

Social trust and online banking in the era of the digital transition: Evidence for the European regions.

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Abstract

In the era of the digital transition, online banking has become an essential channel for accessing financial services. Social trust is key for financial development, but its specific impact on online banking remains largely unexplored, particularly at the subnational level. This paper analyses the influence of social trust on the adoption of online banking among a sample of 235 European Union regions between 2011 and 2024. The results suggest that social trust is a strong predictor of online banking adoption, and are robust to the inclusion of multiple control variables, fixed effects and endogeneity. These findings offer valuable insights for regional policies related to the digital transition within the European Union member states. The results have relevant implications for EU policies aimed at closing territorial gaps in digitalization. Strengthening trust-related institutional and community factors may accelerate the diffusion of online financial services, support financial access in lagging regions, and contribute to a more balanced territorial development across the EU.

Keywords: Digital transition; European regions; Online banking; Social trust

JEL classification: G20; R11; Z10

1. Introduction

The digital transition across European regions is a central pillar of the European Union's (EU) policy agenda. The European Commission is dedicated to creating a Europe ready for the digital era by equipping individuals, businesses, and public administrations with next-generation technologies that ensure a digital transformation beneficial to all. Initiatives such as the Digital Decade policy programme 2030 and the Digital Europe Programme aim to foster digital transformation as a driver of economic competitiveness, social inclusion and regional development (European Commission, 2025), as well as to support the sustainability transition (Muench et al., 2022). This sweeping transformation encompasses more than just technological upgrades; it is fundamentally reshaping business models, public services, and daily life across EU. In the light of a regional digital divide in the EU, characterized by sharp differences in digitalization between regions (Crespo Cuaresma and Lutz, 2021), this technological shift reflects broader digital innovation and illustrates the need for new infrastructure, skills, and policy frameworks.

The digital transformation has also reached the financial sector, whose importance for economic growth has long been recognised (King and Levine, 1993; Levine, 1997). Financial development allows for the accumulation of productive factors and, according to Gilchrist and Zakrajsek (2012) fosters the provision of credit while minimizing the impact of economic downturns, at the time it also supports the development of technologies and knowledge (Madsen and Ang, 2016). The banking sector is a fundamental element in the financial system, particularly in the EU countries. These countries are characterised by a continental model, in which businesses and families rely heavily on bank loans to finance their operations and investments. Access to these services is therefore essential, and the digital transition is changing the way people access them. While physical branches once dominated, online banking has now become the norm (Cruz-García and Peiró-Palomino, 2023; 2025; Rossi and Scalise, 2022), driven by reductions in staff as well as marketing and IT costs for banks. Most banking activities can now be carried out via a smartphone app, eliminating the need for a physical branch and accelerating the diffusion of technology by offering greater convenience to consumers. Indeed, it has been argued that digital banking holds strong potential to replace physical cash in formal economic activity (Rogoff, 2017). It is therefore important to understand the extent to which people are able to use online banking and the specific factors that explain potential disparities.

The literature supports that social capital, understood as a combination of social trust, cooperation, collectivism and unwritten social norms (Putnam, 1993) is an important driver of financial development. In their pioneering study of the Italian context, Guiso et al. (2004) revealed a

significant correlation between social capital and the utilisation of financial services. Cruz-García and Peiró-Palomino (2019) found a positive link between social trust and the provision of credit. Guiso et al. (2008) argued that participation in the stock market depends not only on an evaluation of potential risks and returns based on the available information, but also on an act of faith that the information is reliable and that the system is fair. Similarly, Anggraeni et al. (2021) argue that, in a collectivist culture characterised by high social trust, opinions and information from others affect people's intentions and actions, thereby conditioning financial decisions and participation in the markets. Following these contributions, this paper analyses the impact of social trust, which is one of the most important dimensions of social capital, on the adoption of online banking. Indeed, the importance of trust increases when considering online banking; it is not only important for entering into financial contracts, but also for maximising participation through digital platforms without face-to-face interaction.

The study focuses on the European regional context, for which the importance of social trust to explain economic and social progress disparities has been largely demonstrated (Peiró-Palomino et al. 2024; Forte et al. 2015; Muringani et al., 2021). Online banking is a new way of accessing financial services, and given the important role of finance in development processes, it is important to understand what drives it. Previous studies have related social trust to financial development (Guiso et al., 2004; Cruz-García and Peiró-Palomino, 2019); this paper develops a more specific analysis by addressing whether increased social trust might influence the adoption of online banking practices.

Previous literature considering financial development at the subnational level for several countries are virtually non-existent due to the scarcity of comparable data. An exception is Rossi and Scalise (2022), which elaborated a dataset of 110 EU regions considering information from different national datasets. They found that what matters the most for regional economic growth is the agglomeration of a complex financial sector rather than the mere presence of bank branches. Our study focuses on a specific dimension of finance, namely online banking. This indicator has gained importance in the last 15 years as a result of the above-mentioned transformation of the banking sector after the financial crisis of 2008, which resulted in a more efficient less dependent on branches system. The unstoppable advance of the digital transition has accelerated this process, and, interestingly, the generation and availability of comparable information at the subnational level for policymaking purposes. In particular, we use the Digital Society Statistics, elaborated by the European Commission, which provides information on online banking use at the subnational level since 2011.

The contribution of this paper to the previous literature is twofold. First, most studies examining the nexus between social trust and financial development have completely overlooked online banking, for which social trust could even play a more relevant role. Although in the advent of the Global Financial Crisis in 2008 digitalization was considered as a complement of branches (Hernando and Nieto, 2007), recent papers are questioning the importance of branches for economic development (Cruz-García and Peiró-Palomino, 2025), suggesting that the focus should be put now on online forms of banking that are completely reshaping the traditional business model. So far, the studies that have analysed the specific role of trust for the use of online services (see Omotayo and Adebayo, 2015; Nurmaliki and Mirza, 2021) are based on a specific country and conclusions are hardly generalizable to other countries and banking systems.

As a second contribution, we consider the EU context, for which studies on online banking are, to our knowledge, non-existent. Notably, we conduct a regional level analysis considering a representative sample of 235 NUTS-2 EU regions for the period 2011-2024. In the EU context, within country disparities in terms of both social trust and the usage of online banking are important, so a subnational level analysis can offer a more accurate perspective. In addition, NUTS-2 regions are the territorial level at which cohesion policies are implemented, and the time period analysed covers the period of rapid digitalisation. The digital transition is expected to affect regions differently (Maucorps et al., 2023) due to the varying technology diffusion trajectories and technological readiness. Our results can offer policymakers more insightful conclusions and contribute to EU territorial development.

The results show that social trust has a positive influence on online banking. These findings remain consistent even when a wide range of control variables are included, such as economic and demographic factors, other financial development indicators, and multiple fixed effects. The findings are also robust when different sample aggregation and estimation methods are employed, including instrumental variables to account for endogeneity bias. In this case, social trust is proxied using geographical and linguistic variables, which largely explain social trust levels, yet are uncorrelated with the factors that explain online banking.

