0	1
Employed (Yes:1, No:0)	0.562	0.496	0	1
Years of education	12.372	3.690	1	20
Spanish (Yes:1, No:0)	0.956	0.204	0	1
Has computer/laptop (Yes:1, No:0)	0.865	0.342	0	1
Uses internet daily (Yes:1, No:0)	0.831	0.375	0	1
e-trust level	0.700	0.577	0	2
Medium skills of mobile and computer (Yes:1, No:0)	0.463	0.499	0	1
Household income (category)	2.671	1.227	1	5
Household size	2.561	1.219	1	13
			17.20	32.81
Province population over 65 (%)	23.379	2.665	0	9

Table 4. Panel logit models estimates for e-banking dependent variable

VARIABLES	model0	model1	model2	model3	model4
Bank branches by 1,000 inhabitants	-1.060 *** 0.110	-1.105 *** 0.103	-0.906 *** 0.100	-0.934 *** 0.111	-0.766 *** 0.126
Age		0.120 *** 0.006	0.139 *** 0.006	0.135 *** 0.007	0.136 *** 0.007
Age squared		-0.0014 *** 0.0001	-0.0014 *** 0.0001	-0.0015 *** 0.0001	-0.0015 *** 0.0001
Male		0.302 *** 0.035	0.218 *** 0.034	0.173 *** 0.038	0.176 *** 0.038
Working		0.760 *** 0.038	0.711 *** 0.037	0.636 *** 0.042	0.635 *** 0.042
Years of education		0.301 *** 0.006	0.220 *** 0.005	0.200 *** 0.006	0.199 *** 0.006
Spanish		0.721 *** 0.077	0.590 *** 0.074	0.505 *** 0.081	0.520 *** 0.081
Has computer/laptop			1.053 *** 0.048	1.116 *** 0.055	1.113 *** 0.055
Uses internet daily			1.090 *** 0.040	1.067 *** 0.045	1.064 *** 0.045
e-trust level			0.514 *** 0.026	0.494 *** 0.029	0.494 *** 0.029
Medium skills of mobile and computer			1.183 *** 0.034	1.191 *** 0.039	1.189 *** 0.039
ln(household income)				0.440 *** 0.029	0.439 *** 0.029
ln(household size)				-0.792 *** 0.062	-0.791 *** 0.062
ln (habitat)					0.069 ** 0.028
Province population over 65 (%)					-0.015 * 0.008
2018.Year	0.018 0.033	0.066 * 0.035	0.703 *** 0.040	0.687 *** 0.047	0.694 *** 0.047
2019.Year	0.208 *** 0.038	0.392 *** 0.039	0.334 *** 0.040	0.286 *** 0.045	0.300 *** 0.046
2020.Year	0.493 *** 0.042	0.841 *** 0.044	0.894 *** 0.045	0.874 *** 0.052	0.897 *** 0.053
2021.Year	0.763 *** 0.046	1.087 *** 0.047	1.105 *** 0.048	1.117 *** 0.055	1.147 *** 0.056
Constant	0.946 *** 0.079	-6.190 *** 0.184	-8.961 *** 0.192	-10.310 *** 0.288	-10.170 *** 0.322
no of observations	62,443	62,338	62,281	51,585	51,585
Number of ID	25,118	25,095	25,087	23,028	23,028
Chi2	641	4,636	6,448	5,196	5,193
p-value	<0.001	<0.001	<0.001	<0.001	<0.001
log likelihood	-37,615	-32,575	-30,446	-24,582	-24,577
LLR test (+)		8,292.27	3418.76	369.26	10.21
p-value		<0.001	<0.001	<0.001	<0.001

Robust standard errors below estimates. \*\*\*, \*\*, \* indicates significance at 1, 5 and 10% level. (+) LLR tests are computed for models restricted to sample size of model 4.

