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THE DIGITAL TRANSFORMATION IN THE ITALIAN BANKING SECTOR

by Davide Arnaudo, Silvia Del Prete, Cristina Demma, Marco Manile, Andrea Orame,
Marcello Pagnini, Carlotta Rossi, Paola Rossi and Giovanni Soggia*

Abstract

Using a unique dataset based on the results of a survey of almost 280 Italian banks (Regional Bank Lending Survey), this paper presents early evidence on the digital transformation of the Italian banking sector over the period 2007-2018. By building a composite indicator that measures the digital supply of financial services, we show a growth in digitalization over the entire period, with a clear acceleration since 2013. The adoption of digital technologies is not homogeneous across banks and, to an even greater extent, business areas: digitalization started in payment services at the end of the 1990s and then spread to asset management, whereas the use of digital channels in lending is still less frequent. More recently, banks have also implemented new FinTech projects, mainly for digital payments and asset management activities. Lastly, we find a positive correlation between the intensity of technological innovation and bank profitability, and a negative correlation with the number of branches, signalling a potential substitution effect between physical and digital channels.

Contents

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1. Introduction[1]

In recent years, technological innovation has contributed to the structural change of the banking system worldwide. This development was already in place before the Covid-19 pandemic. The digital transformation proved crucial during the pandemic to assure a smooth access to financial services by bank customers. Even though the analysis conducted in this paper concerns the period prior to the pandemic, its results are useful to understand the resilience of the Italian banking industry during the Covid-19 crisis.[2]

International statistics show that Italy is still lagging behind with respect to other European countries, considering both the use of digital financial services by customers and the level of FinTech investments; the Italian digital gap appears particularly substantial when compared to the United Kingdom and to countries in Northern Europe.

Studying the effects of the ICT-related transformation in the banking sector is not straightforward. On the one hand, digital innovation and technology-based business models open up new opportunities for financial intermediaries by transforming the delivery of products and services. On the other hand, ICT could disrupt the existing structure and organization of the financial industry by blurring its boundaries and setting in place a disintermediation process. Moreover, ICT-related services in banking can foster competition from new intermediaries. In order to survive, incumbent banks will thus have to cope with increasing competitive pressure and to adopt innovative yet costly strategies.

In this paper we describe the ICT-driven transformation of the Italian banking sector by using a unique dataset based on a survey on a large sample of Italian banks. Through the survey, we are able to analyse the supply side of this digital transformation, considering different business areas (i.e. payments, lending and saving management). We also provide a detailed picture, updated to 2018, on bank investments in FinTech (crypto assets, e-wallets, crowdfunding, cloud-computing, etc.) and in Big Data, i.e. those techniques that allow banks to elaborate and exploit the digital footprints created through the interactions with their customers. To the best of our knowledge, this paper is the first study to depict an overview of the ICT-driven transformation of the supply of financial services by Italian banks.

Our evidence shows that the adoption of digital technologies is far from being homogeneous across business areas and bank categories. Digitalization started in payment services: in 2018 all the banks supplied digital payment services and three-fourth of them provided also online micro-payments. The digital transformation was widespread also in asset management and nearly 60 percent of the banks in the sample used digital channels in this business area. On the contrary, banks started to offer online loans only later on: in 2018, less than 30 percent of banks was lending online to households, and less than 10 percent to firms. The digital intensity (i.e. the possibility to almost completely finalize a financial operation or a contract digitally) reflected these differences and it was quite poor for the contracts of residential mortgage. As expected, the supply of financial services

[2] First evidence on the impact of the pandemic crisis on the banking system, in particular on the most innovative payment services, is shown by Ardizzi et al., 2021.

through digital channels was common especially among large banks (classified as significant for supervisory purposes), less among smaller intermediaries.

More recently, banks implemented also FinTech projects: in 2018 around half of the banks invested in technologically innovative processes, especially for digital payments and asset management activities, which are perceived as strategic areas of business by most of the Italian banks. These projects were mainly aimed at improving cross-selling strategies, while the use of Big Data in the lending process, to evaluate the creditworthiness of borrowers, was less frequent.

We provide a metric for monitoring the digital transformation of the Italian banking industry by building a composite indicator, which considers both the number of online services actually provided by each bank and the lag since the first-time adopter. The trend of this indicator shows a gradual growth in the supply of financial services through digital channels over the period 2007-2018, with an acceleration starting in 2013.

The digital transformation in the banking sector is frequently associated with improved bank profitability and debranching. With the aim to investigate these topics, we also use the Bank of Italy's Supervisory Reports, which contain information on bank branches, profitability, riskiness, capitalization, size, institutional form, headquarters' location, home banking contracts and online transfers. We study both the correlation between digital transformation and bank performance over the period 2007-2018, and between digital transformation and the structure of banks' geographical network in 2018. In the latter exercise, we consider *a)* the number of branches owned by each bank, *b)* the lender-borrower distance, *c)* the distance between the bank's central headquarters and its local branch managers. We find a positive correlation between digital innovation and profitability, mainly driven by the generation of new sources of income. However, this transformation might be costly and it requires time to bring about cost saving results, essentially *via* a revision of the traditional supply channels. Furthermore, results show a negative correlation between the degree of digitalization and the number of branches, signalling a potential substitution for bank supply between physical and digital channels.

The rest of the paper is organized as follows. Section 2 reviews the main literature on the topic, while Section 3 shows some international evidence. Section 4 describes the digital transformation of the Italian banking system since the end of the 1990s in terms of supply of banking services and investments in FinTech and Big Data. In Section 5 we propose a composite indicator which synthesizes the degree of digitalization of bank services. Section 6 and Section 7 analyse the correlation between digital innovation and bank performance and between digital innovation and the structure of the branch network, respectively. Finally, Section 8 highlights some concluding remarks.

2. Literature review

Despite the digitalization of financial services is attracting increasing attention from academics and policymakers, evidence of its effect on banks is still mixed (see, for a wide review, Abbasi and Weigand, 2017). The digitalization of financial services can affect banks' performances in many respects. It may offer significant cost-saving opportunities in the distribution of financial services in the medium-long term and can improve credit risk models by using new data and methods that are particularly helpful in screening opaque and riskier borrowers (Branzoli and Supino, 2020). However, it may entail new business opportunities for more innovative banks and non-financial institutions

investing in FinTech activities, thus increasing the competitive pressure stemming from new competitors and new products (Philippon, 2016; Barba Navaretti et al., 2017; Buchak et al., 2017). Therefore, the digitalization of financial services opens a window for new players in the financial industry, giving access to tasks and functions previously reserved to banks, such as lending, payments or investment. Differently from other emerging industries, banks reacted mainly by undertaking strategic partnerships with FinTechs, postponing the decision to modernize their own ICT infrastructure (Brandl and Hornuf, 2017).

Consequently, the advance of digitalization in finance generates a trade-off affecting bank performance, stemming from new revenues in new market segments, requiring significant investments in digital technologies and human capital, as well as the increasing threat posed by the competition from new FinTech players.[3]

As far as European banking systems is concerned, virtual banks may pose a credible challenge for traditional banks. Arnaboldi and Clayes (2010) examine the strategic choices of a sample of large EU banking groups with respect to online services, considering the supply of direct online facilities versus the creation (or acquisition) of a separate internet bank. They find evidence that banks with a heavy cost structure, a large market share in retail deposits and a high ratio of non-interest income on total assets are more likely to supply directly internet banking facilities, while competitive pressure seems to drive towards the establishment of a separate internet bank within the banking group. However, banks seem to gain few synergies from a separate internet bank, whereas mixing online to traditional banking seems to improve cross-selling possibilities, despite smaller cost savings. Concerning the United States financial systems, Dandapani et al. (2018) suggest that credit unions adopt transactional internet banking (i.e. customers can buy and use services online) when they serve many customers and when there is increased competition from other financial institutions. Credit unions use transactional internet banking to attract new customers and to limit competitive pressure, a strategy consistent with profit-maximization behaviour.

Some studies for Italy and worldwide show that banks investing more in ICT capital increase their productivity (Casolaro and Gobbi, 2007), are more prone to offer high value-added services (Ciciretti et al., 2009), and are able to implement strategies of revenues diversification, offering to their customers new products or old ones by the new digital channels (DeYoung et al., 2007; Hernando and Nieto, 2007).

The digitalization of financial services interacts directly with the structure of the branch network, affecting the borrower-lender distance and the centre-periphery distance within the bank organization. As for the physical branches, there is a debate about the possibility that digitalization acted as a complement (Xue et al., 2011; Campbell and Frey, 2009; Ciciretti et al., 2009) or a substitute (Bonaccorsi di Patti et al., 2003; Carmignani et al. 2020; Galardo et al. 2021) for the brick-and-mortar transactions.[4] Another stream of the literature argues that the lender-borrower distance has increased

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[3] For a new approach on the link between competition and profitability for Italian banks, see Benvenuti and Del Prete (2019).