The rest of the paper is structured as follows. Section 2 provides a review of the relevant literature. Section 3 introduces the empirical framework, including the sample, data and models. Section 4 presents the main results, together with a battery of robustness tests. Finally, Section 5 concludes and provides policy recommendations.

2. Literature review

2.1 *Social trust and finance*

La Porta et al. (1997, p.333) define societal trust as “a propensity of people in a society to cooperate to produce socially efficient outcomes and to avoid inefficient non-cooperative traps”. Consequently, the expectation is that societal trust matters for principal agent relations not to exploit uncontracted contingencies. In communities where social capital is strong, individuals tend to trust each other more, partly because social networks create mechanisms for holding people accountable for misconduct (Coleman, 1990). Additionally, these communities often foster moral norms through education, which encourages people to keep their promises (Banfield, 1958). Accordingly, as Boix and Posner (1998) argued, norms and expectations of appropriate behaviour induce people to comply with existing rules and regulations, even if enforcement mechanisms are absent. Since increasing social trust positively affects economic growth (Putnam and Helliwell, 1995), it may also contribute to the development of specific sectors, such as the financial sector.

Drawing from the contract theory, financial agreements inherently require a high degree of trust, as they involve exchanging money now in return for a future repayment. The success of such transactions relies not only on legal enforcement but also on the trust the lender places in the borrower. Likewise, individuals’ willingness to engage in financial contracts is influenced by how much they trust the other party (Guiso et al., 2004). The benefits of trust are closely linked to enhanced cooperation and lower transaction costs. Arrow (1972) emphasized that trust is fundamental to economic exchanges and argued that its absence may significantly contribute to economic underdevelopment. In a similar vein, Coleman (1990) underscored trust’s role in curbing opportunistic behaviour, while Knack and Keefer (1997) found that cooperative norms help mitigate moral hazard, agency problems, and reduce the need for costly monitoring. Many theoretical perspectives on the relationship between trust and finance highlight the role of information asymmetries in financial transactions. Since trust facilitates transparency, its absence can exacerbate information gaps, ultimately hindering credit availability (La Porta et al., 2007). In high-trust environments, credit institutions are generally more inclined to extend financial resources under more favourable terms, as they perceive lower levels of risk (see, for example, Hasan et al., 2017).

Trust also plays a crucial role on the demand side. Guiso et al. (2008) proposed a model where investors' demand for stocks depends not only on expected returns but also on their risk aversion, which is influenced by the likelihood that the counterparty will act honestly. Individuals in low-

trust contexts tend to be more sceptical about the reliability of information, which can discourage their participation in financial markets. Along these lines, Moro and Fink (2013) found that trust enhances access to soft information, thereby reducing information asymmetries and facilitating smoother financial transactions. In the same vein, Lesmeister et al. (2022) conclude that in high-trust countries investors are less concerned about being expropriated and therefore they reduce their costly monitoring efforts. There is abundant empirical evidence supporting the role of trust in financial behaviour. For instance, Guiso et al. (2004) found that in Italy, higher levels of trust correlate with increased use of financial instruments such as checks and formal credit. Similar findings have been reported in other contexts: Mwangi and Ouma (2012) in Kenya, Talavera et al. (2012) in China, Heikkilä et al. (2016) in Uganda, and Cruz-García and Peiró-Palomino (2019) for a wide sample of countries—all highlighting that trust significantly influences access to credit.

2.2 Social trust and online banking

As online banking is a recent phenomenon and data tends to be scarce, the literature on it is narrower. While most of the mechanisms described above also apply to online banking, there are others related to the lack of face-to-face interaction that make trust even more important. Most studies analysing this relationship are context-specific. Ullah Khan (2022) concludes that the digitisation of services in countries like Pakistan and China has ultimately developed a digital culture affecting and being shaped by the cultural values of individuals working in the technological environment.

This culture of digitisation has increasingly shifted customers' focus away from traditional approaches to banking technology towards more sophisticated and automated choices. Omotayo and Adebayo (2015) and Nurmaliki and Mirza (2021) demonstrate the existence of a significant impact of trust on the adoption of internet banking in southern Nigeria and Indonesia, respectively. Customers' trust in internet banking applications affects their intention to use them, as they believe that their transactions are safe and that banks maintain the confidentiality of their personal information. According to their results, demographic characteristics are not significant predictors, but individual factors such as attitude, perceived usefulness, ease of use, behavioural control and particularly trust largely explain the use of these services. Kusumawati and Rinaldi (2020) and Anggraeni et al. (2021) focused on the factors that influence consumers' intentions to use and their actual usage of digital banking in the Indonesian context. They found that hedonic motivation and social influence also predict intention. Djalil et al. (2020) also showed that trust and security positively affect digital banking adoption, whereas perceived risk has a negative effect. Alkhowaiter (2020) conducted a meta-analysis of the determinants of online banking and found that perceived security, perceived usefulness, and trust were strong predictors.

Financial development studies in the European regional context are very limited and have not focused on online banking. Rossi and Scalise (2022) confirm a positive correlation between regional financial development and economic growth, although some financial development indicators such as the number of branches appear to be less significant, consistent with the findings by Cruz-García and Peiró-Palomino (2025) in the Spanish context. The latter authors point to a potential substitution effect between physical branches and online banking. Rodríguez-Pose and Sandu (2025) explore the factors influencing access to banking services in Central and Eastern European regions, with a particular focus on institutional trust, socio-economic characteristics, and geographical context. Their analysis highlights notable disparities in financial inclusion across different banking products: while institutional trust enhances access to current accounts and savings deposits, its impact on loan accessibility is more limited. Despite the previous attempts for the EU context, the impact of social trust on online banking remains largely unexplored at the subnational level. We argue that online banking can nowadays increase financial inclusion, particularly in areas without branches (Cruz-García and Peiró-Palomino, 2023). The subsequent empirical analysis aims to shed light on a context for which evidence is still lacking.

3. Empirical framework

3.1 Sample and main variables

The sample comprises 235 NUTS-2 regions, the basic regions for the application of regional policies, from the 27 EU countries. The study covers the period 2011-2024. Although the time period is recent and high enough to capture the evolution of trust and digital banking over time, this selection obeys to availability of the main variables for the analysis.

The variable of interest is online banking, as measured by the Digital Society Statistics (DSS) database, compiled by Eurostat. This dataset contains several indicators of the use of technological devices for different purposes. One of these indicators measures the proportion of people who have accessed banking services through a bank's website or mobile application in the last three months. The period of analysis has been marked by a profound restructuring process in the banking sector, aimed at improving efficiency and maintaining profits during a turbulent period. The Great Recession of 2008 triggered a wave of mergers and acquisitions, leading to increased banking concentration to improve competitiveness. In parallel, digitalisation has become increasingly prevalent in all areas of human life, including the banking sector. Consequently, over the last decade, there has been a reduction in the number of bank branches,

while mobile applications and websites that enable customers to access their bank services from their own devices have also been developed.