Table 5. Predicted probability of e-banking for several ages and bank branches densities

age	bank branches density by 1,000 inhabitants			
	(1)	(2)	(3)	(1)-(3)
	0.3	0.6	0.9	
20	0.533	0.538	0.542	-0.010
30	0.629	0.617	0.604	0.025
40	0.681	0.657	0.633	<b>0.049</b>
50	0.695	0.663	0.629	0.066
60	0.672	0.633	0.593	0.078
70	0.608	0.566	0.523	<b>0.085</b>
80	0.500	0.459	0.418	0.081

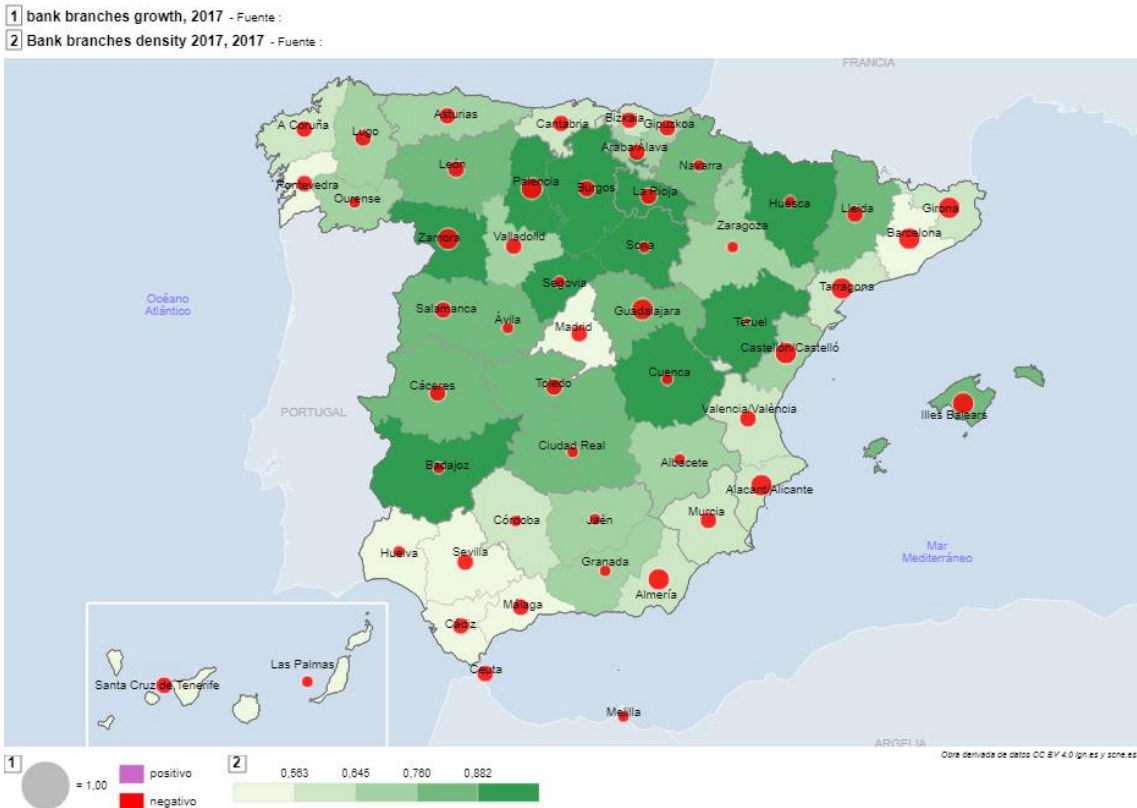
Table 6. Proportion of specific e-banking operations by year

year	e-banking	sale of shares	insurance	borrowing
2017	0.547	0.031	0.068	0.018
2018	0.560	0.035	0.076	0.023
2019	0.586	0.044	0.119	0.036
2020	0.637	0.031	0.070	0.019
2021	0.678	0.040	0.081	0.025
All years	0.601	0.036	0.080	0.024