[4] Xue et al. (2011) and Campbell and Frey (2009), focusing on the demand side, find that physical branches and online access were complements. A similar result was obtained by Ciciretti et al. (2009), this time looking at the supply side of Italian banks in the period 1992-2002. Bonaccorsi di Patti et al. (2003) tried to identify supply and demand effects jointly; based on their findings, the number of local branches and online access displayed an inverse relation. Carmignani et al. (2020) analysed the same nexus in the 2012-15 time span; they found that the reduction in bank branches was more intense in those local markets where the digital baking services was spreading faster (substitution effect). Recently,

in recent years and ICT adoption and digitalization might be one of the main driver for this trend.[5] Finally, other contributions show that more ICT-intensive banks increased their span of control over their geographical network, interacting at a longer distance with their local branch managers.[6]

3. Stylized facts on bank digitalization

Digitalization in financial services differs widely across European countries, reflecting both supply factors, such as the availability of internet banking platforms, and demand components related to the overall digitalization of the society, as well as the general trust in internet banking.

According to Eurostat statistics, the share of population using internet banking is higher in Northern Europe, especially in the Netherlands, Finland, Denmark, Sweden and Estonia where more than 80 out of 100 people used internet banking in 2019 (Figure 1). In Italy only 36 out of 100 adults used internet banking in the same year, having a slightly higher share in the regions of Centre-North than in the South (Figure 2). A survey conducted by the World Bank finds that Italy ranks poorly even in the use of digital technologies in accessing payments services.[7] The shares of adults (at least 15 years old) using digital payments, e-payment or internet banking in monetary transactions are lower in Italy than in the Euro area (Figure 3).

On the one hand, greater use of internet and mobile banking, especially in Nordic countries, is associated to less dense branch networks. On this point, Italy has a rather high number of branches in relation to its population (Figure 4). On the other hand, the use of internet banking is generally strongly correlated with internet diffusion, and Italy underperforms in the use of internet, too (Figure 5). According to the 2019 Digital Economy and Society Index (DESI),[8] Italy ranks 25th out of the 28 EU Member States in terms of overall digital performance.

On the supply-side, technological investments in finance (the so-called FinTech) have spread more rapidly in China and in the United States,[9] whereas in Europe only the United Kingdom has shown a significant development in this sector, as reported by the CBInsights survey.[10] Italy performs poorly among the EU countries also in investment activity to innovate financial processes, showing the lowest share of investments in FinTech (Figure 6).

Galardo et al. (2021) have shown that banks that invest more in ICT capital close more frequently their branches, especially in those local markets where broadband connections are widespread.

[5] Petersen and Rajan (2002) documented that, thanks to the information revolution, the distance between firms and their lenders increased, even for opaque borrowers.

[6] See Berger et al. (2005) for evidence on financing of US small firms. Felici and Pagnini (2008) showed that, following the advent of ICT, the ability of Italian banks to open branches in markets, which are distant from those where they had been already established, improved.

[7] Dermirgüç-Kunt et al., 2017.

[8] The DESI is an index that summarizes five relevant dimensions (connectivity, human capital, use of the internet, integration of digital technology, and digital public services) of the overall digital performance of each European country. For more details: https://digital-strategy.ec.europa.eu/en/policies/desi.

[9] See Commette on the Global Financial System and Financial Stability Board (2017).

[10] A company that records data on innovative and digital start-ups.

4. The ICT transformation of the Italian banking industry

To study the evolution of ICT transformation in the Italian banking industry, we use a unique survey performed by the Bank of Italy on a large sample of Italian banks (Regional Bank Lending Survey, RBLS hereafter). The sample is composed by around 280 banks, which covers almost 90 percent of deposits and 85 percent of loans to firms and households. In 2019, a section of the RBLS focused on the digital transformation of the banking sector, including questions about the adoption of digitalization strategies in traditional business areas and on the relationship with the FinTech industry and the use of Big Data.

Using such data, in this Section, we recognize three pillars of ICT transformation in the banking industry: (1) the digitalization of traditional services; (2) the adoption of new processes or the supply of innovative products (i.e. FinTech) and (3) the use of Big Data.

4.1 The digitalization of banking services

The digital transformation spread across different types of banking activities whit a different speed. Digitalization started in payment services: in 1998, one-fourth of banks in the survey already allowed their clients to make or receive payments digitally; ten years later, in 2008, this ratio was close to 90 percent and in 2018 all the surveyed banks provided digital access to payment services (Figure 7). Moreover, in the same year, 75 percent of banks (corresponding to over 80 percent of deposits) allowed for online micro-payments and peer-to-peer money transfers through mobile devices, a share that was lower than 5 percent just 4 years before. The increase in the number of banks offering payment services through mobile devices partly reflects the favour of customers for these tools to access banking services.

Since the early 2000s, the digitalization process spread out also to asset management,[11] even though at a slower pace than that observed for other banking services: in 2018 less than 60 percent of the surveyed banks placed savings products through digital channels.

The use of digital channels to manage most part of the lending process began to spread only later on: in 2018 the number of banks offering credit through internet portals was still low, close to 30 percent for lending to households (either mortgage or consumer credit) and lower than 10 percent for non-financial corporations. Around 23 percent of the interviewed banks offered consumer credit to households, while the possibility of accessing an online mortgage was slightly lower (these loans were supplied by just under 20 percent of banks).

The supply of financial services through digital channels was widespread among larger banks, especially those classified as "significant" for supervisory purposes: in 2018 all significant banks allowed customers to use online services for the management of savings; 80 percent has developed projects for the supply of payment services via mobile devices and has allowed households to use internet to access mortgage contracts. Compared to less significant banking groups, the gap is substantial for savings management and lending to households.

The digital intensity (i.e. the possibility to almost completely finalize an operation or a contract digitally) was highly heterogeneous across business areas, performing poorly for residential

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[11] Digital savings management includes both online placement of financial products and the offer of automated consultancy services (such as, for example, through robo-advisors).

mortgages compared to consumer credit and – to a larger extent – asset management: only around 10 percent of the surveyed banks fully digitalized the residential mortgage activity; the same share was 40 percent for the supply of consumer credit and 50 percent in the asset management services. The digital intensity was instead very high in the area of payment services. Significant intermediaries generally performed better than the less significant ones (Figure 8).

4.2 FinTech banks

The second pillar of ICT transformation in the banking industry is related to FinTech, which pertains to the adoption of technologically intense and innovative processes that could result in new financial products and services.[12]

There are many ways through which FinTech can interact with banking. The literature on the topic studies innovations in payment systems (including cryptocurrencies), lending (comprising P2P lending) and insurance. Blockchain-assisted smart contracts are also part of this literature (Thakor, 2020).

At the end of 2018, almost 55 percent of the Italian banks in the survey declared that they had already implemented FinTech projects or that they intended to implement them in the following three years (Figure 9); the share of intermediaries that had already started these projects was around 35 percent.[13]

Since bank size is important to deploy these innovations, due to initial investments and the need of highly skilled employees, FinTech diffusion tends to be higher among significant banks compared to less significant intermediaries. Unreported results show a positive correlation between bank size and the implementation of FinTech investments,[14] suggesting that size could be a crucial constraint to bank digitalization.

FinTech projects might be adopted through initiatives within the banking groups following *in–house* strategies, as well as through projects shared with external companies. In this perspective, around half of the Italian significant banks indicated the use of joint-ventures or commercial agreements with specialized FinTech corporations as effective strategies to adopt FinTech.

Digital payments[15] (including e-wallets, peer-to-peer payments, and mobile payments) represent the business area for which FinTech is considered strategic by Italian banks (Figure 10), since

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[12] Barba Navaretti et al. (2017) state that "FinTech refers to the novel processes and products that become available for financial services thanks to digital technological advancements". More precisely, the Financial Stability Board defines FinTech as "*technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services*".

[13] Since 2017, every two years the Bank of Italy has carried out another survey to detect the state of adoption of technological innovations applied to financial services in the Italian financial system (more details are available at the link: https://www.bancaditalia.it/pubblicazioni/indagine-fintech/2021/index.html). This survey has a different focus respect to the survey used in our paper in terms of perimeter of the technologies detected and of intermediaries interviewed, including also non-banks (for more details, see Bank of Italy, 2021).

[14] We estimate a multivariate logistic model where the dependent variable is the implementation of FinTech investments in at least one of the four relevant business areas that are considered in our survey (payment systems, investment services, lending to households, lending to firms) while the regressors are the usual bank balance sheet indicators.

[15] The label "Digital payments" represents all those payments mainly enabled by mobile devices, provided both by financial and non-financial institutions. Those payments have huge potential to change lives of millions of people in developing countries by offering financial services to the unbanked masses. Despite their potential, their development remains heterogeneous across countries, mainly due to perceived cyber-correlated risks. In order to ascertain the various

payments are the area in which banks are most likely to experience competition from non-financial enterprises. Automated services for asset management, such as automated financial consultancy and robot advisors, are also perceived as a strategic business area, particularly by larger banks.

FinTech projects appear of little relevance in digital services specifically targeting firms: e-factoring, commercial circuits[16] and crowdfunding[17] are judged relevant by less than 10 percent of surveyed banks. As suggested by a consolidated literature on the topic, lending to firms is information-intensive and the lender-specific relationship is difficult to replace, especially for small and medium-sized enterprises (SMEs): the bank branch network could play a crucial role in this area of business, which remains more protected by the competition of specialized FinTech intermediaries and their online platforms (Hauswald and Marquez, 2006).

4.3 Information technology and Big Data

The application of technological innovation to the banking sector offers new and better opportunities to process information collected through the interactions with customers (the so-called Big Data).