Figure 1 illustrates the growth in the proportion of online banking between 2011 and 2024. While less than 40% of people were online banking users in 2011, this figure has risen to close to 70% by 2024. However, these aggregate figures hide important between and within country heterogeneity. Figure 2 shows the distribution of online banking usage in our sample of regions in 2011 and 2014. As expected, the distribution has shifted to the right, indicating an increase in the average proportion of users. However, there is still high variability, with some regions having scores below 30% in 2024. Conversely, others are above 80%. To understand these disparities, the first panel of Figure 3 shows the average regional scores. The different categories correspond to the quintiles of the distribution. The highest values are found in the Nordic and Baltic countries, Ireland, Belgium, the Netherlands and France. Austria, the Czech Republic, Germany, some Polish regions and northern Italy have intermediate scores. By contrast, Spain (excluding Madrid and Catalonia—two highly developed regions), most of Italy, Bulgaria and Romania have the lowest scores. In these countries, the average score is below 40%.

INSERT FIGURE 1 HERE

Social trust is measured using information from the European Social Survey (ESS), which is conducted biennially and measures the attitudes, beliefs, and behavioural patterns of diverse populations in more than thirty countries. To align the social trust data with the online banking information, the ESS from 2010 to 2023 (the latest available edition) is used. The social trust indicator captures the extent to which respondents trust and expect fairness from others. Following standard practice in the literature, it is measured by the question: “Generally speaking, would you say that most people can be trusted, or that you can’t be too careful in dealing with people? Please tell me on a scale of 0 to 10, where 0 means you can’t be too careful and 10 means most people can be trusted”. Banerjee (2018) confirms that this question is a valid measure of long-term, stable beliefs about people’s trustworthiness. Using microdata from different ESS waves, we aggregate responses by NUTS-2 regions and calculate the average score.

INSERT FIGURE 2 HERE

Panel B of Figure 2 shows the average regional scores. The categories reflect the different quintiles of the distribution. The highest levels of social trust are found in the Nordic countries, Estonia, the Netherlands, Ireland, the Flemish region of Belgium, northern Austria, south-eastern Germany, and several regions in Spain, particularly Navarre and the Basque Country. Conversely,

social trust is low in most French regions, southern Italy and most eastern European regions. These figures are aligned to recent analyses in the social trust literature for the EU regional context (see, for instance, Peiró-Palomino et al., 2024). From observing the two maps, it can be seen that there is a positive relationship between online banking and social trust. Figure 3 confirms this positive link. However, other variables might interfere with this relationship, which is something to be considered.

INSERT FIGURE 3 HERE

3.2 Control variables and instruments

The econometric models that will be presented in the next section are coherent with previous literature and will incorporate a wide range of control variables of different types. The first of these is the intensity of internet use, which is defined as the proportion of people who have accessed the internet at least once a week in the last three months. This data is provided by the DSS. This variable controls for the propensity to use the internet. A positive correlation is expected between general internet use and the intensity of online banking.

We also consider a set of economic variables. GDP per capita controls for the level of regional development, which can affect the availability and degree of implementation of internet infrastructure, as well as the number of users. The investment rate is used as a proxy for the general economic cycle, which can also affect the intensity of financial service use. We also control for other structural features of regional economies by including sectoral composition (secondary and tertiary sector shares). The nature of economic activities can affect the necessity for, and access to, financial services and the provision of credit. All these variables are provided by Eurostat. The quality of regional governments may also be important. A higher quality of government can provide a framework of guarantees that increases people's perception of security when using online banking services. We use the EQI index, developed by the University of Gothenburg (see Charron et al., 2014), which is available for the years 2010, 2013, 2017, 2021 and 2024. The index measures the quality of regional governments based on three pillars: control of corruption, impartiality, and the quality of public services. The EQI index is coherent with the methodology implemented by the World Bank to estimate the Worldwide Governance Indicators (Kaufmann et al., 2011).

Other features that can affect how often people use online banking are related to demographics. These include the dependency ratio (the proportion of the population below and above 65 years of age compared to the population aged 16–64) and the proportion of young people (the proportion

of the population below 15 years of age compared to the total population). The level of education of the population can also influence the use of online banking services. We include the proportion of people who have completed secondary and tertiary education. The demographic and educational information comes from Eurostat. Finally, we control for some financial development indicators provided by the International Monetary Fund. These are the number of bank branches, the number of ATMs, and the number of credit cards, all expressed per 100,000 adults. Unfortunately, these variables are not available at the regional level, which is one of the main reasons why regional analyses of financial development are so scarce. A complete description of all the variables and their sources can be found in Table 1, whereas Table 2 provides some descriptive statistics.

INSERT TABLE 1 HERE

INSERT TABLE 2 HERE

Some of the results that will be described in the next section will involve the use of instrumental variables estimation as robustness checks. The selection of instruments draws on prior research carried out in comparable contexts. Several country-level studies—such as those by Tabellini (2010), Bjørnskov (2010), and Bjørnskov and Méon (2013)—have used geographical and linguistic variables to instrument social trust. At the European regional level, studies by Akçomak and Ter Weel (2009) and Peiró-Palomino (2016) have considered the historical presence of universities in the region as a potential instrument, following the path-dependence paradigm stemming from institutional economics, which suggests that current institutional outcomes seem to be shaped by prior historical trajectories. In our case, however, identifying suitable instruments is more complex. While many of the conventional instruments show strong correlations with social trust, ensuring the exclusion restriction becomes more difficult given the nature of our dependent variable. For instance, the historical presence of universities is likely linked to current levels of higher education and, by extension, to digital banking practices.

Bjørnskov and Méon (2015) suggest that lower temperatures are associated with higher levels of social trust. The link between climate and cultural traits dates back to ancient Greek thought, rooted in the belief that surviving harsh winters in colder regions often required relying on assistance from those beyond one's immediate family. In contrast, such external cooperation was less necessary in milder climates. As a result, societies in colder areas, such as the Nordic countries, developed stronger norms of trust toward non-family members, giving rise to historically higher levels of generalized trust in those regions, and these values have been passed thorough generations. In fact, Bergh and Öhrvall (2018) demonstrate that social trust among

Swedish expatriates remains remarkably stable and is largely unaffected by the characteristics of the host country. Following the approach of Peiró-Palomino (2016; 2019), we use latitude as a proxy for temperature in the regional European context. The correlation between latitude and social trust is 0.50, being significant at the 1%. In addition to this geographical variable, we include a linguistic feature: whether the dominant language allows pronoun dropping. This is generally a national-level characteristic. According to Bjørnskov and Méon (2015), languages that retain the first-person pronoun tend to reflect greater interpersonal respect, which positively correlates with trust (0.40), being also significant at the 1% level.

3.3 Econometric model

In order to assess the impact of social trust on online banking we estimate the following empirical model described as follows in equation (1):

$$\text{Online banking}_{it} = \beta \text{Social trust}_{it} + \delta X_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where online banking and social trust are the two key variables, X is a vector including all the control variables, i and t refer to regions and years, respectively, and β , δ , α , and γ are the model parameters. Finally, ε is the error term of the model.

