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WHY DO BANKS CLOSE? THE GEOGRAPHY OF BRANCH PRUNING

by Paolo Emilio Mistrulli[*] (coordinator), Luca Antelmo[*], Maddalena Galardo[♥], Iconio Garrì[♦], Dario Pellegrino[♥], Davide Revelli[♠] and Vito Savino[♣]

Abstract

In the aftermath of the Great Recession, the number of bank branches declined in most developed countries. In this paper, we investigate how banks have downsized their branch networks in Italy by comparing the pre- and post-crisis spatial distribution of branches. By using a detailed dataset that includes a wide set of controls for the characteristics of each bank branch, we estimate the probability of a branch being closed as a function of its distance from both proprietary and competitors' branches. We find that banks are more prone to close branches in those areas where other proprietary branches are closer and also where competitors' branches are closer. This indicates that, since the start of the crisis, banks have closed branches especially in those areas where their proprietary network was relatively more populated and competition was fiercer.

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Contents

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1 Introduction[1]

In the aftermath of the Great Recession, the number of bank branches declined in many developed countries after a long period of continuous expansion. According to the 2017 *Report on Financial Structures* of the European Central Bank, in the euro area the number of bank branches declined by about 20 percent (by 36,902 units) from 2008 to 2016.[2] In Italy, the number of branches declined less (15 percent, more than 5,000 units). In the US, according to the Federal Reserve Bank of New York (2016), banks shuttered 4,821 branches between 2009 and 2014, about a 5 percent decline.

In this paper, we investigate how Italian banks have reshaped their branch networks by comparing the pre and post crisis spatial distribution of branches. Using a detailed dataset that includes a wide set of variables controlling for the characteristics of each bank branch operating in Italy, we estimate the probability of a branch being closed as a function of its relative distance from both proprietary and competitors' branches, while controlling for relevant bank branch and location characteristics. Indeed, branches are part of a network and then some externalities arise within it not only among other proprietary branches but also with respect to competitors' branches.

In order to identify how the pre-crisis spatial distribution of branches has affected branch closure decisions we have to take into account many potential confounding factors, both on the demand and the supply side. First, the crisis had a heterogeneous impact within the country, e.g. due to a different degree of financial and economic integration, which in turn may have had a different impact on banks' expectations on future demand for banking services delivered through the branch network. Changes in demand for *brick-and-mortar* banking services may have also been driven by technological changes allowing people to access banking services in a *click-and-mortar* mode (Petersen and Rajan, 2002).[3] It follows that, due to a different availability in ICT infrastructures and ICT literacy within the country, the information revolution has reasonably had an heterogeneous geographical impact too. On the supply side, banks were hit by the crisis and, among other actions taken to restore profitability, they have pruned their branches in order to save money on operating costs. However, banks were not affected in the same way by the crisis and this has arguably led to different branch pruning decisions.

To estimate the role of spatial distribution of branches on closure decision we rely on a very granular database including data at the branch level and we run a linear probability model (LPM) to investigate the drivers of bank branch closures. We run estimates on a cross-sectional database including all branches operating at the end of 2007 where we define a dummy that equals 1 if a branch was not active at the end of 2014, and 0 otherwise. We rely on fixed effects for both *Labour*

[1] This paper is part of a Bank of Italy research project on 'The agglomeration and the geographical relocation of the Italian banking system'. We thank Marcello Pagnini, Carlotta Rossi, Paola Rossi, Paolo Sestito and participants to seminars held at the Bank of Italy for their helpful comments. The views expressed herein are those of the authors and do not involve the responsibility of the Bank of Italy.

[2] For the euro area see the European Central Bank (2017). For the US see Morgan, Pinkovskiy and Yang (2016).

[3] See Bonaccorsi di Patti, Gobbi and Mistrulli (2003) and Carmignani et al. (2018) for an empirical investigation on the role of ICT on bank branching in Italy.

Market Areas (LMA), computed by the Italian Statistical Institute (ISTAT), and banks.[4] LMAs' fixed effects control for the local heterogeneity in the impact of the crisis on the demand for banking services and for the different diffusion of financial literacy, which may affect the substitution of brick-and-mortar services for click-and-mortar ones. LMAs are geographical areas that seem quite suitable for our purposes. Indeed, they are defined by the area within which people mostly commute for job or educational reasons. Therefore, they could also proxy for the areas within which people mostly access brick-and-mortar banking services. Bank fixed effects control for the different bank characteristics and thus, in our cross-sectional setup, also for the different impact of the crisis on banks' balance sheets and banks' supply. However, since banks' supply might be geographically heterogeneous we mostly rely on joint LMA-Bank fixed effects. In this way, we are able to investigate, for any given bank, how some heterogeneity within any given LMA where banks had branches at the end of 2007 affected the decision to close or not a branch between 2007 and 2014.

While the main aim of the paper is to explore the role distance played for closure decisions, other characteristics of the bank and of the local market are also worthwhile to investigate before focusing on the main topic of the paper. Then, since our estimates are based on a cross-section, we first rely on LMA fixed effects to verify whether banks' characteristics (size, liquidity, ICT capital, leverage, wholesale fund-raising) affected the intensity of branch pruning. Similarly, in order to explore the role of the local market characteristics (internet broadband diffusion, ageing, presence of banks, importance of small firms), we plug bank fixed effects only. In the most of the paper, we use joint LMA-Bank fixed effects to focus on the distance from other branches while banks' and local market characteristics are introduced as interaction terms with distance.

The main results are the following. As far as banks' characteristics are concerned, we find that the probability of closing a branch was overall smaller for those banks more reliant on retail fund-raising and with a better quality of lending. Banks involved in M&As were also more likely to close their branches, suggesting that branch network restructuring was at least partially due to over-branching phenomena. Also banks that invested more in ICT capital tended to close more frequently their branches As far as the local market characteristics are concerned, we find that banks were more prone to close in those LMAs where the diffusion of the broadband was greater and the LMA was little populated by small firms. These results show that banks tended to, at least partially, substitute remote banking services for *brick-and-mortar* ones, unless the presence of opaque borrowers, whose credit assessment is largely based on soft information, is high.

As far as distance regards, we find that closing decisions are positively correlated with both proprietary and competitors' branch proximity. However, the impact of distance evanishes beyond a certain threshold and, in particular, distance has no role in case a branch is 3 and 5 kilometers distant, respectively, from the closest competitors' and proprietary branch. We also show that distance has a greater impact on the probability of closure in non-peripheral areas where competition is reasonably fiercer. Furthermore, our results show that banks are more likely to close a branch when other proprietary branches are relative close in areas with a wider broadband diffusion. This may reflect that in areas where the broadband is more diffused banks are better able

[4] Arnaudo e Rossi (2018) identify local credit markets by using an approach that is similar to that adopted for the LMAs but relies on credit flows instead of commuting ones. They find that the areas identified are a good proxy for local credit markets.

at substituting remote banking for branches. On the contrary, we are not able to detect any differentiated impact of the distance from competitors' branches across areas that differ in terms of the internet broadband availability.