At the end of 2018, the use of Big Data (which refers to collection, systematization and exploitation projects of unstructured and large data) involved 40 percent of the Italian banks in the survey: around one-fourth declared to have already started to use Big Data, while 15 percent of the banks intended to undertake these projects in the short-term (i.e. within a 3-year horizon).[18] Analogously to FinTech investments, the share of banks that had implemented or intended to implement Big Data projects was higher for significant banks (table 1).

The main reason why banks claim to use Big Data is to extend cross-selling (30 percent) as well as to improve their offering through a better understanding of customers' needs (28 percent). The evaluation of customers in the lending process and the improvement of the information supplied to customers are perceived as less important.

5. A metric for the digital transformation

In order to have an overall picture of the evolution of the digitalization process of banking activities over time, we built a composite index that considers both the number of online services (payments, financial investments, loans, and applications for mobile devices) actually provided by each surveyed bank and the time elapsed since the initial introduction by the early adopter. The index is normalized to have a range between 0 and 1 for each bank; it grows with the number of services digitally offered by each bank and decreases with the delay with which the bank started offering the service digitally relative to the first-time adopter. Banks that supply a greater range of online services

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drivers and inhibitors behind digital payment adoption, see Patil et al. (2018). For the determinants of peer-to-peer payments (P2Ps), see Havrylchyk et al. (2019).

[16] They include, among others, the development of web platforms for the disposal of invoices (for example, invoice trading without the intermediation of an institutional operator).

[17] Fund-raising tool for a specific project or activity. The following are distinguished: lending crowdfunding, debt-securities crowdfunding, equity crowdfunding, reward-based crowdfunding and social-lending crowdfunding; whatever the purpose of the collection, it takes place through internet portals. For a dissemination on crowdfunding, see Rau (2020).

[18] See also the results of other surveys conducted by the Bank of Italy (Bank of Italy, 2017, 2019 and 2021).

or have offered them earlier have a higher digitalization rate, which should be understood as a proxy of *relative* digitalization for Italy, i.e. compared to peer Italian banks.

More in detail, for each bank *b*, the indicator is the weighted average of seven dichotomous variables, one for each service considered in the survey: these variables take the value of 1 if the bank *b* offers the service *k* online, and 0 otherwise; *k* takes values from 1 to 7 according to the service recorded by the survey (on-line payments, peer-to-peer payments, smartphone applications, asset management, mortgages to households, consumer credit, loans to firms).[19] Therefore, the indicator of the degree of bank digitalization can be written as follows:

$$S_b^{dig} = \frac{1}{7}\sum_{k=1}^{7} w_{b,k} \mathbf{1}_{b,k}$$

The average weights are given by:

$$w_{b,k} = \frac{n.years_{b,k}}{n.years_k}$$

where:
- *n.years$_{b,k}$* is the number of years during which the bank *b* has been offering the service *k;*
- *n.years$_k$* is the number of years in which the service has been available online on the Italian market (which is determined by the year of the first online introduction of this service in Italy within the surveyed banks).

The trend of this supply indicator shows a gradual growth in digitalization over the entire period considered (2007-2018) with an acceleration starting in 2013 (Figure 11.a). The result is robust when we consider an alternative formulation of the indicator, which discards the weights and thereby the information on the number of years the services have been offered by the bank (Figure 11.b). Furthermore, the use of an alternative indicator as the share of online current accounts over total current accounts, drawn by RBLS, and available since 2015, confirms the growing trend in the supply of bank digital services (Figure 12).

6. Digitalization and bank performances

In order to assess the relationship between the supply of digital financial services and various proxies of bank performance, we correlate the composite indicator of digital supply presented in Section 5 with balance sheet indicators and with other bank characteristics drawn by the Bank of Italy's Supervisory Reports. Therefore, our exercise considers different performance indicators over the period 2007-2018, as well as the intensity and the early adoption of digital technologies by the banks in our sample.

We estimate the following equation:

$$Y_{bt} = \alpha + \beta Digital_{bt} + \delta X_{bt} + \mu_b + \gamma_t + \varepsilon \qquad \text{[eq.1]},$$

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[19] The index implicitly assigns the same weight to every service provided, with no distinction of their (possibly heterogeneous) relative importance.

where:

- − *Y* is a bank economic outcome (profitability, diversification of revenues, cost indexes, etc.), able to account for banking performance over time;

- − *X* is a vector of bank-level controls, varying over time and related to bank size (as the log of bank total assets), bank capitalization (as the share of equity on total assets) and a measure of portfolio riskiness (as the share of bad loans over total loans);

- − *Digital* is our main measure of bank supply digitalization, varying across banks and over time, as defined in Section 5;

- − *μ* are bank fixed effects, in order to account for unobservable time-invariant bank features (e. g., management skills, governance strategy, bank history, etc.);

- − *γ* are year fixed effects in order to account for the business cycle effects.

The main results of the analysis are reported in Table 2.[20] The findings suggest that – other things being equal – there is a strong and positive correlation between supply digitalization of bank activities and profitability (columns [1] and [2]): the higher the intensity of digitalization, measured by our composite indicator, the higher the bank profitability, both in terms of return on total assets (ROA) and of return on equity (ROE). Ciciretti et al. (2009) find similar results for a large sample of Italian commercial banks, underlining a significant link between the supply of internet banking products and bank performance by using different definitions for internet activity.

The increased profitability appears to be driven by the strong correlation between digitalization and overall fees and commissions (column [3]), as well as from asset management activities (column [4]). This result might point to improve income diversification due to digitalization. In the same vein, DeYoung at al. (2007), using a sample of more than 400 US community banks, find that in the late-1990s internet adoption boosted bank profitability, mainly through increasing revenues from deposit services.

On the contrary, there is no evidence of any significant correlation between digitalization and cost savings, while the incidence of total costs on assets is correlated inversely with bank size and portfolio riskiness (columns [5]).[21] This result suggests that the cost-structure of the banking industry is still mainly affected by lending activity, which relies more on the traditional supply channels, such as branches, and depends on relationship-based interactions among the bank and its customers (see also Section 7). Moreover, as previously found in the literature, cost saving policies induced by ICT investments may take time to become effective and generate spillovers on profitability. In this direction, Hernando and Nieto (2007), using a sample of Spanish commercial banks, suggest that the adoption of the internet as a delivery channel in the second-half of 1990s involved only a gradual reduction in overhead expenses (particularly, staff, marketing and ICT).

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[20] In an unreported exercise, we considered also one or two lags of the digitalization index, obtaining very similar results.
[21] These results are confirmed by unreported regressions where the dependent variable is the cost-income ratio.

7. Digital transformation and debranching

The digital transformation in the banking sector is conventionally correlated with the speed up of the debranching process. After a long period of expansion, in Italy the number of bank branches started to decline in 2009, after the global financial crisis, similarly to other European countries.

In Italy the number of bank branches declined by about 29 percent between the end of 2008 and the end of 2019 (Figure 13); at the same time, the geographical extent of the branch network was significantly reduced, with a 12 percent drop in the number of municipalities served by banks. This reorganization of the territorial network was accompanied by a process of consolidation of the banking system, with a reduction in the number of intermediaries.

In order to explore the relationship between digitalization and branch networks we provide a conditional-correlation analysis. We proxy the branch network characteristics with the number of branches scaled by total assets, the distance between branches and borrowers (lender-borrower distance), and the distance between a bank's headquarter and its branches (centre-periphery distance).[22]

The lender-borrower distance (LBD) – In order to provide an adequate measure of LBD, we introduce an indicator at the bank level, measuring physical distance between branches and borrowing firms. Specifically, we consider S_{bit} as the group of branches owned by bank b in the municipality i at time t. Let F_{ijt} denote the set of firms in the municipality j borrowing from S_{bit} at time t and R_{bijt} the number of these credit relationships. Thus, we define D_{ij} as the physical distance between municipalities i and j. When $i = j$ we compute distances using the surface of the municipality assuming that it is inscribed in a circle: bank branches are presumed to be located at its centre and the borrowing firms on its perimeter. When $i \neq j$ we consider the geodetic distance between the two city halls. Based on these variables, for each bank b we can define the following distance: [23]

$$LBD_t = \frac{\sum_i \sum_j R_{ijt} D_{ij}}{\sum_i \sum_j R_{ijt}}$$

where i belongs to the set of municipalities where bank b's branches are located and j to the group of municipalities where firms borrowing from bank b's branches are located. In other words, LBD_{bt} represents a weighted average of the distances between bank b's branches locations and the locations of the firms they lend to, where weights are the share of credit relations pertaining to the municipalities i and j over the total number of credit relations for bank b.

According to our index, the median lender-borrower distance increased from 13 to 17 km between 2001 and 2018 (Table 3).[24] As expected the median distance is higher for larger banks.[25]

The centre - periphery distance (CPD) – As described in Albareto et al. (2011), this is a measure of the organizational distance, i.e. the distance between the bank's headquarter and the managers of

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[22] The different measures of distance analyzed could depend on bank size; for this reason, we control for bank size in the empirical analysis.

[23] For the sake of simplicity, we drop the index b from the notation.

[24] See the seminal paper by Pertersen and Rajan (2002), and DeYoung et al. (2011) for the US. Other contributions found a less clear-cut tendency about the increase in lender-borrower distance (see Brevoort et al. (2010) for the US and Degryse and Ongena (2005) for Europe).