To estimate Equation (1), the data are first aggregated into subperiods of three to four years. Information on online banking is available yearly, although some regions have missing data. Furthermore, social trust data is available biennially, while institutional quality indicators are provided triennially. Other control variables also have some missing data. To address this, the original dataset was collapsed into the following subperiods: 2010–12, 2013–16, 2017–20, and 2021–24, with the available information averaged across each period. This strategy maximises the availability of information in terms of regions and variables, minimises the effects of potential measurement errors and better captures the evolution of the variables during business cycles. To capture unobserved effects, the model includes regional and temporal fixed effects, with the latter being defined for the aforementioned periods.

4. Results

4.1 Baseline estimations

We present our baseline results as follows in Table 3. Our dependent variable is online banking for all scenarios from column 1 to 7. While the first column seeks to isolate the effect of social trust, the second and third column adds the variable of internet users. In the rest of the columns, we add the remaining socioeconomic control variables progressively. Results from the third to seventh columns incorporate regional and year fixed effects to account for unobservable characteristics.

INSERT TABLE 3 HERE

The impact of social trust is positive and significant across all the scenarios considered. These results are consistent with previous studies on the role of trust in banking (e.g., Cruz-García and Peiró-Palomino, 2019; Rodríguez-Pose and Sandu, 2025), and they confirm the importance of trust in the emerging business models of Industry 4.0, which reduce face-to-face interactions. While the coefficient in the first scenario is 0.145, the effect gradually declines to 0.021 when control variables are incorporated into the model, but the variable remains significant.

We now turn on to explain control variables. As expected, the variable internet users is positive and significant for all the scenarios considered. A higher proportion of users means a larger universe of potential online banking users. It is noteworthy that the coefficient for internet users decreases slightly from 1.1 to 0.9 when all the control variables are included in the regressions. Per capita income is positive and significant across all scenarios considered, confirming that higher income levels are positively correlated with the digital skills necessary to engage with online banking platforms (Weber et al., 2024). Investment is also positive and significant in most scenarios, suggesting that investment, particularly in ICT capital, contributes to the uptake of digital finance (Neves et al., 2023). Sectors of economic activity also appear to be relevant, as both the secondary and tertiary sectors show positive and significant effects, except for the secondary sector in two scenarios. This highlights not only the physical nature of bank branches but also the role of digitalization in the tertiary sector in explaining access to online banking (Hernando and Nieto, 2007). In what concerns to institutional quality, the variable is not statistically significant, and coefficients are very close to zero. This fact can be explained because this impact could be overridden by other variables in the model such as income per capita.

Population characteristics also appear to play a key role in explaining access to digital banking. A high dependency ratio is negatively associated with access, as increasing age is one of the main barriers to technology diffusion (Billon et al., 2009). Contrary to the expected outcomes, the share of young people is positive only in column 7 and negative in the remaining scenarios, but these results may be correlated to human capital. All education-related variables have positive

coefficients, but their significance varies across educational levels. Secondary education is not significant in Model 6, but becomes significant in Model 7 when variables related to bank branches are included, highlighting the importance of early financial training. Tertiary education is significant in Model 7, which is not surprising given its role in shaping long-term financial planning (Rodríguez-Pose and Sandu, 2025).

Finally, our results show that the coefficients for ATMs, credit cards, and physical branches are negligible in magnitude and not statistically significant. This is not surprising, as these variables represent elements of traditional banking, which have been gradually replaced by digital banking (Cruz-García and Peiró-Palomino, 2025).

4.2 Robustness checks

As a first robustness check, we exclude extreme observations from the sample to reduce the potential influence of outliers in the online banking and social trust variables. The results are presented in Table 4.

INSERT TABLE 4 HERE

We perform several robustness scenarios by excluding different percentages of extreme observations. Model 1 excludes 10% of the online banking variable; Model 2 excludes 20%. Model 3 excludes 10% of the social trust variable; Model 4 excludes 20%. Model 5 excludes 10% of both online banking and social trust, while Model 6 excludes 20% of both variables.

According to our results, the presence of outliers does not appear to affect the robustness of the estimators, as the magnitude and significance of the coefficients remain largely stable across scenarios. The only exceptions are the variables of secondary and tertiary sectors as well as young people, which become significant in a few cases. The secondary sector variable is significant in Models 3 and 5 at the 10% level, while the tertiary sector variable becomes significant in Models 3, 4, and 5 at the 5% level. In contrast, the variable of young people seems to be more sensitive to extreme values, as we can find substantial changes in the sign and the significance. However, as most of the signs and magnitudes of these coefficients remain consistent, these changes have negligible impact on the overall findings.

The control variables described in Section 3.2, along with the inclusion of regional and temporal fixed effects, should mitigate the impact of unobserved factors that could bias the results. However, apart from omitted variables, another potential issue is the possibility of an endogenous

relationship between social trust and online banking driven by reverse causality. The literature on this topic is inconclusive. On the one hand, societal trust is persistent over time as its formation is tied to historical developments often dating back hundreds of years and as beliefs and values are transmitted fairly unchanged from one generation to the next one (see Guiso et al. 2004; Algan and Cahuc, 2010). Bjørnskov and Méon (2013) argue that trust has generally remained stable at least since World War II, while other authors such as Uslaner (2008) and Nunn and Wantchekon (2011) suggest even longer periods.

Some scholars, however, question the stability of trust over time, suggesting that the growing reliance on digital technologies may be influencing its dynamics. As noted by Martínez-Navalón et al. (2023), consumers' trust in digital banking platforms increases when they perceive high levels of privacy and security. This perceived trust enhances the platforms' ease of use, reinforcing a positive feedback loop: the more intuitive and secure users find these platforms, the greater their trust in the company behind them. Liu et al. (2024) analysed data from China's A-share listed firms between 2012 and 2022 to explore the connection between corporate financial digitalization and public trust in businesses. Their findings indicate a strong and positive link between digital financial adoption and trust in firms. Similarly, Lan et al. (2024) investigated how regional digital financial inclusion interacts with social trust. Their study reveals that regions with more developed digital financial services tend to exhibit higher levels of trust.

In our sample of EU regions, the sharp increase in online banking usage contrasts with the high stability observed in social trust. It is therefore implausible that there is a reverse causal relationship from online banking to social trust, which could lead to endogeneity bias. In any case, previous findings in other contexts suggest the need for robustness checks. Social trust data from the various ESS waves do not follow any specific trend and values are fairly similar. It can therefore be argued that disparities across waves are the result of random noise, suggesting that social trust scores follow a random walk around a stationary value. This could explain why most social trust studies use cross-sectional analysis rather than panel data. Although we prefer to retain the panel specification due to increased variability in the data, we control for the possibility that social trust is actually stable. To do so, we use a Hausman-Taylor (HT) estimation procedure, which allows us to incorporate both time-invariant and time-varying variables into the model. In brief, the Hausman and Taylor (1981) estimator uses instrumental variables, as endogenous regressors are instrumented using their within (fixed-effects) transformed variation, and estimation is performed using Generalized Least Squares. This approach allows us to address endogeneity bias without relying on external instruments, making it a suitable complement to traditional IV estimations and enriching the robustness of our results. For this estimation, we use the average social trust value for the entire period to make it time-invariant. The results, shown

in the second column of Table 5, indicate that the impact of social trust remains positive and significant, with a coefficient of 0.058. This coefficient is similar to that obtained using a random effects panel model (see column 1 in Table 5) and greater than that obtained using our fixed effects model as the baseline estimation.