Table 7. Panel logit models estimates for e-banking specific operations

VARIABLES	e-banking	shares	insurance	borrowing
Bank branches by 1,000 inhabitants	-0.766 *** 0.126	-0.070 0.298	-0.953 *** 0.161	-0.972 *** 0.292
Age	0.136 *** 0.007	0.030 * 0.017	0.057 *** 0.010	0.117 *** 0.018
Age squared	-0.001 *** 0.000	0.000 0.000	-0.001 *** 0.000	-0.001 *** 0.000
Male	0.176 *** 0.038	1.204 *** 0.089	0.469 *** 0.044	0.411 *** 0.074
Working	0.635 *** 0.042	-0.067 0.101	0.227 *** 0.055	0.470 *** 0.096
Years of education	0.199 *** 0.006	0.184 *** 0.015	0.080 *** 0.007	-0.007 0.012
Spanish	0.520 *** 0.081	0.298 0.234	-0.341 *** 0.098	-0.287 * 0.162
Has computer/laptop	1.113 *** 0.055	0.505 *** 0.186	0.791 *** 0.102	0.331 ** 0.150
Uses internet daily	1.064 *** 0.045	0.759 *** 0.144	0.684 *** 0.086	0.385 *** 0.132
e-trust level	0.494 *** 0.029	0.360 *** 0.066	0.284 *** 0.037	0.318 *** 0.064
Medium skills of mobile and computer	1.189 *** 0.039	0.693 *** 0.104	0.821 *** 0.060	0.594 *** 0.102
ln(household income)	0.439 *** 0.029	0.873 *** 0.076	0.273 *** 0.037	0.128 ** 0.064
ln(household size)	-0.791 *** 0.062	-0.660 *** 0.131	-0.364 *** 0.069	-0.172 *** 0.117
ln (habitat)	0.069 ** 0.028	0.351 *** 0.066	0.020 0.033	0.028 0.057
Province population over 65 (%)	-0.015 * 0.008	0.032 * 0.017	-0.010 0.010	-0.033 * 0.017
2018.Year	0.694 *** 0.047	0.648 *** 0.124	0.647 *** 0.073	0.619 *** 0.123
2019.Year	0.300 *** 0.046	0.070 0.107	0.317 *** 0.062	0.504 *** 0.108
2020.Year	0.897 *** 0.053	-0.066 0.114	-0.018 0.067	0.076 0.118
2021.Year	1.147 *** 0.056	0.245 *** 0.117	0.079 0.066	0.278 ** 0.115
Constant	-10.170 *** 0.322	-18.560 *** 0.869	-8.349 *** 0.393	-8.390 *** 0.679
no of observations	51585	47654	47654	47654
Number of ID	23028	22376	22376	22376
Chi2	5193	807	1466	395
p-value	<0.001	<0.001	<0.001	<0.001
log likelihood	-24577	-6294	-12723	-5315