The existing literature on the determinants of branch location is scarce. Only very recently a paper by Qi *et al*. (2018) has investigated the impact of the introduction of information sharing on spatial clustering of bank branches in Eastern Europe countries. While they focus on new branch opening decisions we concentrate on branch closures occurred in the aftermath of the Great Recession.

Most of the available literature has the effects of an exogenous expansion in the branch network on the functioning of the credit market. For example, Cetorelli and Strahan (2006) have shown that branch deregulation fostered competition among banks and improved access to external finance. The attention paid on bank entry and branch openings stemmed from the fact that, in most of developed countries, bank branches have grown almost continuously until the Global Crisis eruption. However, even before the recent crisis, ICTs development made bank branches less pivotal for delivering banking services. Petersen and Rajan (2002) documented that, thanks to the information revolution, the distance between firms and their lenders increased, even for opaque borrowers. Similarly, Felici and Pagnini (2008) showed that, following the advent of ICTs, the ability of banks to open branches in markets distant from those where they were already present improved. Gobbi and Lotti (2004), also investigating branch expansion before a wide diffusion of ICTs in Italy, document that the probability of banks' entry in a local market was mostly related with business opportunities in the provision of financial services which do not require the acquisition of substantial proprietary information. Gilje, Loutskina and Strahan (2016) show that branches also play a crucial role for the ability of banks to raise deposits. More recent research has investigated the impact of branch closures on credit market functioning. Bonfim, Nogueira and Ongena (2016), investigate loan conditions charged to borrowers that switch banks following the closure of branches of incumbent bank themselves. Their findings are consistent with the view that banks gain an informational monopoly and that branch distance from the borrower is a crucial ingredient of this ability. Nguyen (2019) shows that, even in markets where the branch network is dense, closings can have large effects on local credit supply. In particular, small business lending declines for several years, since lending to small and medium enterprises (SMEs) is information-intensive and lender-specific relationships are difficult to replace.[5]

The paper is structured as follows. Section 2 contains some stylized facts about bank branching in Italy in the last two decades. Section 3 describes the data and the econometric strategy, section 4 comments on the estimation results and Section 5 concludes.

2 Branch pruning in Italy: some stylized facts

The number of bank branches increased in Italy since the beginning of the 1950s, and then peaked in 2008. At the end of 1950 the number of branches in Italy was about 7,000 and it took almost four decades to double. Since the removal of bank branching restrictions, at the beginning of

[5] For a recent analysis of the impact of branch closures on lending see Garrì (2018).

the 1990s, bank branches dynamics accelerated and it doubled in only one decade.[6] After the global crisis that followed Lehman Brother default, the number of branches started declining and by the end of 2016 almost 5,000 branches closed. This pattern almost affected in a similar way all major areas of the country (Panel A of Figure 1).

However, within those large areas the decline in bank branches was not homogenous. In particular, if we consider Labour Market Areas (LMA), that are sub-provincial areas identified by the Italian National institute of statistics (ISTAT),[7] we find that the decline in the number of branches was greater in "urban" LMAs than in "non-urban" areas[8] (Panel B of Figure 1).

Furthermore, banks have closed branches in those areas where the number of per capita branches was greater before the crisis. Indeed, as shown in Figure 2, the greatest changes in the number of branches occurred in those areas where their number was the highest (the dark blue areas in the picture).

The timing in the decline of number of bank branches was also heterogeneous among different kinds of banks. Indeed, up until 2015, the drop in the number of branches was only due to largest banks. For smaller banks the size of their branch network was almost stagnant between 2008 and 2015, and started declining only in 2016 (Figure 3).

3 Data and Empirical Strategy

3.1 Data

We build a unique dataset by exploiting three main data sources. First, from the GIAVA database, which is managed by the Bank of Italy and that contains the list of all branches owned by all banks operating in Italy since 1936, we obtain the full address for each branch operating at the end of 2007 and at the end of 2014. This allows us to geocode all the branches and compute the relative distances among them. Second, we match the list of branches with bank supervisory reports collecting information at the branch level on an end-of the year basis. In particular, banks have to report to the Bank of Italy the total volume of loans and deposits and the total number of employees. We complement the database with information collected from ISTAT at very local level. To this aim we rely on the Population Census that contains a wealth of information for each *Labour Market Area*.

We map and collect information for 63,228 branches at two dates (December 2007 and December 2014), operated by 850 different banks, located in 5,980 different municipalities and 611 LMAs (Table I).[9] For each branch, we compute the linear distance from the other branches of the bank or branches belonging to the same banking group and from those branches of all other

[6] See De Bonis, Farabullini and Fornari (1998) for an analysis of the impact of branch liberalization on bank branch expansion in Italy.

[7] LMAs are sub-regional geographical areas where the bulk of the labor force lives and works, and where establishments can find the largest amount of the labor force necessary to occupy the offered jobs. LMAs are defined on a functional basis, the key criterion being the proportion of commuters who cross the LMA boundary on their way to work." LMAs extension ranges from 10.5 to 3,892 km^2, with a median value equal to 389.7 km2, that is equivalent to the area of a circle with a radius of 11.14 km.

[8] See Lamorgese and Petrella (2016) for more details on the classification of LMAs as urban or non-urban.

[9] We drop 2,322 observations because it was not possible to geocode them using the street address and 94 because of other mapping errors. The percentage of not mapped observations is small (4 per cent in 2007 and 3 per cent in 2014).

competing banks or banking groups, also distinguishing between branches that are located within the same LMA and those that are located in adjacent ones (on average around 98 percent of branches located within 5 km belong to the same LMA). We then match each branch with the amount of loans, deposits and the number of employees at the branch level obtained from supervisory reports.

In the following, we then focus on a sample of 30,682 branches that were open in 2007 (out of 32,878) and for which we were able to match all the relevant information. Table IV reports the related definitions and descriptive statistics.

In order to define branch openings and closures between 2007 and 2014 we proceed as follows. First, we compare the list of branches at the two dates. Each branch is identified on the base of the combination of two codes, the bank code and the branch code. Since in the 2007-2014 years some bank mergers occurred we would observe, at the same time, some closures and openings only due to bank mergers (i.e. to the fact that the bank code changes as a consequence of the merger). To the aim of taking into the account bank mergers we transform the "original" bank code (observed in 2007) into the "final" one (at 2014). This means that, for the purposes of identifying branch closures and openings, we assume that all bank mergers occurred at the beginning of the period under investigation. However, since we are aware of the role of M&As for banks' branch choices we control not only for bank mergers but also for bank acquisitions by defining a dummy (M&A) that it is equal to one for all bank branches involved in some M&A between 2007 and 2014 located within 5 km from other branches affected by the same operation, 0 otherwise.