Another robustness check consists of changing how the dependent variable is defined. In our baseline model, we use the share of online banking users. For this robustness check, however, we use the variation in online banking usage, whereas social trust still remains measured in levels. This model includes an additional control for the share of online banking in the previous period. The results are shown in columns 3 and 4 of Table 5, which correspond to estimations using panel fixed and random effects, respectively. In both cases, social trust is positive and statistically significant, suggesting that online banking increases further where social trust is high. The last two columns in Table 5 present the random and fixed effect estimations using yearly data instead of results by the subperiods used in the main analysis. The results remain robust.

INSERT TABLE 5 HERE

In order to complement the previous analyses, we run 2SLS IV estimations using the latitude and the pronoun drop feature as instrumental variables. The first stage uses social trust as the dependent variable, and the second stage uses online banking as the dependent variable, following the IV approach. Panel data results are presented in Columns 1 and 2 of Table 6. The use of panel data allows us to account for unobserved heterogeneity, but given the time invariant nature of the instruments, the models are estimated using random effects. As a complement, we also provide cross-section results in Columns 3 and 4. Although less rich than the panel data approaches, the cross-section results are totally aligned with the panel data models. In particular, social trust is positive and statistically significant across all specifications. Its estimated coefficient is slightly lower in the panel data IV model (0.219) compared to the cross-sectional IV model (0.411), which is consistent with the panel approach accounting for time dynamics. Regarding the instruments, both latitude and pronoun drop are positive and significant, in line with previous findings (Bjørnskov and Méon, 2015). Concerning instrument validity and strength, both estimations yield a first-stage F-statistic exceeding the threshold of 10 recommended by Angrist and Krueger (1991), and the Sargan test does not indicate problems of overidentification. The coefficients for the remaining control variables are consistent with the expectations.

INSERT TABLE 6 HERE

5. Conclusions and policy implications

In this study, we examine the impact of social trust on online banking across a sample of 235 NUTS 2 European regions from 2011 to 2024. The findings suggest that social trust contributes positively to the development of digital banking at the regional level in Europe. In contrast, other factors that were relevant under previous banking business models—such as physical branches, ATMs, or credit cards—do not appear to foster the development of digital banking. The results are robust to several empirical strategies, including sample aggregation, changes in estimation methods, and potential endogeneity bias.

This study offers valuable policy recommendations. It is important to consider that social trust tends to remain stable over time. Cultural values are passed on from one generation to the next, so policies aimed at increasing social trust levels are unlikely to succeed. It is therefore essential to understand that the implementation and use of digital banking technologies can be hindered in regions with low trust levels, but boosted in regions with high trust levels. This could exacerbate the existing digital divide and jeopardize a fair digital transition. Therefore, policies should pay careful attention to social trust levels. This means taking social trust into account as an element that is essentially rooted in the territory and difficult to change in the short and medium term. Understanding this limitation is fundamental to providing extra resources to low-trust regions to counterbalance the negative effects of low trust.

A useful strategy governments can apply is to reduce the perceived social risks associated with online financial activity, thereby fostering wider adoption of online banking through supportive legislation. These policy measures might help to reduce persistent disparities in digitalization across European regions. It has been highlighted how differences in technology lead to the existence of left-behind places and contribute to regional economic stagnation (Rodríguez-Pose et al., 2024). But at the same time, technology diffusion can increase economic development and reduce social exclusion, thereby narrowing the gap between core and peripheral regions (Barbero and Rodríguez-Crespo, 2022). Therefore, it is crucial for the banking sector to explore how technology can lead to a virtuous circle in digital banking, in which social trust can play a fundamental role by enhancing customers' confidence and encourage broader adoption, among other benefits.

Finally, this study opens important avenues for future research. First, it is necessary to further explore the types and dimensions of trust, including trust in public versus private institutions, as well as cultural variations in how trust influences digital banking adoption, as done in recent studies (Rodríguez-Pose and Sandu, 2025). Second, while the Internet has undeniably played a

key role in the development of online banking, future discussions should also consider the impact of emerging technologies, such as the recent case of Artificial Intelligence, which are increasingly enhancing banking services (Rahman et al., 2023) and could affect the trust relationship between banks and customers.

Acknowledgements

This research was supported by Projects PID2023-148534NB-I00, PID2024-159788NB-I00, and PID2022-138212NA-I00 funded by the Ministerio de Ciencia, Innovación y Universidades, Agencia Estatal de Investigación MCIN/AEI/10.13039/501100011033/FEDER, UE, and Projects PROMETEO CIPROM 2022/50 and PHS-2024/PH-HUM-530, funded by the Generalitat Valenciana and Community of Madrid, respectively.

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Tables and Figures

Table 1. Variables description and sources

	Description	Source	
Online banking	Share of people who, in the last 3 months, have used Internet for Internet banking via a website or app	Digital Society Statistics (Eurostat)	
Social trust	To what extent respondents trust and expect fairness from other people (scale 0 – 10)	European Social Survey	
Internet use	Share of people who, in the last 3 months, have accessed the internet, on average, at least once a week (regular use)	Digital Society Statistics (Eurostat)	
GDP per capita	Gross Domestic Product per capita (in logs). Constant euros of 2015	Eurostat	
Investment rate	Gross fixed capital formation divided by GDP Constant euros of 2015	Eurostat	
Secondary sector	Share of the secondary sector in the total NACE activities	Eurostat	
Tertiary sector	Share of the tertiary sector in the total NACE activities	Eurostat	
Institutional quality	European Quality of Government Index (EQI)	University of Gothenburg	
Dependency ratio	Population below 15 and above 65 with respect to population aged 16-64	Eurostat	
Young people	Population below 15 years old with respect to total population	Own calculation with data from Eurostat	
Secondary education	Share of population with upper secondary and post-secondary non-tertiary education	Eurostat	
Tertiary education	Share of Population with tertiary education	Eurostat	
Branches	Total number of bank branches per 100,000 adults	International Fund	Monetary
ATMs	Total number of operational Automated Teller Machines (ATMs) per 100,000 adults	International Fund	Monetary
Credit cards	Total number of active credit cards issued by financial institutions per 100,000 adults	International Fund	Monetary

Table 2. Descriptive statistics

	Mean	St. dev.	Min.	Max.
Online banking	0.513	0.231	0.009	0.965
Social trust	4.988	0.839	2.079	7.171
Internet use	0.792	0.139	0.329	0.986
GDP per capita (log)	10.054	0.597	8.228	11.552
Investment rate	0.211	0.044	0.074	0.714
Secondary sector	0.277	0.094	0.071	0.746
Tertiary sector	0.692	0.101	0.241	0.929
Institutional quality	0.122	0.987	-2.672	2.822
Dependency ratio	0.537	0.063	0.371	0.740
Young people	0.151	0.019	0.104	0.217
Secondary education	48.302	13.555	11.533	77.533
Tertiary education	29.210	9.771	10.267	61.567
Branches	29.100	18.126	4.935	89.585
ATMs	87.094	35.118	25.754	190.711
Credit cards	478.126	407.504	119.800	4638.180