[25] The high mean value of the LBD for large banks could be driven by the higher frequency, for this type of banks, of credit relationships between firms and borrowers in large and far cities.

the branches where lending decisions are taken. We start from the municipality *j*, hosting bank *b*'s headquarters. Let BR_i denote the number of bank *b*'s branches located in municipality *i*, where *i* belongs to the set Nb_t denoting all the municipalities where bank *b*'s branches are located at time *t*. Let $dist_{ij}$ represent the geographical distance between municipalities *j* and *i*. Thus, we can define the following:

$$CPD_{bt} = \frac{\sum_{i \epsilon N_{bt}} BR_{it} dist_{ij}}{\sum_{i \epsilon N_{bt}} BR_{it}}$$

Summing up, this indicator is a weighted average of headquarters - local branches' distances at municipality level, where weights are given by the number of branches in each municipality over the total number of bank *b*'s branches.[26]

The CPD increased between 1998 and 2018 (Table 4), involving both small and large sized banks. In other words, banks were increasingly able to cope with distance-related costs generated through interactions with peripheral units. Besides the decision of banks to close their branches, the increase of the CPD could depend on the consolidation process (mainly through merger operations) featuring Italian banks during the period covered by our analysis. To gauge the latter, we compute CPD also getting rid of the effect of the merger operations.[27] The growth in the span of control still holds even when we net out for the effects of the consolidation process, although its expansion is smaller. Furthermore, once we control for the mergers, we do not observe any further increase in the span of control for the large banks from 2008 onwards.

Correlation analysis – In order to assess the link between digitalization and banks' network characteristics, we perform a simple cross-section regression analysis. Since some measures of distance and control variables are available only in few different points in time, this limitation does not allow to implement a panel analysis, as in the previous section. Therefore, the correlation analysis in this section is conducted on 2018, the final year of the period under scrutiny, by estimating the following equations:

$$\frac{Branches}{Assets}_b = \alpha + \beta \, Digital_b + \gamma X_b + \varepsilon_b \qquad \text{[eq.2]}$$

$$LBD_b = \alpha + \beta \, Digital_b + \gamma X_b + \varepsilon_b \qquad \text{[eq.3]}$$

$$CPD_b = \alpha + \beta \, Digital_b + \gamma X_b + \varepsilon_b \qquad \text{[eq.4]}$$

where, for each bank *b*:

- LBD_b and CPD_b, are the two distances in 2018 and $\frac{Branches}{Assets}_b$ is the log of the number of branches owned by bank *b* in 2018, normalized by bank's *b* total assets;

- $Digital_b$ is a measure of bank supply digitalization, considering either the share of online current accounts over the total number of current accounts (drawn by RBLS) or our measure

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[26] We compute distances in a similar way as that adopted for the lender-borrower distance. Alessandrini et al. (2005, 2009) use a similar measure and coined the term 'functional distance' for it. Notice however that their indicator is referred to the weighted average of the distance of the branches located in a specific market with respect to the location of their corporate headquarters. Ours is a measure at bank-level, picking up the ability of banks to spread their control over distant markets (span of control).

[27] We consider the banks existing in 2018 and projected this configuration backwards assuming that it holds throughout the period.

of digitalization described in section 5. The first measure reflects both the demand for these payment services by customers and the digital supply of these services by the bank; the second measure includes a wider spectrum of financial services, looking at the adoption of digital technologies only from the supply-side point of view.

- X_b includes a small set of controls, consisting of a set of area dummies for the macro-region where the bank's headquarters are located, another dummy for cooperative credit banks, and indicators for bank size, based on the quantiles of the distribution of total assets.[28] These controls could have an important impact that must be accounted for; for example, besides to LBD, bank size could be positively correlated with CPD given the significant consolidation operations as bidder over the period under analysis.

Results reported in Table 5 are consistent across different dependent variables and specifications. Our indicator for online services displays a negative correlation with the number of branches. Banks that more intensely use online banking services resort to a lower number of branches for a given volume of activity. Moreover, the same banks are able to interact at longer distances both with their borrowing firms and with their local branch managers.

These results rely on a specific proxy for the degree of digitalization of banking services. We replicate the same analysis using a wider set of variables that measure the adoption of digital technologies in the provision of financial services. As shown in Table 6, we alternatively include: *a)* the share of online current accounts with a 3-year lag; *b)* the bank supply digitalization index illustrated in the Section 5, that is a wider measure of digitalization, taking into account the number of financial services offered online and the year of adoption; *c)* the share of home banking contracts over total deposit contracts, and *d)* the share of online transfers over total transfers, both coming from Supervisory Reports. Considering alternative measures of digitalization, previous results are largely confirmed.

These results are consistent with Carmignani et al. (2020) and partially at odds with other contributions that find no evidence of a substitution effect between online services and physical branches. The findings on lender-borrower distance are in line with Petersen and Rajan (2002) and the literature that followed (see, in particular, DeYoung et al., 2011, and Granja et al., 2018). Finally, the results on the centre-periphery distance support the evidence already found in the literature on the nexus between the span of controls and ICT technologies (Berger et al., 2005, and Felici and Pagnini, 2008).

8. Conclusions

The financial landscape has been shaped in recent years by the introduction of new products, new business models, new players and new relationships between FinTech and banks, all prompted by financial digitalization. Such innovations determine potential effects on banking competition and stability, posing serious challenges for the traditional banking business model (Bofondi and Gobbi, 2017).

In a context of a wide digital gap relative to EU-peers, the ICT-transformation of the Italian banking industry spreads to a diverse extent across business areas and bank categories. In 2018 all

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[28] We discretize this variable to avoid collinearity between bank size and our ICT indicator.

the banks allow their clients to digitally access to payment services while, at the other end of the spectrum, only around one-fourth of Italian banks offer loans through digital channels. Even the degree of completeness of the digital supply (i.e. the possibility to fully complete a contract digitally) varies significantly across business areas and bank categories: it is higher in asset management and consumer credit activities, and among significant (i.e. larger) banks. Consistently, the adoption of digital channels is significantly and positively correlated with bank profitability, especially revenues stemming from asset management activities. In the long-run, the digitalization of financial services might bring about also cost-saving results, which are not yet detected in our data, because they need time to be deployed.

The degree of digital transformation across banks favour the substitution of banks branches by digital channels. We provide evidence of a correlation between branch network size and digitalization: the higher the digital supply to customers, the lower the number of branches and the greater the *lender-borrower* and *centre-periphery* distances. The result, which is robust to different measures of digitalization, might suggest that in the long-term the digitalization of financial services could partially offset traditional lending activities based on branching. However, branch closings and the increase in the *lender-borrower* and *centre-periphery* distances could negatively affect credit availability, especially for small firms, whose credit rely more heavily on soft information and relationship lending (Bonfim et al., 2016; Hauswald and Marquez, 2006; Levine et al., 2020; Nguyen, 2019).

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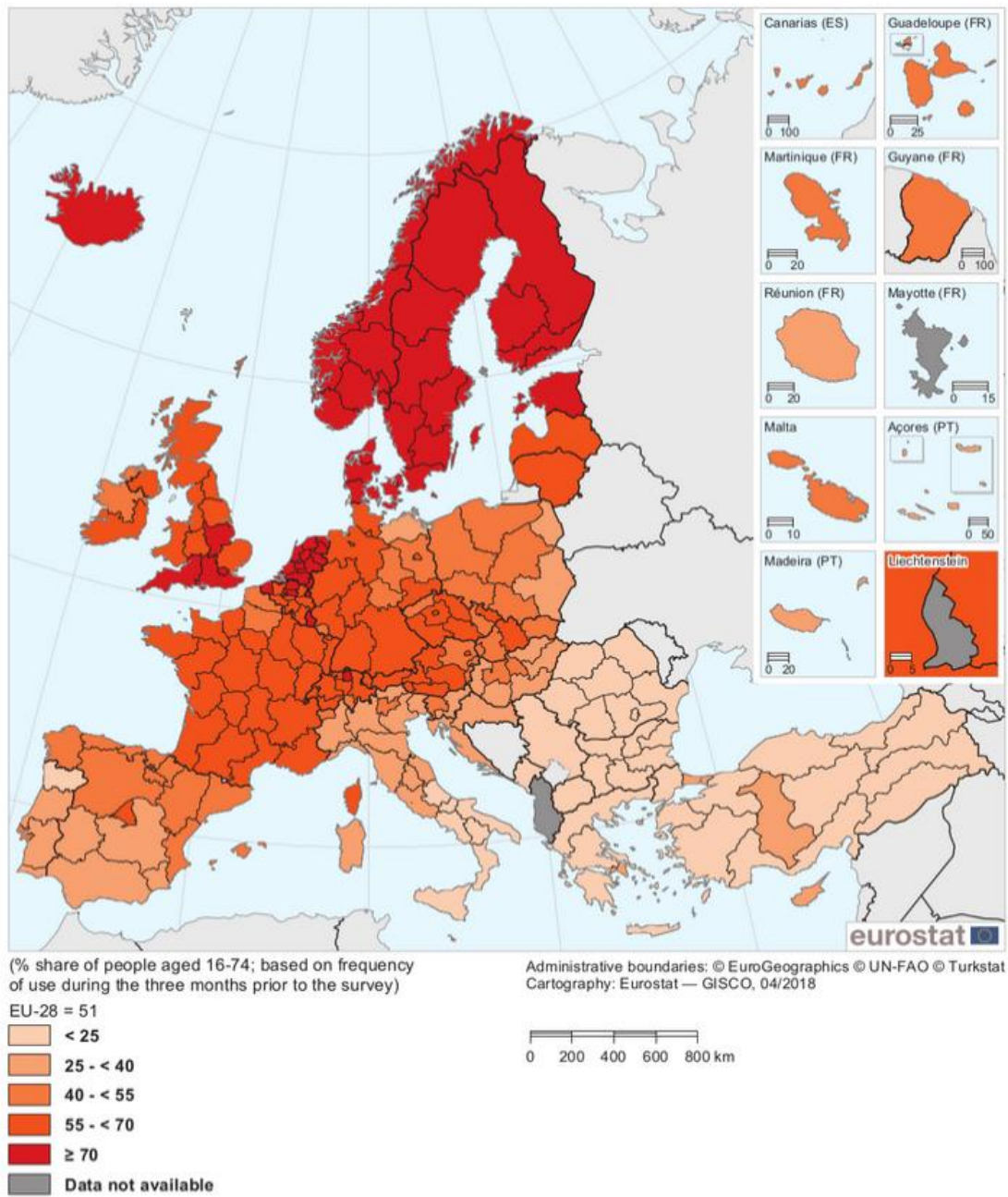
Figures