Another difficulty may arise from the possibility that banks, even if are not involved in a merger, may vary the branch code for reasons that may be not related to changes in the branch network. In order to exclude these changes and then define true closures and openings we also rely on branch geographical coordinates to check whether a branch closure and openings really occurred. In other terms, we also check whether a branch, identified by its coordinates, disappeared/appeared between 2007 and 2014. To this aim, we assume that a branch has been not affected by any changes if its geographical position did not change within a radius of about 40 meters.

3.2 Empirical Strategy

We estimate the probability a branch, active at the end of 2007, being closed between the end of 2007 and the end of 2014, by using the following linear probability model:

$$Closed\ Branch_{ijk} = a + b * DistComp_{ij} + c * DistBank_{ij} + d * BankLMA_{ijk} + \varepsilon_{ijk}$$

where our dependent variable, $CLOSED\ \_BRANCH_{ijk}$, equals one if the branch j, that was active at the end of 2007, was located in LMA k and was owned by bank i, has been closed between 2007 and 2014, zero otherwise. On average, the percentage of 2007 branches closed between 2007 and 2014 is equal to 21.6 percent. Table IV reports descriptive statistics for the independent variables that we define below.

We adopt a linear probability model since maximum-likelihood estimates are known to be biased in case of a large number of fixed effects (Lancaster, 2000). An additional advantage of employing linear probability models is that for the interaction terms, the main focus of the analysis, the estimated coefficients are directly interpretable and the standard errors require no corrections.

We employ a set of variables to measure our main variable of interest that is the distance of branch j, owned by bank i and located in LMA k, from other branches. In line with the literature on spatial discrimination (e.g. Degryse and Ongena, 2005) we distinguish between branches owned by bank i and from branches owned by competitors. Furthermore, since LMAs are defined as areas where people mostly commute for job reasons, in a robustness exercise we focus on branches that are located within the same LMA (Table XVII).

The distinction between proprietary and competitors' branches allows us to identify two distinct drivers of branch closures. While the distance from other branches owned by the bank is a proxy for eventual phenomena of over-branching, the one from competitors' branches is a proxy for bank competition. We argue that, following the crisis shock that had an unexpected impact on banks' profitability, banks have had to shrink their branch network and they did this by expanding the area served by their branches, thus mitigating possible overlaps of branches and exploiting more intensively economies to scale. At the same time, banks took into account the presence of competitors. We expect that, everything else being equal, the probability of closing branch j is greater in case competition is fiercer, i.e. competitors' branches are closer to branch j.

We provide some evidence indicating that LMAs are not only relevant for identifying the area within which people mostly commute from home to the workplace but also for identifying the area within which people usually travel in order to access to banking services delivered by branches. In particular, we check whether LMAs are also self-contained not only in terms of commuting flows but also with respect to credit flows. We find that at the end of 2007 the amount of lending granted to firms within LMAs, i.e. granted by bank branches that are located in the LMA where the borrower is headquartered, was equal to 75.6 percent and also rose to 77.3 at the end of 2014 (Table III), in line with one of the criteria adopted by ISTAT to identify LMA which have to contain at least 75 per cent of daily commuting from home to work. Interestingly, those percentages are significantly greater for small firms (firms with less than 20 employees) which, being relatively informational opaque, are less able to access credit from distant bank branches (the ratio of loans granted within the same LMA was 82.9 per cent at the end of 2007, 83.6 in 2014).

Branch characteristics

We control for a bunch of branch characteristics that may affect the decision to close. In particular, we control for branch size (i.e. the number of employees) and for a measure of branch productivity defined by the ratio of the sum of deposits and loans intermediated by branch i per branch employee. We define a dummy corresponding to the distribution of the productivity per employee over the median. We expect that both branch size and employee productivity measured at the branch level be negatively correlated to the probability to close the branch.

Labour market areas (LMA)

We include LMA fixed effects. Alternatively we use other controls as: number of branches in the LMA, percentage of small firms headquartered, ageing index, urbanization degree, LMA extension, broadband diffusion (municipality level), altitude (municipality level).

Bank characteristics

We include bank fixed effects controlling for heterogeneity in banks' supply across banks and, in particular, for the different exposure to the Lehman default shock. Alternatively we control for bank size by using the Bank of Italy classification (largest, large, medium, small and minor) together with institutional categories (mutual banks, foreign banks, other banks). In some equations, we use bank fixed effects and we also interact our variable of interest (the distance from other branches and other derived measures) with the bank size and institutional categories dummies.

As highlighted by Petersen and Rajan (2002), the distance between borrowers and lenders has increased, following the diffusion of ICTs. Thanks to a greater availability of computers and communication equipment, banks became better able at processing a huge amount of hard information thus making them less dependent on soft information, which is typically gathered through a repeated and close interaction with borrowers and, as a consequence, is mostly collected locally. This allowed banks to lend to a greater distance without large informational losses. Naturally, banks did not invest on ICT capital all at the same time and by the same size. For this reason, we include in our set of controls the level of the ICT capital at the end of 2006.[10] We expect that banks that were already endowed with more ICT capital before the crisis were also more prone to close branches once hit by the crisis.

Mergers and acquisitions operations are also strongly associated with branch closures.[11] It might be that, even if M&As are overall efficiency improving, some inefficiencies may arise because branches that were formerly competitors become, as a consequence of the M&A, reciprocally redundant. Thus, following an M&A, banks might be quite prone to restructure their branch network wherever there are too many branches in the same area. In order to control for this factor, for any given branch j of a bank i involved in a M&As between 2007 and 2014 we check whether within a certain radius are present other branches of banks involved in the same M&A operation. We then define a dummy (**M&A**) that equals 1 in case, within a 5 km radius centered in branch j , there are branches owned by other banks involved in the M&A, 0 otherwise.

4 Results

4.1 Bank characteristics

We explore the role of bank characteristics in Table VI. In equation 1 we keep LMA fixed effects, controlling for the characteristics of the demand for banking services, and we replace bank

[10] Data on bank ICT capital have been provided by Sauro Mocetti. For an analysis of ICTs investments of Italian banks see Mocetti, Pagnini and Sette (2011) and Casolaro and Gobbi (2007).
[11] See Focarelli, Panetta and Salleo (2002).

fixed effects with controls for banks' liquidity, fund-raising structure, leverage, quality of the lending portfolio and investment in information technology.

First, we find that largest banks (including foreign banks) were the most prone to close branches since the start of the crisis. This is partly due to the fact that large domestic banks were greatly involved in M&As that may lead more frequently to over-branching phenomena since some branches that were formerly owned by different banks become, as a consequence of a M&A operation, part of the same bank or banking group.