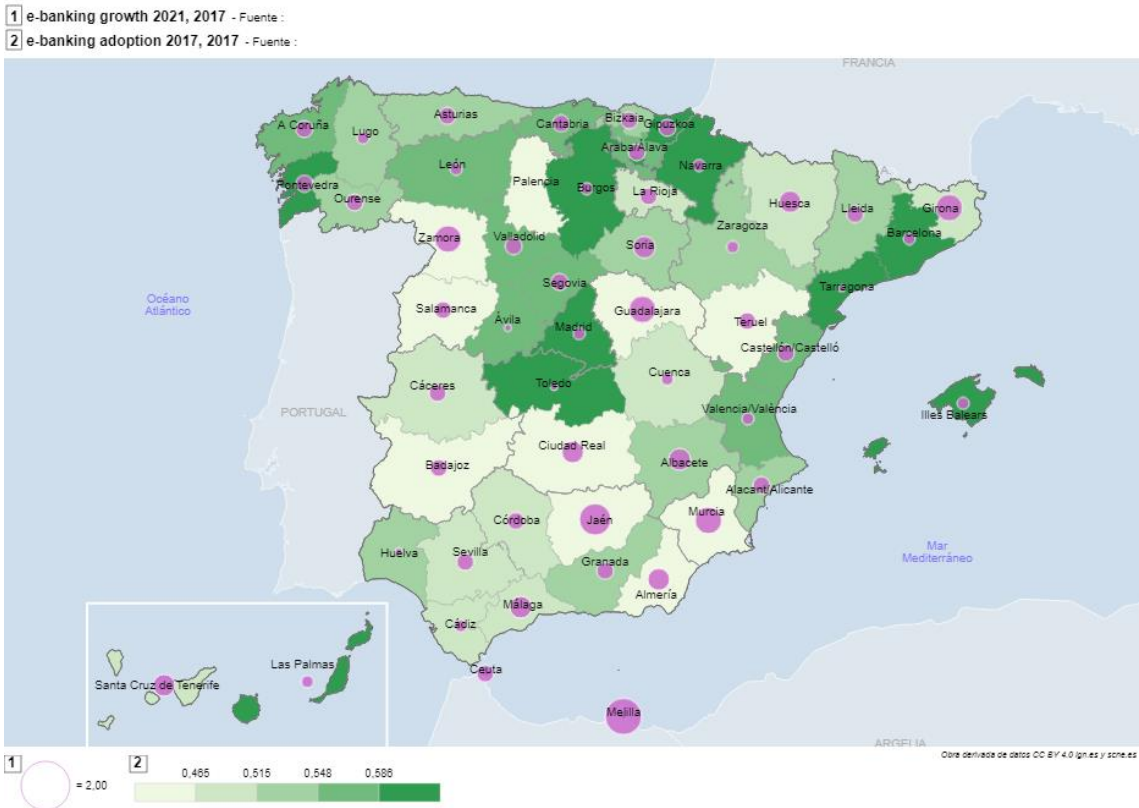
Figure 1. Bank Branches density by 1,000 inhabitants (2017) and growth rate 2017-2021



Growth rates in circles, larger size indicates more negative growth rate



Figure 2. Proportion of e-banking 2017 and growth rate 2017-2021



Growth rates in circles, larger size indicates more positive growth rate of e-banking

Figure 3. Relationship between bank branches density and e-banking proportion by province (2021)

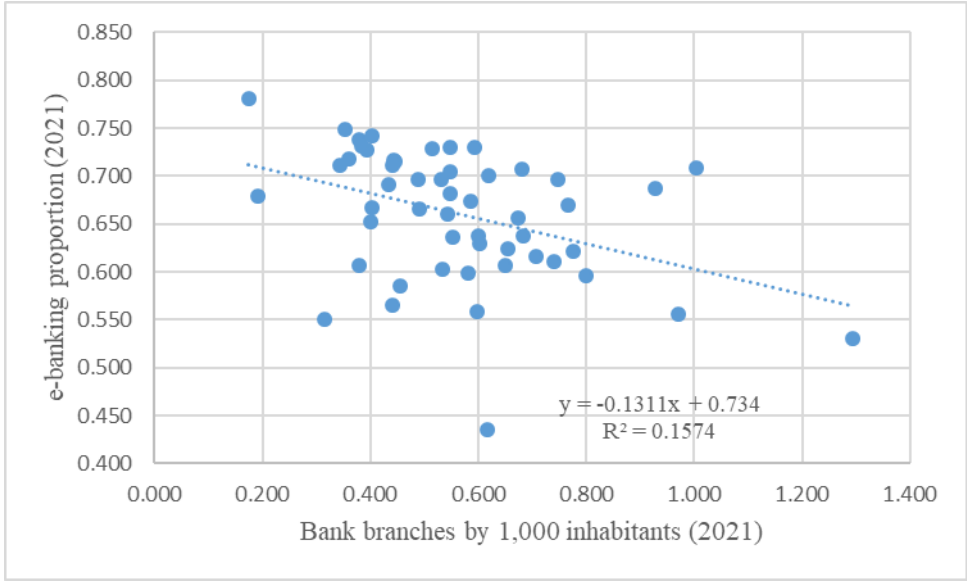


Figure 4. Predicted probability of e-banking for several ages and bank branches densities