Table 3. Determinants of online banking. Baseline estimations

	Dependent variable: Online banking						
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
Social trust	0.145*** (0.011)	0.044*** (0.007)	0.016** (0.006)	0.018*** (0.006)	0.017*** (0.006)	0.018*** (0.006)	0.021*** (0.007)
Internet users		1.116*** (0.023)	0.935*** (0.046)	0.933*** (0.049)	0.908*** (0.047)	0.927*** (0.061)	0.929*** (0.077)
GDP per capita				0.182** (0.077)	0.241*** (0.073)	0.223*** (0.062)	0.228*** (0.073)
Investment rate				0.162** (0.068)	0.130** (0.058)	0.132** (0.054)	0.004 (0.076)
Secondary sector				1.211* (0.679)	1.019 (0.646)	1.177* (0.649)	1.064 (0.799)
Tertiary sector				1.477** (0.675)	1.373** (0.643)	1.422** (0.641)	1.390* (0.779)
Institutional quality				-0.002 (0.009)	-0.003 (0.009)	0.005 (0.008)	0.009 (0.009)
Dependency ratio					-0.311* (0.161)	-0.328** (0.159)	-0.443** (0.186)
Young people					-0.805** (0.406)	-0.189 (0.502)	0.549 (0.687)
Secondary education						0.001 (0.001)	0.005*** (0.001)
Tertiary education						0.007*** (0.001)	0.010*** (0.001)
Branches							0.000 (0.001)
ATMs							0.000 (0.000)
Credit cards							0.000** (0.000)
Constant	-0.190*** (0.055)	-0.582*** (0.033)	-0.303*** (0.047)	-3.552*** (0.748)	-3.720*** (0.732)	-3.952*** (0.690)	-4.343*** (0.887)
R ²	0.088	0.864	0.887	0.896	0.901	0.909	0.908
Region FE	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes
N	734	734	734	734	734	729	617
χ^2	183.44***	2625.17***					
F			392.90***	259.59***	245.68***	279.31***	215.86***

Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Robustness tests (I). Excluding extreme observations

	Dependent variable: Online banking					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Excl. 10% Online banking	Excl. 20% Online banking	Excl. 10% Social trust	Excl. 20% Social trust	Excl. 10% Online banking & social trust	Excl. 20% Online banking & social trust
Social trust	0.020*** (0.006)	0.020*** (0.007)	0.021*** (0.006)	0.026*** (0.007)	0.022*** (0.006)	0.027*** (0.007)
Internet users	0.903*** (0.087)	0.969*** (0.086)	0.890*** (0.079)	0.893*** (0.083)	0.828*** (0.083)	0.989*** (0.080)
GDP per capita	0.370*** (0.062)	0.334*** (0.063)	0.328*** (0.059)	0.354*** (0.062)	0.336*** (0.059)	0.310*** (0.062)
Investment rate	0.017 (0.076)	-0.023 (0.076)	-0.037 (0.073)	-0.061 (0.067)	-0.030 (0.075)	-0.078 (0.076)
Secondary sector	0.755 (0.738)	0.023 (0.713)	1.147* (0.686)	1.169 (0.714)	1.266* (0.719)	0.392 (0.735)
Tertiary sector	1.092 (0.714)	0.504 (0.677)	1.431** (0.660)	1.531** (0.664)	1.510** (0.666)	0.881 (0.668)
Institutional quality	0.018*** (0.006)	0.024*** (0.006)	0.025*** (0.006)	0.025*** (0.006)	0.024*** (0.006)	0.029*** (0.006)
Dependency ratio	-0.227 (0.187)	-0.165 (0.199)	-0.241 (0.175)	-0.292 (0.179)	-0.143 (0.191)	-0.248 (0.205)
Young people	0.741 (0.767)	-0.123 (0.804)	1.256* (0.697)	1.045 (0.756)	0.854 (0.826)	-0.272 (0.792)
Secondary education	0.005*** (0.001)	0.005*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.002)	0.005*** (0.001)
Tertiary education	0.011*** (0.001)	0.009*** (0.001)	0.011*** (0.001)	0.011*** (0.002)	0.012*** (0.001)	0.009*** (0.001)
Branches	-0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)
ATMs	0.000* (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.001*** (0.000)
Credit cards	0.000*** (0.000)	0.000** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000 (0.000)
Constant	-5.628*** (0.769)	-4.581*** (0.740)	-5.675*** (0.687)	-6.007*** (0.685)	-5.846*** (0.684)	-4.672*** (0.700)
R ²	0.929	0.941	0.935	0.941	0.937	0.951
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
N	571	517	560	501	539	465
F	237.69***	367.01***	251.21***	257.11***	247.83***	428.66***

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Robustness tests (II). Changing estimation methods, periods and dependent variable.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	OLS	Hausman Taylor	OLS	OLS	OLS yearly panel	OLS yearly panel
Dep. Var.	Online banking	Online banking	Δ Online banking	Δ Online banking	Online banking	Online banking
Social trust	0.043*** (0.007)	0.058*** (0.022)	0.038*** (0.012)	0.028** (0.012)	0.027*** (0.004)	0.015*** (0.004)
Online banking (t-1)			-1.242*** (0.107)	-1.915*** (0.163)		
Internet use	1.062*** (0.062)	0.863*** (0.050)	1.762*** (0.127)	1.811*** (0.161)	0.772*** (0.054)	0.598*** (0.061)
GDP per capita	-0.002 (0.017)	0.022 (0.034)	-0.050 (0.037)	0.360** (0.156)	0.062*** (0.019)	0.221*** (0.063)
Investment rate	0.132 (0.094)	0.132* (0.074)	-0.019 (0.161)	-0.062 (0.189)	0.007 (0.064)	-0.045 (0.059)
Secondary sector	-0.168 (0.322)	0.991** (0.462)	-2.887*** (0.651)	-0.582 (1.458)	-0.042 (0.291)	0.530 (0.459)
Tertiary sector	-0.161 (0.311)	1.011** (0.456)	-2.895*** (0.629)	-0.292 (1.429)	-0.032 (0.280)	0.808* (0.419)
Institutional quality	0.012* (0.007)	0.001 (0.007)	-0.029** (0.015)	0.005 (0.019)		
Dependency rate	0.116 (0.097)	-0.014 (0.114)	-0.039 (0.205)	-1.507*** (0.407)	0.332*** (0.108)	-0.776*** (0.243)
Young people	0.569** (0.265)	0.357 (0.360)	-1.345** (0.640)	0.560 (1.498)	1.866*** (0.324)	3.098*** (0.643)
Secondary education	-0.000 (0.001)	0.003*** (0.001)	0.002* (0.001)	0.010*** (0.003)	0.000 (0.001)	0.003* (0.001)
Tertiary education	0.004*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.014*** (0.004)	0.002*** (0.001)	0.003** (0.002)
Branches	-0.000 (0.000)	-0.001* (0.000)	0.004*** (0.001)	0.004*** (0.001)	-0.002*** (0.000)	-0.001** (0.000)
ATMs	-0.000* (0.000)	0.000** (0.000)	-0.000* (0.000)	-0.000 (0.000)	-0.001*** (0.000)	0.000** (0.000)
Credit cards	-0.000 (0.000)	0.000** (0.000)	-0.000** (0.000)	0.000** (0.000)	0.000 (0.000)	-0.000 (0.000)
Constant	-0.566** (0.274)	-2.113*** (0.398)	2.405*** (0.533)	-4.130** (1.655)	-1.263*** (0.229)	-3.282*** (0.694)
R ²	0.877	0.825	0.618	0.685	0.879	0.898
Region FE	No	No	No	Yes	No	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
N	617	657	458	458	730	730
χ^2	4897.17***	4656.23***	688.98***		6232.49***	-
F	-	273.90	-	34.61***	-	211.05***