Figure 1

The share of population using internet banking in EU countries

(percentage of individuals who used internet banking in 2019)
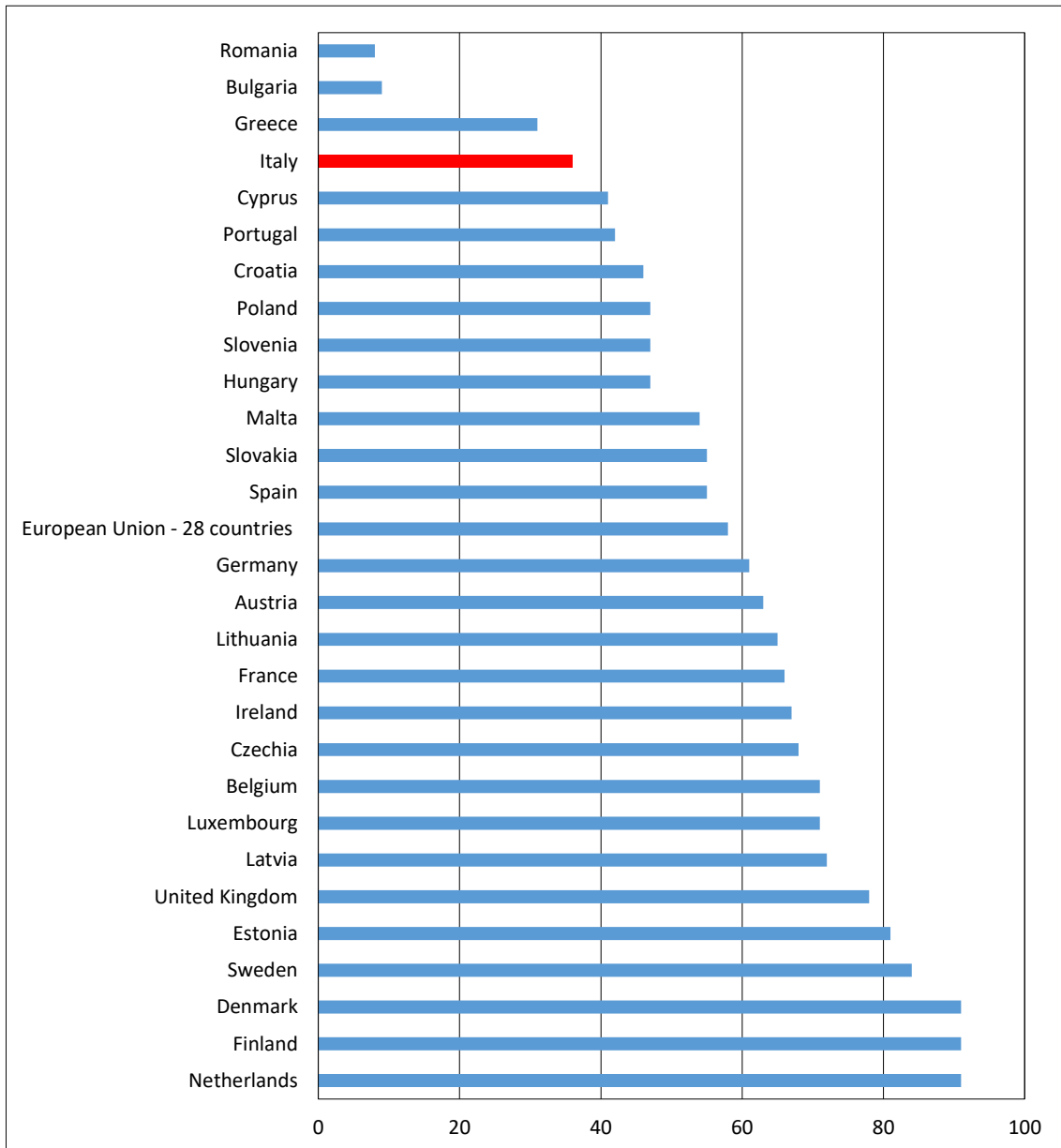
Source: Eurostat - Survey on ICT usage in households and by individuals.

Figure 2

Proportion of people using internet banking, by NUTS 2 regions, 2017
(% share of people aged 16-74; based on frequency of use during the three months prior to the survey)

(% share of people aged 16-74; based on frequency
of use during the three months prior to the survey)

EU-28 = 51

- < 25
- 25 - < 40
- 40 - < 55
- 55 - < 70
- ≥ 70
- Data not available

Administrative boundaries: © EuroGeographics © UN-FAO © Turkstat
Cartography: Eurostat — GISCO, 04/2018

0   200   400   600   800 km

Source: Eurostat - Survey on ICT usage in households and by individuals.
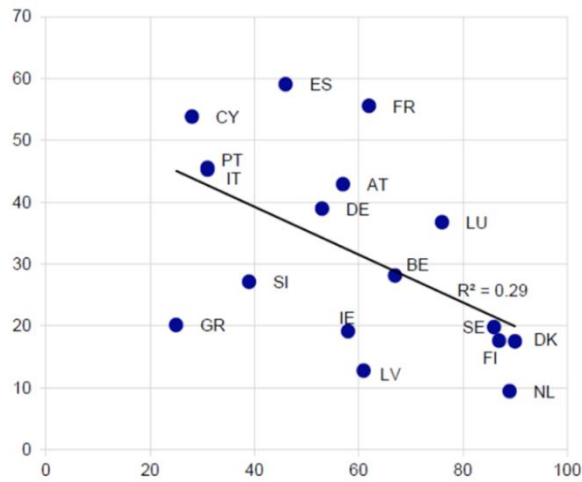
Figure 3