Indeed, once we control for M&A, we get a positive coefficient for the M&A variable and the magnitude of the coefficient of dummy for large banks declines but it still appears greater than that estimated for other bank size dummies.

As far as other controls are concerned we find that the more banks are reliant on whole-sale funding the higher the probability of closing branches. This is in line with a recent paper by Gilje, Loutskina and Strahan (2016), showing the crucial role of bank branches in raising deposits at the local level. Furthermore, we find that the probability to close branches is higher for banks having a worse quality of lending, measured by the ratio of non-performing loans out of total lending. Other bank controls have also a significant effect on bank closures: banks that are more liquid, more leveraged and with a lower NPL ratio are less prone to close branches.

All in all, these results indicate that banks that were sounder and more liquid before the crisis started were less prone to close branches during the crisis. This is in line with the view that banks closed branches partly because they had to enhance cost efficiency. Apparently, the negative coefficient estimated for leverage would contrast this interpretation. However, the level of leverage could also capture the ability of banks to tap the market for funding and then it could be greater for those banks that suffer less from financial frictions. Indeed, we observe that leverage is higher for larger banks which generally are much able to raise funds on the market, once needed.

Finally, to investigate the extent to which investment in ICTs has affected the probability of closing a branch we introduce a dummy variable taking value 1 if bank *i*'s investment in ICTs is over the median. Following Mocetti *et al*. (2010), we use the log of investment in ICT capital stock per employee measured at the end of 2006 and we find that banks endowed with more ICT capital were more prone to close branches in line with the view that those banks were better able at processing hard information and then substituting it, at least partially, for soft information.

4.2 Local market characteristics

In equation 3, Table VI, we plug bank fixed effects and we drop LMA ones since we want to explore how the LMA characteristics impact on branch closures. In order to control for unobservable characteristics of the market we introduce province fixed effects.[12] We can do this since LMA are sub-provincial areas. In practice, we are exploiting some heterogeneity measured at the LMA level or, in some cases, at the municipality one, within provinces.

[12] Italian provinces correspond to the third level of the EU developed *Classification of Territorial Units for Statistics*. As shown by Bonaccorsi di Patti and Gobbi (2001), these geographical units are also good proxies for local lending.

First we control for the **broadband** diffusion at municipality level and we find that the probability to close a branch is lower for those cities where the broadband is less diffused, confirming the view that branch proximity matters less wherever ICT are more developed, in line with Petersen and Rajan (2002). Also, the probability to close a branch is lower for those cities with a relatively high altitude. This may signal that mountainous areas are, ceteris paribus, less exposed to spatial competition due to worse transportation facilities.

Furthermore, we control for the age of the branch and we find that older ones have a lower probability of being closed, after having controlled for the location, the size and the productivity of the branch itself. Indeed, older branches might have accumulated over time a lot of knowledge about the local market where they are settled that would be mostly lost whether the branch were closed (Berger and Dick, 2007).

Finally, we find that the probability of closing a branch depends on the presence of small firms in the LMA where the branch is located. Indeed, this probability is lower in those areas where the share of small firms is relatively high (LMAs are included in the fourth quartile of the ratio of the number of small firms out of the total). This is consistent with the broadly hold view that physical distance matters especially for opaque firms that banks have to assess mostly on the base of soft information collected through repeated lender-borrower interactions.

4.3 The geography of branch pruning

In this subsection we investigate the core issue of our paper, that is how the relative geographical position of a branch within the network affected closure decision. In Table VII we report baseline results. We start from two quite simple equations, (1) and (2), that include: a) **branch controls** (*branch size*, i.e. the logarithm of the number of employees, *branch age*, i.e. the logarithm of the age of the branch in years, and *high branch productivity* that is a dummy that equals 1 if the productivity of the branch, measured by the per employee total amount of loans and deposits, is greater than its median value, and 0 otherwise), a dummy variable that equals 1 if the branch belonged to a bank involved in a merger or an acquisition; b) the **distance** from the closest branch owned by the bank and the distance from the closest branch owned by competitors.

In equation (1) we plug LMA fixed effects while in (2) bank fixed effects. The results obtained are mostly the same: the probability that a branch closes is lower for larger and more productive branches, indicating that banks tended to rationalize their branch networks since the crisis started. Furthermore, the decision whether to close or not a branch depends on its position both relative to other branches of the bank, that is a proxy for over-branching, and of competitors, a proxy for competitive pressure. We find that, as expected, the probability to close a branch is inversely correlated with the distance from the closest branch of the bank. In other terms, banks were more prone to close branch not so distant from other proprietary ones. Similarly, the closure probability is also inversely correlated with the distance from the closest competitors' branch. Again, this indicates that once bank took the decision to downsize their physical delivering network they tended to close those branches that were closer to those of their competitors, possibly to mitigate competitive pressure.

These results are confirmed once we plug both LMA and bank fixed effects, separately (eq. 3), and when we plug LMA-Bank fixed effects, jointly (eq. 4). In this latter case, while the coefficients for branch characteristics are largely unaffected, those for both types of distance change. In particular, the coefficient for the distance from the closest branch of the bank is greater in equation 4 compared to other ones while the opposite holds for the distance from competitors. Branch's age and M&A are no longer significant.

Equation 4 will be from now on referred as the benchmark equation, which we are going to enrich in the following sections. This is our preferred setup to identify how the position of a branch relative to other branches affects the closure decision. Indeed, it allows us to control for observable and unobservable time invariant characteristics of banks' supply and demand for banking which may differ across different banking markets that are identified on the base of *Labour Market Areas* (LMA).

Heterogeneity in geographic distance

In Table VIII, we use different dummies to control for potential non-linear effects of the distance. Our results indicate that banks were more prone to closures where they had relatively close branches owned by themselves (eq. 1). This effect is stronger for shorter distances and evanishes once the distance goes beyond 5 km.

We run a similar equation for the case of distance from competitors' branches and we get similar results. The probability to close is inversely related with distance from the closest branch of competitors (eq. 2). This might be due to the fact that banks were more prone to close branches where, ceteris paribus, competition was fiercer. Only the dummies accounting for distances up to 5 km and to 3, respectively, for the closest branch of the bank owning the branch and the closest branch of competitors, were statistically significant (eq. 3). This suggests that banks consider that a branch, on average, may perform well within a radius of 5 km while competition is expected to have a significant impact only within a radius of 3 km.

Since the distance from the closest branch might not fully capture the characteristics of the network structure around the branch to be eventually closed, in equation 4, instead of the abovementioned dummies, we include the mean of the distance from all the branches within a radius of 5 and 3 km, respectively, for other branches of the bank and for those owned by competitors. Again our results indicate that both types of distances have a negative impact on the closure probability. Finally, in equation 5 we account for the number of branches within 5 and 3 km, confirming the view that banks tend to be more prone to close a branch as the number of branches, both those owned by the bank itself and those owned by competitors, increases.