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The R^2 in the HT estimator (Column 2) coefficient is computed using the approach described in Carrère (2006): $1 - (\text{Sum of squared residuals} / \text{Total sum of squares})$.

Table 6. Robustness tests (III). Two-stage least squares instrumental variable estimations

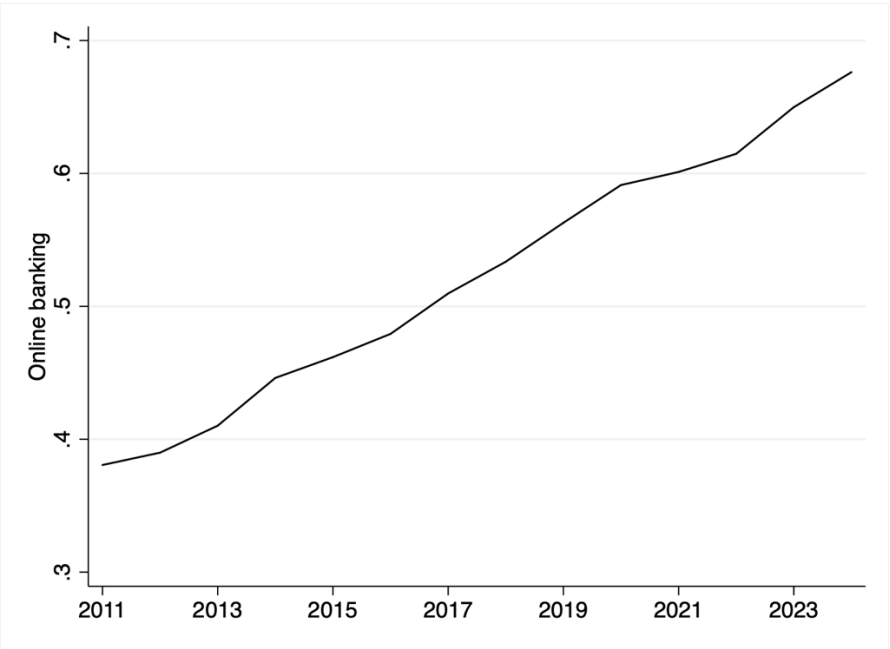
Dep. Var.	Panel data (random effects)		Cross-section	
	First stage Social trust	Second stage Online banking	First stage Social trust	Second stage Online banking
Latitude	0.060*** (0.010)		0.060*** (0.010)	
Pronoun drop	0.427*** (0.105)		0.437*** (0.105)	
Social trust		0.219*** (0.049)		0.411** (0.189)
Internet users		0.869*** (0.117)		0.830** (0.395)
GDP per capita		-0.127*** (0.042)		-0.257** (0.109)
Investment rate		0.053 (0.137)		-0.265 (0.396)
Secondary sector		1.090* (0.593)		2.149** (1.050)
Tertiary sector		1.071* (0.577)		2.056** (1.013)
Institutional quality		-0.035* (0.019)		-0.127 (0.080)
Dependency		0.174 (0.128)		0.005 (0.339)
Young people		0.559 (0.409)		1.055 (0.839)
Secondary education		-0.001 (0.001)		0.000 (0.003)
Tertiary education		0.002** (0.001)		0.003 (0.003)
Branches		-0.001* (0.001)		-0.002 (0.001)
ATMs		0.000 (0.000)		0.002 (0.001)
Credit cards		-0.000*** (0.000)		-0.000* (0.000)
Constant	1.843*** (0.442)	-1.178*** (0.408)	1.842*** (0.445)	-1.895** (0.837)
R ²	0.368	0.848	0.368	0.445
Region FE		No		No
Period FE		Yes		No
N		610		183
F	124.30***	2178.44***	61.46***	305.33***
Sargan test (p-value)		0.541 (0.462)		0.231 (0.631)

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1. Online banking in EU regions