The share of population using e-payments or internet banking
(percentage shares)
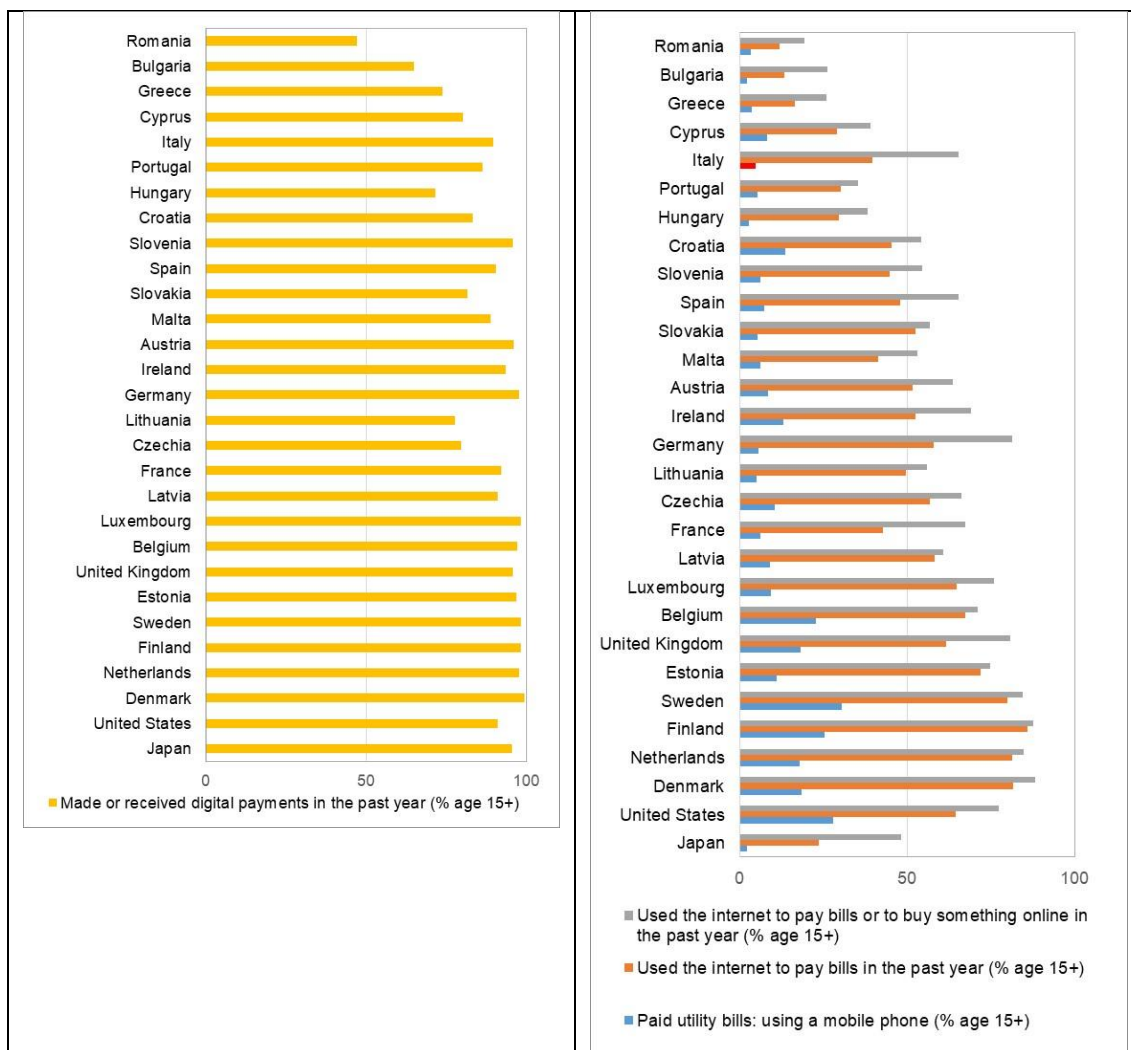
Source: World Bank's survey on Global Financial Inclusion Database; country shares in 2017 of individuals (15+ years old) using e-payments or internet banking to pay bills or to acquire goods or services; (available at https://globalfindex.worldbank.org/
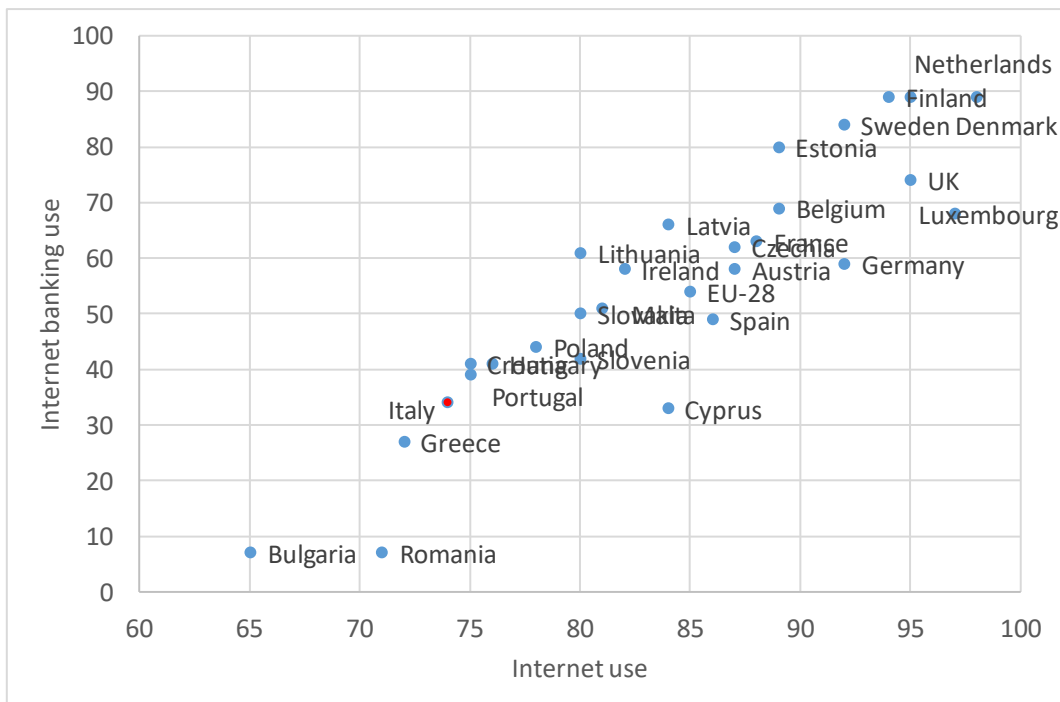
Figure 4

Share of population using internet banking vs branch networks

(x-axis: percentage of individuals who used internet in the last 3 months in 2018; y-axis: the number of branches per 100.000 inhabitants)
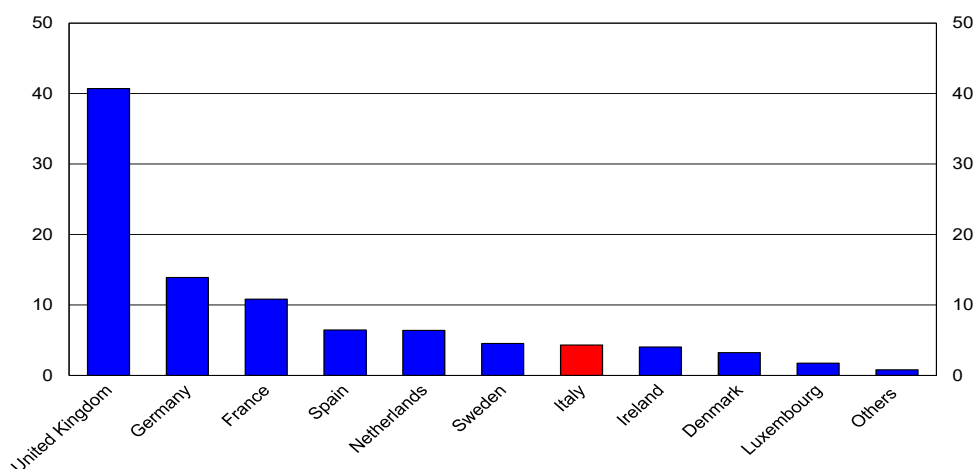

Source: Eurostat and ECB.

Figure 5

The share of population using internet vs. internet banking

(percentage shares)

Source: Eurostat - Survey on ICT usage in households and by individuals.
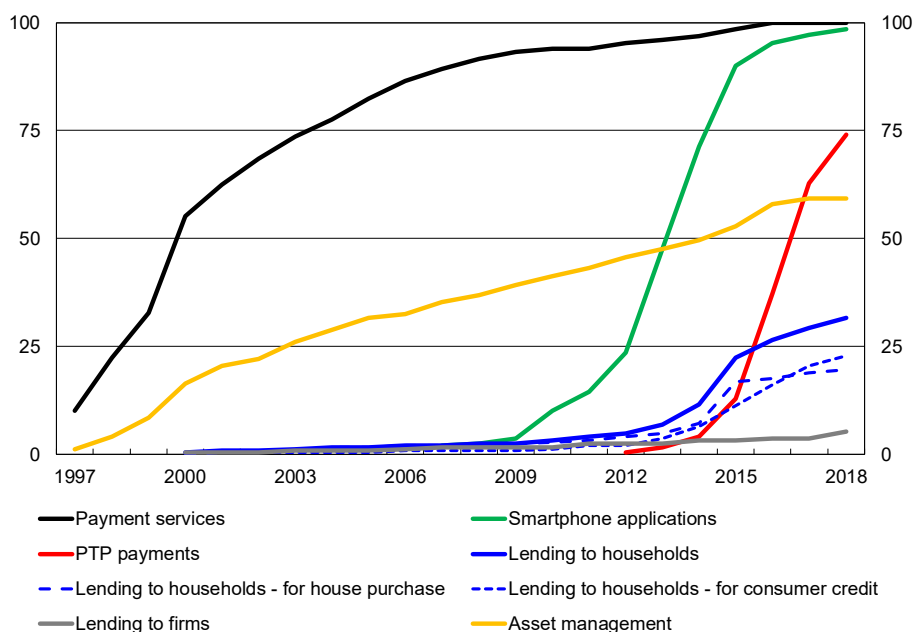
Figure 6

FinTech investments

(percentage shares)

Source: Cbinsights
Country percentage shares of total investment in FinTech companies between 2011Q1 and 2017Q3 on total investments (available at: https: //www.cbinsights.com/).

Figure 7

Supply of banking services offered through digital channels in Italy

(percentage shares)

Source: Regional Bank Lending Survey (RBLS).
Note: Share of banks offering their services through digital channels. Unweighted frequencies. For lending to households and firms, the share refers to banks that provide online estimates of what loans would cost.