Heterogeneity between core and periphery

In this section we verify whether the impact of branch distances differs between core and peripheral municipalities (Table IX). This is due in order to answer the possible objection that within the same LMA municipalities may have different characteristics. We then distinguish between core and peripheral municipalities using the methodology based on transportation, education and the sanitary system developed by the Italian Agency for Territorial Cohesion.[13] First, we estimate the coefficient for the branch distance distinguishing between core and peripheral areas. Then we add to our main specification the interaction of distance among branches and the dummy distinguishing core and periphery. We find that banks, everything else being equal, were less prone to close branches in peripheral municipalities. We also find that the role of distance on the branch closure decision differs depending on the type of municipality. In particular, as far as the proprietary network is concerned, distance has a greater impact in core areas compared to peripheral ones. In other words, banks are more prone to close branches in core areas in case they have other proprietary branches within a radius of 5 km, compared to those branches in the periphery. On the other hand, we find that distance from competitors' branches plays a role only in core areas. This might be due to the fact that in core areas customers are more sophisticated and more prone to switch from one bank to another, and so competition is fiercer.

Heterogeneity in the diffusion of information technology

We have previously shown that banks are more prone to close branches in those areas where alternative deliver channels, in particular remote ones, are more accessible (Table VI, eq.3). In this section, we verify whether our previous results are driven by some areas that differ in term of the diffusion of the broadband, which proxies for availability of remote banking channels. To this aim, we plug into the equation the interaction terms between the distance and three dummies measuring the diffusion of the broadband (high, medium, low). We obtain (Table X) a negative and significant coefficient for all the interaction terms between the diffusion of the broadband and the distance from other proprietary branches. Interestingly, the coefficient is increasing, in absolute terms, in the diffusion of the broadband. This means that banks are more likely to close a branch when the distance from other proprietary branches is shorter in areas with wider broadband diffusion. This may be due to the fact that in areas where the broadband is more diffused banks are better able at substituting remote banking for branches.

As far as the coefficients of the interaction terms between the broadband dummies and the distance from the branches of competitors are concerned we obtain negative coefficients, as expected, but only the one relative to high diffusion of the broadband is statistically significant, reinforcing the overall impact of the broadband diffusion. This means that banks are more likely to close a branch when the distance from competitors' branches is shorter in those areas where the diffusion of broadband is higher. This may be due to the fact that in areas where the broadband is more diffused banks are better able at substituting remote banking for branches and then competition tends to operate also on the remote channel. However, as it will be shown in the following sections (Table XIV and XV), the coefficients of the interaction terms between the broadband dummies and the distance from the competitors lose their statistical significance once we better control for the characteristics of the local credit market. This suggests that the broadband has an impact on banks' closures that is independent of the geography of the branches. This is also in line with the view that ICT "kills" the distance and then has an impact that does not depend on the way branches are settled across areas.

[13] http://www.agenziacoesione.gov.it/it/arint/OpenAreeInterne/.

We already shown that banks investing more in ICT capital were more prone to close branches (paragraph 3.7 and Table VI). As a further check we interact the distance with the level of investment in ICT capital of banks (Table XI), confirming the results we obtained before for the distances from other proprietary branches. As far as the distances from competitors' branches we get results that are consistent with what we found for the role of broadband diffusion. In particular, the coefficient is negative and statistically significant only for the interaction between distance and the dummy indicating that the level of the ICT is beyond the median. Again one may conclude that only banks endowed with more ICT capital are able at substitute click-and-mortar business models for brick-and-mortar ones.

Heterogeneity across banks' characteristics

Finally, we have also verified whether the impact of branch distances differs according to bank size (Table XII). To this aim, we estimate separately the coefficient for the branch distance for different categories of banks (largest and large banks, plus foreign banks; medium-sized banks, small and minor banks, and mutual banks). As far as the distance from proprietary branches, which is a possible proxy for over-branching, we find that the impact of distance is greater for large banks. On the one hand, our results suggest that large banks had a too much populated network that they had to restructure more deeply in the aftermath of the crisis. On the other hand, even before the crisis, they had already invested by a larger amount in ICT equipment, which allowed them to close branches while preserving the relationships with their customer. Furthermore, we find that, the impact of distance is stronger for medium-sized banks when we look at the distance from competitors. At the other extreme, the decision to close a branch by small and minor banks as well as by mutual banks seems unaffected by the distance from competitors.

It is widely acknowledged that mutual banks belong to a specific category of banks. As consequence, it seems reasonable to check whether they mostly suffered competition from other mutual banks.[14] To this aim, we re-estimate the model after having replaced the distance from all competitors with that from other mutual banks. As expected, while we still get a not significant coefficient for the distance from mutual bank competitors, their number is positively correlated with mutual bank branch closures. Interestingly, the coefficient for the overall number of branches is not significant (Table XIII, eq. 5-6). The latter result clearly indicates that mutual banks mostly compete against each other.

5 Robustness checks

We run several robustness checks. First, we have re-run the equations included in Table IX and XI substituting bank-municipality fixed effects for bank-LMA ones and we have got similar results (Table XIV). In Table XV we have adopted a more stringent definition for branch closure which excludes those closures that were followed by the opening of a branch within 5 km, that we interpret as the result of a branch transfer and not a closure. In Table XVI we estimate the probability of closing a branch by using a logit model instead of the LPM. We also re-run our main

[14] See, among others, Angelini, Di Salvo and Ferri (1998), Stefani *et al*. (2016), Demma (2015), Becchetti et al. (2014), Draghi (2009) and Cannari *et al*. (1997).

models focusing only on branches that are located in the LMA where branch *j* is located (Table XVII). All in all, our previous results are mostly confirmed.

6 Conclusion

Italian Banks, up to the Great Recession, have expanded their geographical reach by opening new branches with almost no interruption in the last decades, and in particular since the beginning of the 1990s, when bank branching was liberalized. The number of branches peaked by the end of 2008 and, since then, it steadily declined, in particular for largest banks that were more deeply involved in mergers and acquisitions.

The need for regaining bank profitability and ICT diffusion were the main drivers of the restructuring of bank branch network. Naturally, the way banks downsized their network is crucial. Banks have had to take into account the interdependence within their proprietary network and the relative position of their closest competitors.

In this paper, we investigated how banks reshaped their branch networks in Italy by comparing the pre and post crisis spatial distribution of branches. We exploited the Great Recession event that unexpectedly hit Italian banks, who reacted by downsizing their branch network in order to lower operating costs and regain profitability.