Panel a. Evolution 2011 – 2024



Panel b. Kernel densities, 2011 and 2024

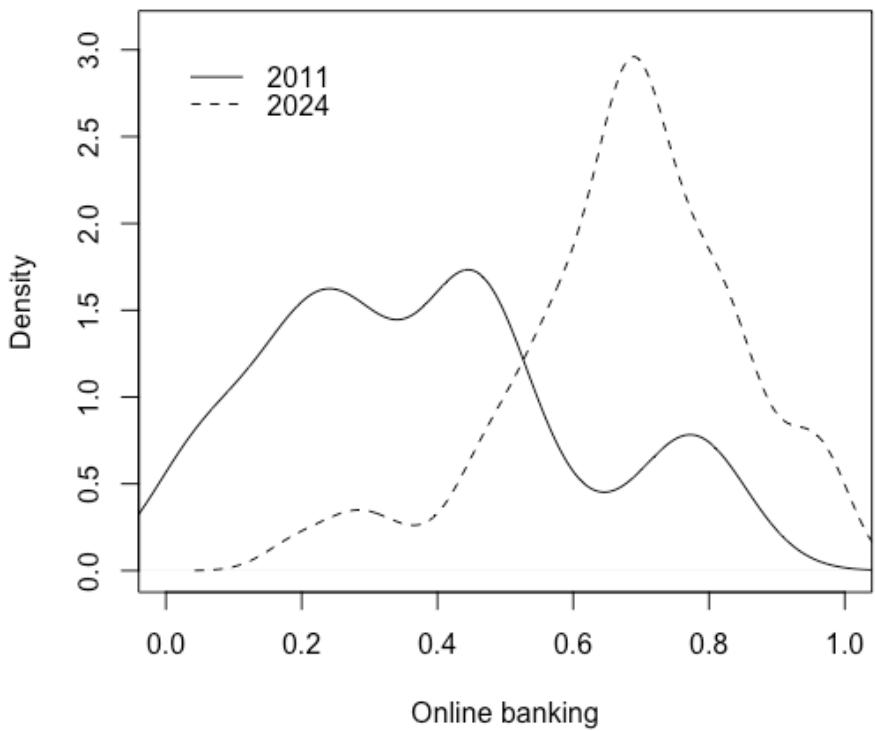
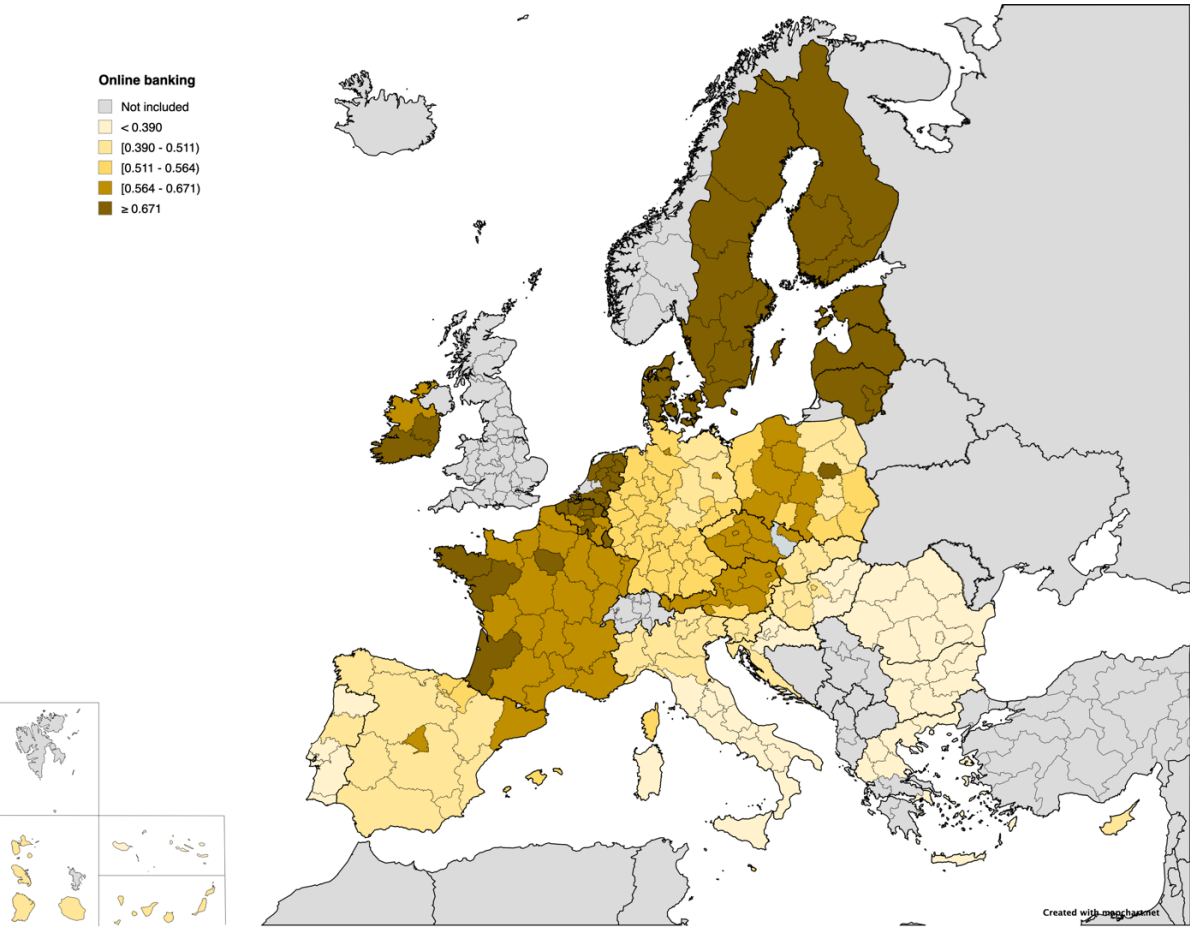


Figure 2. Social trust and online banking in EU regions

Panel a. Online banking (average 2011 – 2024)



Panel b. Social trust (average 2011 – 2024)

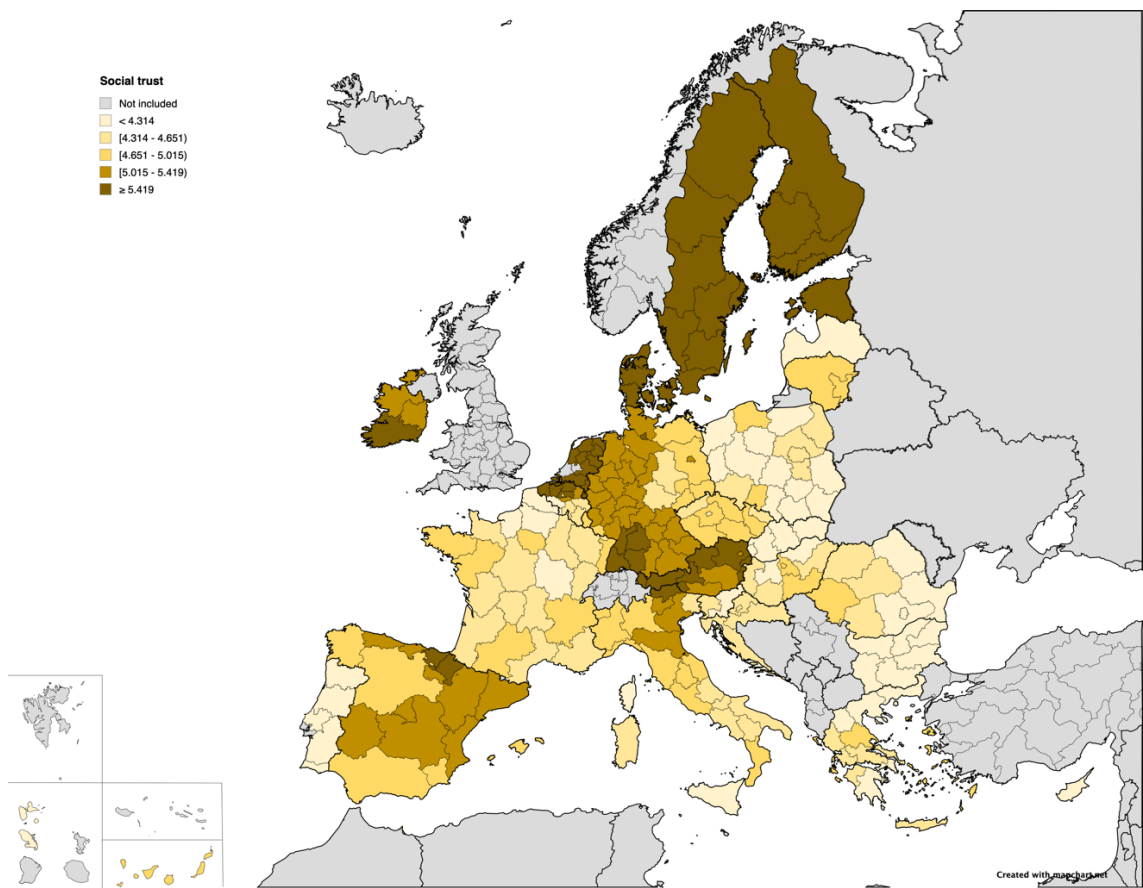


Figure 3. Social trust and online banking (average 2011– 2024)