Figure 8

Digital intensity (degree of completeness)
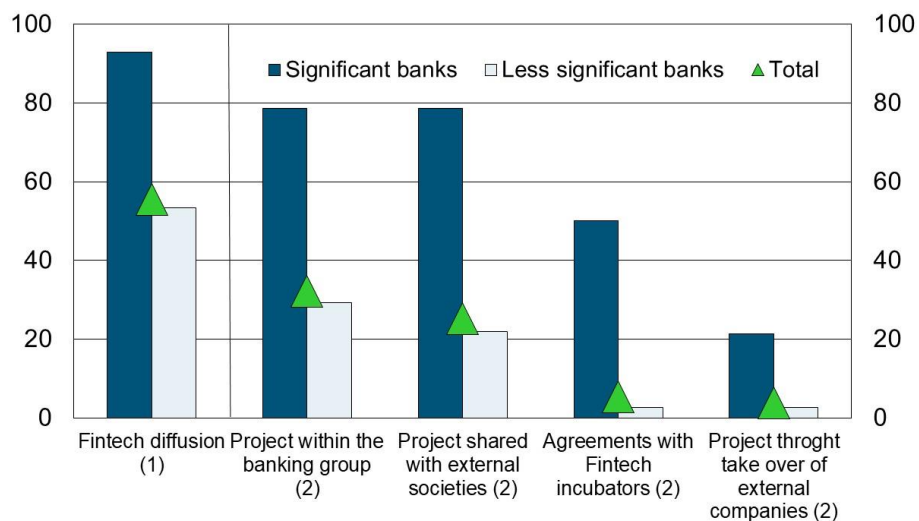
(percentage share of banks)
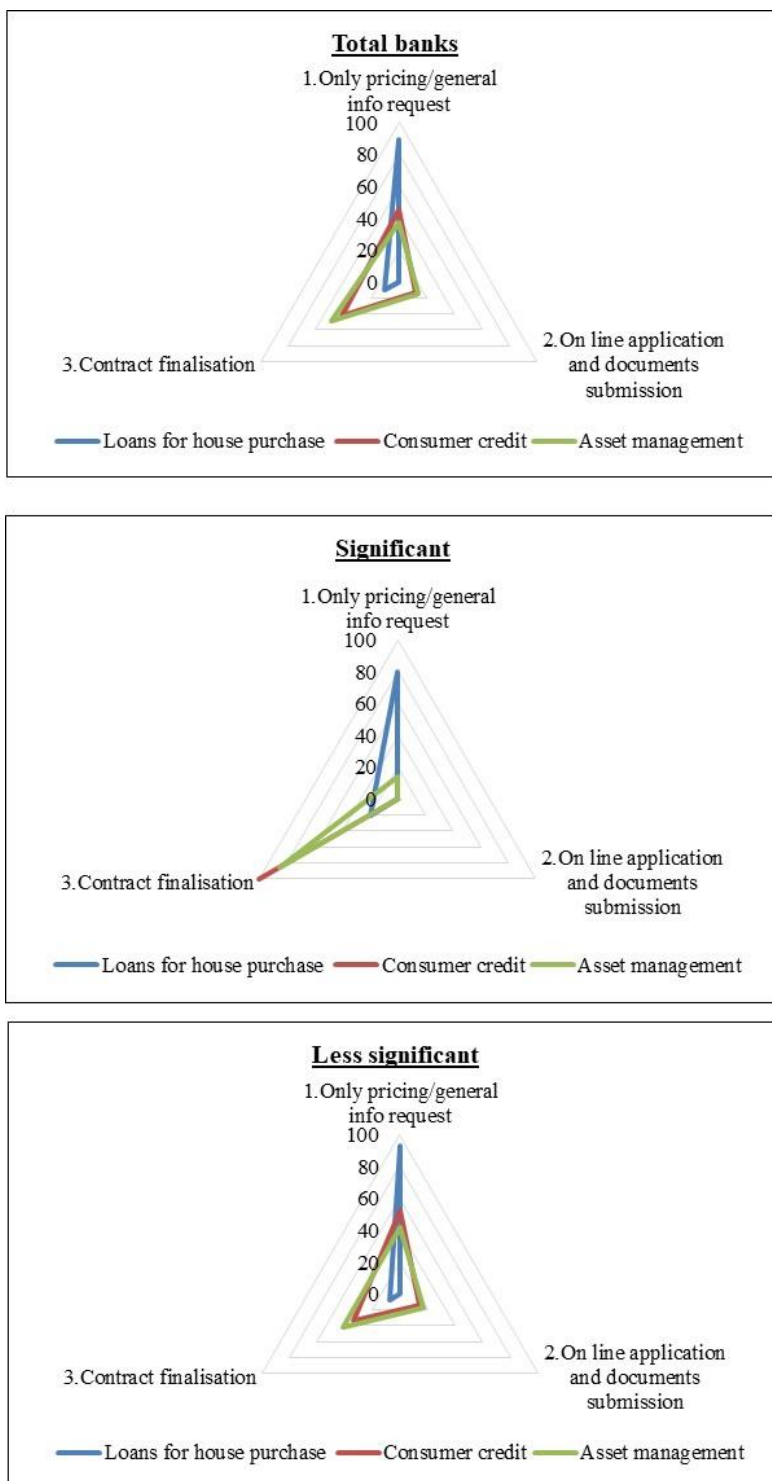
Source: RBLS.
Note: Percentage share of banks offering their services through digital channels in 2018. Unweighted frequencies. For lending to households, the share refers to banks that provide online estimates of what loans would cost.

Figure 9

FinTech: adoption and initiatives
(percentage share of banks)

Source: RBLS, survey referred to 2018.
Note: (1) Percentage share of surveyed banks that had declared that they had already implemented or that they intended to implement in the next three years FinTech projects. Unweighted frequencies. – (2) Percentage share of banks that implemented FinTech project with the labelled characteristics. Unweighted frequencies.

Figure 10

FinTech: Strategic financial business
(percentage share of banks)
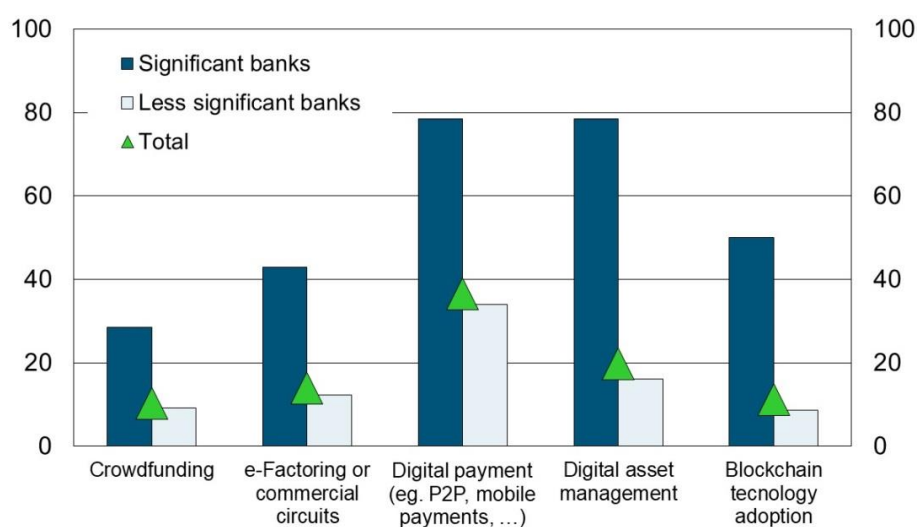
Source: RBLS, survey referred to 2018.
Note: share of surveyed banks answering "slightly" or "very" relevant the question about the relevance of the labelled business areas.

Figure 11

Bank supply digitalization index

(a) weighted index   (b) not weighted index
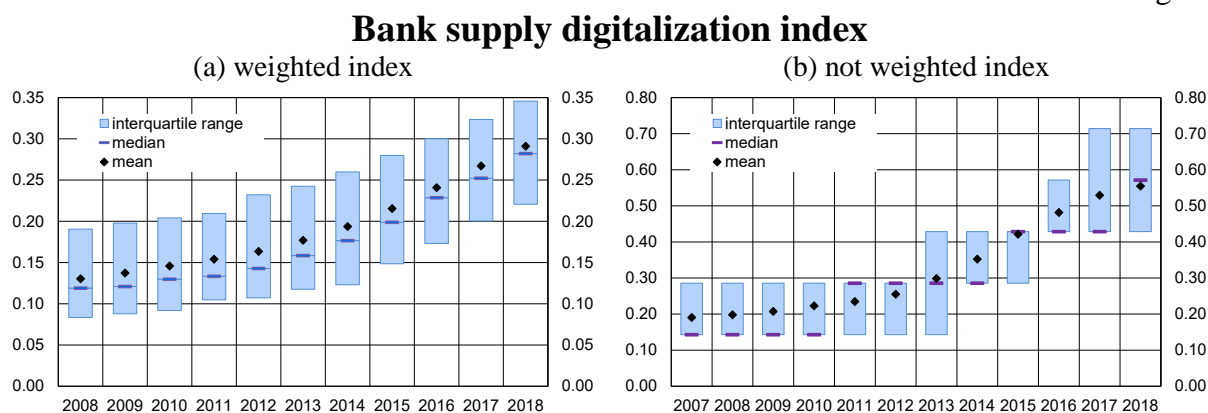
Sources: RBLS. See Section 5 for more details.
(1) For each bank, the index is built as the number of digital financial services offered by the bank weighted by the ratio between the number of years during which the bank has been offering each service and the number of years in which the service has been available online on the Italian banking system. – (2) For each bank, the index is built as the number of digital financial services offered by the bank.

Figure 12

Share of online current accounts over total current accounts

(percentage shares)

Source: RBLS.