By using a detailed dataset that includes a wide set of variables controlling for the characteristics of each bank branch operating in Italy, we estimated the probability of a branch being closed as a function of its distance from both proprietary and competitors' branches, conditional on relevant bank branch and location characteristics.

Our findings support the hypothesis that branch network has been shrunk thanks to the diffusion of ICT infrastructures and to mitigate over-branching phenomena that partly originated from M&A deals. The way banks have closed down some of their branches reveals how bank branching is still relevant, in particular for lending to opaque borrowers, in line with Nguyen (2019), and it also reveals that it is a crucial competition tool.

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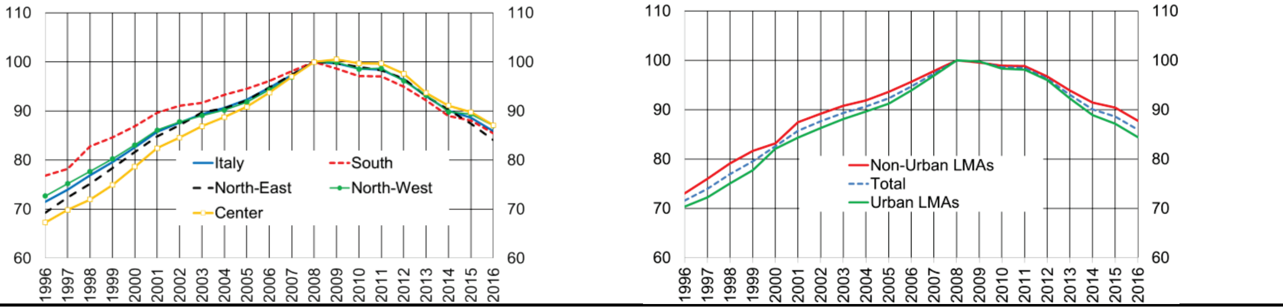
Figure 1

Bank Branches in Italy
(index 2008=100; yearly data)

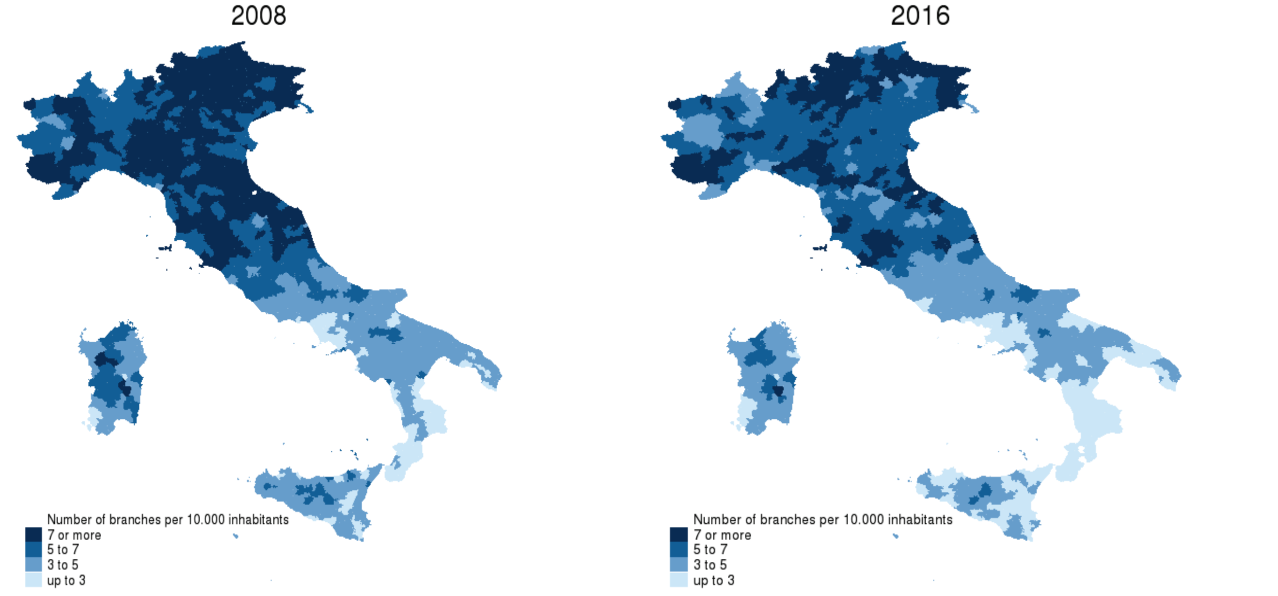
(a) *Main geographic areas* (b) *Urban versus non-urban labor market areas*



Source: Banca d'Italia.

Figure 2

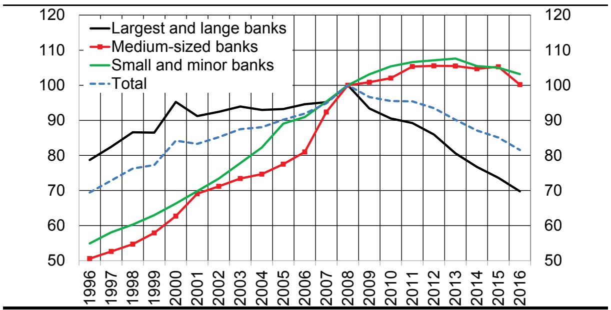
Number of Bank Branches per 10.000 Inhabitants
(units)



Source: Banca d'Italia.

Figure 3

Bank Branches in Italy by Bank Size
(index 2008=100; yearly data)



Source: Banca d'Italia.

Table I
Bank Branches Geographical Statistics
The table provides geographical statistics about the location of branches

Total number of bank branches	63228
Total number of banks	850
Total number of municipalities with bank branches	5980
Total number of LMAs with bank branches	611

	Obs.	Mean	Median	SD	Min	Max
	2007					
Number of bank branches in 5 km	32878	104.86	29	195.67	0	995
Number of branches of the same bank in 5 km	32878	12.02	2	29.66	0	227
Number of branches of competitors in 5 km	32878	92.83	25	175.796	0	984
Distance in km to the closest branch of the same bank	32805	5.38	2.02	18.54	0	932.47
Distance in km to the closest branch of competitors	32878	.62	.12	1.83	0	56.56
Average distance in km among branches of the same bank in 5km	24087	2.67	2.79	1.17	0	5.00
Average distance in km among all the bank branches in 5km	32317	2.28	2.33	1.08	0	4.99
Average distance in km to competitors branches in 5km	32024	2.24	2.28	1.09	0	5.00
	2014					
Number of bank branches in 5 km	30350	88.69	25.5	165.23	0	833
Number of branches of the same bank in 5 km	30350	7.61	2	17.73	0	157
Number of branches of competitors in 5 km	30350	81.08	23	153.06	0	822
Distance in km to the closest branch of the same bank	30303	6.10	2.74	19.36	0	895.85
Distance in km to the closest branch of competitors	30350	.64	.13	1.84	0	56.56
Average distance in km among branches of the same bank in 5km	20875	2.84	2.98	1.13	0	5.00
Average distance in km among all the bank branches in 5km	29801	2.29	2.35	1.09	0	5.00
Average distance in km to competitors branches in 5km	29534	2.24	2.30	1.10	0	5.00

WITHIN LABOUR MARKET AREAS

	Obs.	Mean	Median	SD	Min	Max
	2007					
Number of bank branches in 5 km	32878	103.41	26	195.73	0	994
Number of branches of the same bank in 5 km	32878	11.84	2	29.68	0	227
Number of branches of competitors in 5 km	32878	91.56	23	175.79	0	984
Average distance in km among branches of the same bank in 5km	31979	2.20	2.24	1.09	0	5.00
Average distance in km among all the bank branches in 5km	23275	2.62	2.73	1.17	0	5.00
Average distance in km to competitors branches in 5km	31681	2.16	2.18	1.10	0	5.00
	2014					
Number of bank branches in 5 km	30350	87.25	23	165.10	0	832
Number of branches of the same bank in 5 km	30350	7.46	1	17.73	0	157
Number of branches of competitors in 5 km	30350	79.79	21	152.90	0	822
Average distance in km among branches of the same bank in 5km	20061	2.79	2.91	1.13	0	5.00
Average distance in km among all the bank branches in 5km	29484	2.21	2.25	1.10	0	5.00
Average distance in km to competitors branches in 5km	29218	2.16	2.18	1.11	0	5.00

Table II
Distribution of Branches within Local Market Areas

Within a distance of

	1 km	3 km	5 km	10 km
	2007			
Percentage of branches in the same LMAs	99.38	99.28	98.62	94.33
Percentage of branches of the same bank in the same LMAs	99.30	99.27	98.51	94.07
Percentage of branches of competitors in the same LMAs	99.38	99.28	98.63	94.37
	2014			
Percentage of branches in the same LMAs	99.25	99.14	98.37	93.71
Percentage of branches of the same bank in the same LMAs	98.98	99.03	97.97	92.42
Percentage of branches of competitors in the same LMAs	99.27	99.15	98.41	93.83

Table III
Labor Market Area and Local Credit Market

	Same Municipality	Same Region	Same LMA		
				Urban	*Non Urban*
	2007				
Firms	49.1	92.8	75.6	79.8	70.5
Large and medium-sized firms	43.6	90.8	70.9	76.4	62.4
Small firms	57.3	95.7	82.9	86.5	79.7
	2014				
Firms	51.3	93.5	77.3	81.4	72.9
Large and medium-sized firms	44.7	91.7	71.7	77.6	63.4
Small firms	58.8	95.5	83.6	87.1	80.8

Table IV
Data Description
The table defines the variables employed in the empirical specifications and provides their descriptive statistics

VARIABLES	Units	Definition	Obs.	mean	median	SD	min	max
Dependent variables								
Closed Branch	0/1	=1 if the branch has been closed between 2007 and 2014	30682	0.216	0	0.411	0	1
"Strictly" Closed Branch	0/1	=1 if the branch has been closed between 2007 and 2014 and no new branch of the same bank has been opened within 5 km	30682	0.143	0	0.350	0	1
Measures of Spatial Location								
Distance to closest branch of the same bank	-	log(1+distance to closest branch of the same bank)	30621	1.238	1.136	0.944	0	6.839
Distance to closest branch of competitors	-	log(1+distance to closest branch of competitors)	30682	0.292	0.113	0.475	0	4.053
Average distance among branches of the same bank (in 5km)	-	Average distance in 5 km from same bank's branches/5	30682	0.665	0.678	0.288	0	1
Average distance among branches of the competitors (in 3km)	-	Average distance in 3 km from competitors' branches/3	30682	0.437	0.429	0.260	0	1
Number of branches of the same bank (in 5km)	-	log(number of branches of the same bank in 5 km)	30682	1.408	1.099	1.316	0	5.429
Number of branches of competitors (in 3km)	-	log(number of branches of competitors in 3 km)	30682	2.793	2.708	1.550	0	6.529
Closest same bank branch in 1 km	0/1	=1 if the bank has another branch in 1 km	30621	0.365	0	0.481	0	1
Closest same bank branch between 1 and 3 km	0/1	=1 if the bank has another branch between 1 and 3 km	30621	0.219	0	0.414	0	1
Closest same bank branch between 3 and 5 km	0/1	=1 if the branch has another branch between 3 and 5 km	30621	0.142	0	0.349	0	1
Competitor bank branch in 1 km	0/1	=1 if the branch has a competitor branch in 1 km	30682	0.883	1	0.322	0	1
Competitor bank branch between 1 and 3 km	0/1	=1 if the branch has a competitor branch between 1 and 3 km	30682	0.0626	0	0.242	0	1
Bank characteristics								
Largest and large banks (foreign includ.)	0/1	=1 if the branch belongs to a bank classified by the Italian bank law as large bank or to a foreign bank	30682	0.628	1	0.483	0	1
Medium-sized banks	0/1	=1 if the branch belongs to a bank classified by the Italian bank law as medium-size bank	30682	0.120	0	0.325	0	1
Small and minor banks (bcc excl)	0/1	=1 if the branch belongs to a bank classified by the Italian bank law as small or minor bank (mutual banks excluded)	30682	0.128	0	0.334	0	1
Mutual banks (bcc)	0/1	=1 if the branch belongs to a mutual bank (bcc in Italy)	30682	0.124	0	0.330	0	1
M&A	0/1	=1 if the branch belongs to a bank affected by M&A located within 5 km from other branches affected by the same M&A	30682	0.513	1	0.500	0	1
Liquidity	%	((Cash+Securities)/(Total Assets)) *100	30677	7.865	5.562	7.656	0	71.64
Loan to Asset ratio	%	(Loans/Total Assets)*100	30682	64.60	65.27	13.88	0	98.10
Wholesale Funding ratio	%	((Interbank liabilities+Bank bonds)/(Interbank liabilities+Bank bonds+Dposits))*100	30657	42.57	43.13	17.63	0	100

Table IV (continued)