28
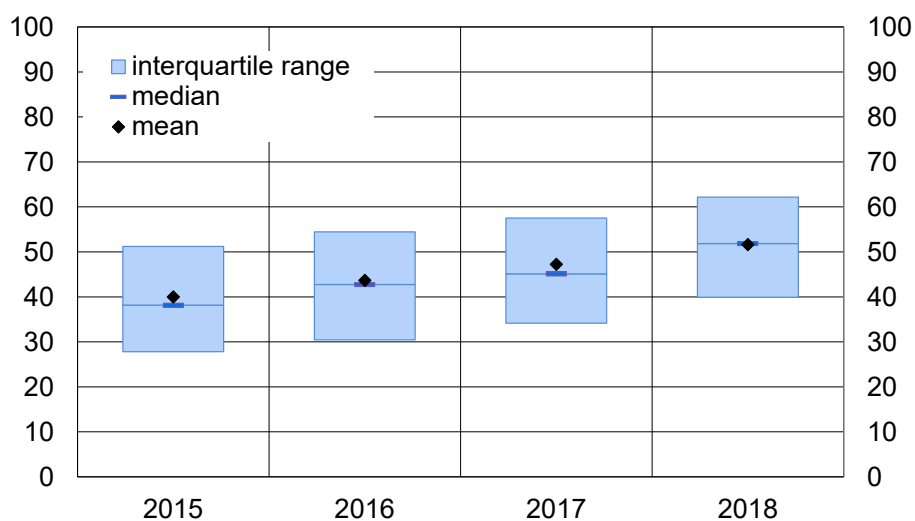
Figure 13

Number of banks, bank branches and municipalities served by banks
(indices: 2007=100)

Source: Bank of Italy.

Tables

Table 1

Big Data (1)
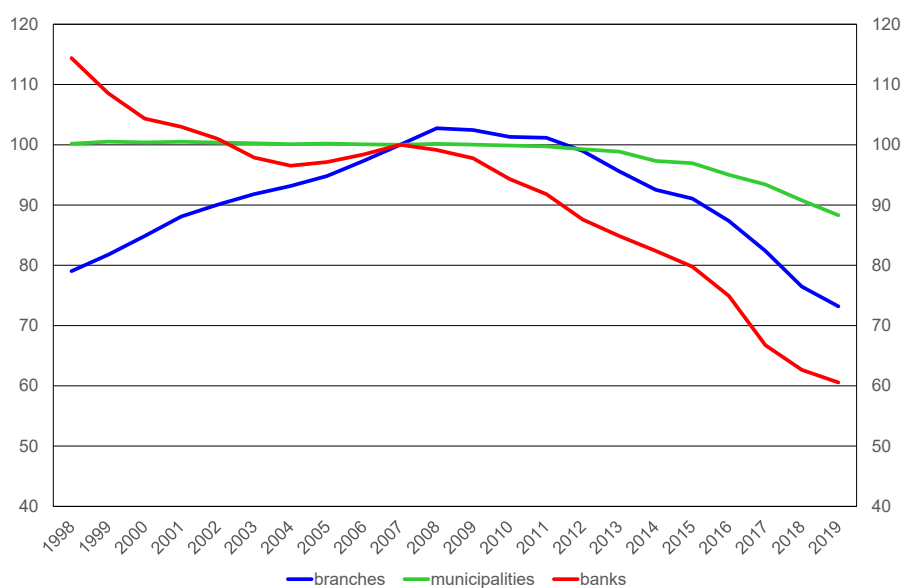
	Total banks		Significant banks		Less significant banks	
	yes	**no**	**yes**	**no**	**yes**	**no**
Diffusion						
Big Data diffusion (2)	39.2	60.8	83.3	16.7	36.0	64.0
Project undergoing	23.8	–	55.6	–	21.5	–
Planned project	15.4	–	27.8	–	14.5	–
Main purpose of the use of Big Data						
Increase the information available on clients	18.5	25.8	50.0	27.8	16.1	25.6
Commercial purposes (customers targeting)	27.7	15.4	66.7	11.1	24.8	15.7
Improve cross selling strategies	29.6	13.5	77.8	0.0	26.0	14.5
Loans to firms	19.6	24.2	38.9	38.9	18.2	23.1
Loans to household	20.0	23.5	50.0	27.8	17.8	23.1
Methods of exploitation of Big Data in the lending process						
Granting	19.2	1.5	44.4	11.1	17.4	0.8
Pricing	12.3	8.5	33.3	22.2	10.7	7.4
Monitoring	17.7	3.1	38.9	16.7	16.1	2.1

Source: RBLS, survey referred to 2018.
(1) Unweighted frequencies. The row total may not be equal to 100 because of no responses. – (2) Percentage share of surveyed banks that had declared that they had already implemented or that they intended to implement in the next three years Big Data projects.

Table 2

Bank digitalization and performance

Bank outcomes	(1) ROA	(2) ROE	(3) Net fees and commission income / total assets	(4) Net income from asset management fees and commissions / total assets	(5) Total costs / total assets
Sizebank	-0.032	-0.131	-0.290***	-0.074***	-0.445***
	(0.069)	(0.524)	(0.018)	(0.010)	(0.052)
Riskbank	-0.047***	-0.268***	-0.001	0.003***	-0.013***
	(0.004)	(0.033)	(0.001)	(0.001)	(0.003)
Equity	-0.021***	-0.183***	-0.006***	-0.002***	0.031***
	(0.005)	(0.037)	(0.001)	(0.001)	(0.004)
Digital	1.047**	11.991***	0.397***	0.236***	-0.063
	(0.456)	(3.443)	(0.121)	(0.067)	(0.340)
Constant	-0.589	3.566	6.832***	1.615***	11.496***
	(1.473)	(11.160)	(0.390)	(0.217)	(1.100)
FE bank	YES	YES	YES	YES	YES
FE year	YES	YES	YES	YES	YES
Observations	2,947	2,945	2,947	2,947	2,947
R-squared	0.521	0.170	0.139	0.042	0.742
Number of banks	270	270	270	270	270
Adj-R2	0.470	0.0815	0.0480	-0.0603	0.715

Notes: Panel estimation with bank and year fixed effects; standard errors in parenthesis are clustered at bank-level; *,** and *** denote significance at 10, 5 and 1 percent, respectively.

Table 3

LBD: Lender – borrower distance (1)

	2001	2008	2015	2018
Medium and large sized banks	20.9	27.6	31.4	42.5
Small banks affiliated to a banking group	19.3	22.4	21.5	33.3
Stand alone small banks	11.4	13.4	13.6	14.9
Total	**12.9**	**15.5**	**15.4**	**16.9**

Source: Bank of Italy, Central Credit Register.
(1) Median distance in Km.

Table 4

CPD: Centre – periphery distance (1)
(Km – unweighted average)

Year	Total	Large banks	Small banks belonging to a banking group	Small banks not affiliated to a banking group
1998	29	138	55	17
1999	33	147	64	19
2000	34	146	64	20
2001	37	165	62	22
2002	40	161	70	24
2003	41	152	75	24
2004	42	150	76	25
2005	44	157	79	26
2006	45	169	86	25
2007	45	157	90	25
2008	44	154	85	26
2009	45	163	86	26
2010	43	151	83	26
2011	43	163	92	26
2012	42	157	94	25
2013	43	163	102	27
2014	45	169	111	27
2015	49	189	97	31
2016	50	191	110	31
2017	53	202	119	33
2018	55	220	116	33

Source: Bank of Italy, Giava database.
(1) For each bank, CPD is the weighted average of distances at municipality level between the bank's headquarter and its branches.

Table 5

Branch network and digitalization (1)

	Normalized branches	Lender-borrower distance	Centre-periphery distance
Online services	-0.008**	0.007***	0.005*
	(0.003)	*(0.002)*	*(0.003)*
Bank size Quintile 1		0.062	0.280**
		(0.086)	*(0.122)*
Bank size Quintile 2		-0.014	0.461***
		(0.090)	*(0.145)*
Bank size Quintile 3		-0.053	0.624***
		(0.097)	*(0.164)*
Bank size Quintile 4		0.180	1.330***
		(0.137)	*(0.235)*
Dummy cooperative credit banks	0.357***	-0.709***	-0.921***
	(0.097)	*(0.086)*	*(0.150)*
Dummy area 2	0.112	-0.206**	-0.346**
	(0.137)	*(0.096)*	*(0.137)*
Dummy area 3	0.245**	-0.157	-0.089
	(0.121)	*(0.096)*	*(0.138)*
Dummy area 4	0.372***	0.023	0.237
	(0.116)	*(0.103)*	*(0.150)*
Constant	-4.105***	2.990***	3.072***
	(0.122)	*(0.152)*	*(0.233)*
R-squared	0.19	0.45	0.60
Observations	254	254	254

(1) *, ** and *** denote significance at 10, 5 and 1 percent, respectively. Robust standard errors are reported in brackets.

Table 6

Branch network and digitalization: alternative robustness check (1)

	Normalized branches	Lender-borrower distance	Centre-periphery distance
a. Online services at *t-3*	-0.008**	0.007***	0.005*
	(0.003)	(0.002)	(0.003)
b. Digital index	-0.884	0.580	0.886*
	(0.747)	(0.445)	(0.469)
c. Home banking	-0.024***	0.030***	0.024***
	(0.009)	(0.005)	(0.006)
d. Online transfers	-0.020***	0.026***	0.024***
	(0.008)	(0.004)	(0.004)
Controls	YES	YES	YES

(1) Each row represents a different set of regressions, with the variable in the first column as a proxy of the degree of digitization of banking services. For each regression, the set of controls consists of indicators for bank size based on the quantiles of the distribution of total assets and dummies for cooperative credit banks and for the macro-region where the headquarters are located. *, ** and *** denote significance at 10, 5 and 1 percent, respectively. Robust standard errors are reported in brackets.