VARIABLES	Units	Definition	Obs.	mean	median	SD	min	max
Leverage Ratio	%	((Total Assets – Equity)/Total Assets) * 100	30682	92.29	92.69	3.432	35.14	100
NPL Ratio	%	(Non Performing Loan/Total Loans)*100	30539	3.519	2.682	2.755	0	100
Investment in ICT capital (in 2006)	-	log(ICT capital stock per employee)	29033	-5.802	-5.920	1.251	-11.36	3.665
Labour Market area characteristics								
Urban LMA	0/1	=1 if the area has over 1500 inhabitants per km^2	30682	0.537	1	0.499	0	1
Altitude	0/1	=1 if the area has a mountainous nature	30682	0.155	0	0.362	0	1
Broadband diffusion	1/3	=1 if low diffusion, =2 if medium diffusion, =3 if high diffusion	30654	2.841	3	0.475	1	3
LMAs' area	-	log(LMAs' area in km^2)	30682	6.597	6.595	0.851	2.354	8.267
Ageing Index	%	(Population over 25 year old/population between 20 and 35 years old)*100	30682	132.1	127.6	29.45	58.25	295.7
Number of banks	-	log(number of banks operating in the LMA)	30682	3.146	3.091	0.773	0.693	4.543
Presence of small firms	%	(Small firma/(Small firms+Large firms))*100	30682	42.49	43.45	10.54	19.43	79.45
Low presence of small firms	0/1	=1 if the presence of small firms is in the first quartile	30682	0.654	1	0.476	0	1
High presence of small firms	0/1	=1 if the presence of small firms is in the fourth quartile	30682	0.0676	0	0.251	0	1
Branch Characteristics								
High productivity branch	0/1	=1 if the productivity of the branch (Sum of deposit and loans per employee) is over the median	30682	0.500	0.500	0.500	0	1
Branch's size (log)	-	log(Branch employment)	30682	1.867	1.792	0.577	0.693	6.538
Branch's age (log)	-	log(Branch's age in years)	30680	2.645	2.570	0.455	1.947	4.357

Table V

VARIABLES	Not Closed Branch N	Not Closed Branch mean	Closed Branch N	Closed Branch mean	Not Closed Branch N	Not Closed Branch mean	"Strictly" Closed Branch N	"Strictly" Closed Branch mean
Closest same bank branch in 1 km	24018	0.310	6603	0.566	26257	0.338	4364	0.525
Closest same bank branch between 1 and 3 km	24018	0.234	6603	0.165	26257	0.226	4364	0.179
Closest same bank branch between 3 and 5 km	24018	0.160	6603	0.0742	26257	0.152	4364	0.0813
Competitor bank branch in 1 km	24063	0.872	6619	0.921	26306	0.880	4376	0.901
Competitor bank branch between 1 and 3 km	24063	0.0666	6619	0.0480	26306	0.0631	4376	0.0599
Average distance among branches of the same bank (in 5km)	24063	0.691	6619	0.571	26306	0.676	4376	0.595
Average distance among branches of the competitors (in 3km)	24063	0.437	6619	0.438	26306	0.435	4376	0.452
Number of branches of the same bank (in 5km)	24063	1.308	6619	1.771	26306	1.373	4376	1.619
Number of branches of competitors (in 3km)	24063	2.680	6619	3.203	26306	2.757	4376	3.006
Largest and large banks (foreign includ.)	24063	0.573	6619	0.825	26306	0.596	4376	0.816
Medium-sized banks	24063	0.130	6619	0.0826	26306	0.129	4376	0.0656
Small and minor banks (bcc excl)	24063	0.146	6619	0.0606	26306	0.136	4376	0.0795
Mutual banks (bcc)	24063	0.150	6619	0.0314	26306	0.138	4376	0.0388
Foreign bank branches	24063	0.0016	6619	0.0036	26306	0.0016	4376	0.0048
M&A	24063	0.461	6619	0.701	26306	0.481	4376	0.707
Liquidity	24061	8.617	6616	5.129	26304	8.309	4373	5.192
Loan to Asset ratio	24063	64.77	6619	63.99	26306	64.67	4376	64.17
Wholesale Funding ratio	24043	41.44	6614	46.65	26283	41.84	4374	46.91
Leverage Ratio	24063	92.35	6619	92.07	26306	92.33	4376	92.05
NPL Ratio	23956	3.467	6583	3.711	26192	3.475	4347	3.788
Investment in ICT capital (in 2006)	22878	-5.861	6155	-5.585	25005	-5.828	4028	-5.643
Altitude	24063	0.170	6619	0.101	26306	0.162	4376	0.114
LMAs' area	24063	6.585	6619	6.638	26306	6.595	4376	6.608
Ageing Index	24063	132.0	6619	132.3	26306	132.1	4376	131.9
Presence of small firms	24063	42.85	6619	41.19	26306	42.66	4376	41.45
Low presence of small firms	24063	0.636	6619	0.721	26306	0.645	4376	0.710
High presence of small firms	24063	0.0750	6619	0.0406	26306	0.0708	4376	0.0484
High productivity branch	24063	0.522	6619	0.421	26306	0.523	4376	0.362
Branch's size	24063	1.896	6619	1.760	26306	1.901	4376	1.660
Branch's age	24062	2.681	6618	2.512	26304	2.670	4376	2.493

Table VI – Bank and LMA characteristics

	Eq. 1	Eq. 2	Eq. 3
Largest and large banks (foreign banks included)	0.205***	0.138***	
	(0.014)	(0.015)	
Medium-sized banks	0.064***	0.057***	
	(0.016)	(0.016)	
Small and minor banks (bcc excl.)	0.042***	0.036***	
	(0.011)	(0.011)	
M&A		0.120***	
		(0.008)	
Liquidity	-0.004***	-0.004***	
	(0.001)	(0.001)	
Loan to Asset ratio	0.001	0.000	
	(0.000)	(0.000)	
Wholesale Funding ratio	0.002***	0.002***	
	(0.000)	(0.000)	
Leverage Ratio	-0.013***	-0.014***	
	(0.001)	(0.002)	
NPL Ratio	0.205***	0.138***	
	(0.014)	(0.015)	
High Investment in ICT capital	0.038***	0.040***	
	(0.010)	(0.010)	
High productivity branch	-0.025***	-0.025***	-0.029***
	(0.007)	(0.006)	(0.006)
Branch's size (log)	-0.118***	-0.122***	-0.128***
	(0.006)	(0.006)	(0.006)
Branch's age (log)	-0.038***	-0.045***	-0.025***
	(0.011)	(0.011)	(0.010)
Urban LMA			0.009
			(0.014)
High Altitude			-0.064***
			(0.009)
Broadband medium diffusion			0.052***
			(0.012)
Broadband high diffusion			0.094***
			(0.010)
Area			-0.003
			(0.007)
Ageing Index			0.000
			(0.000)
Number of Banks in the LMA			0.023
			(0.015)
Low presence of small firms			0.014
			(0.011)
High presence of small firms			-0.026**
			(0.013)
Constant	1.493***	1.557***	0.310***
	(0.133)	(0.138)	(0.091)
Observations	30520	30520	30652
R-squared	0.104	0.117	0.063
Prob>F	0	0	0
Province fixed effects	No	No	Yes
LMA fixed effects	Yes	Yes	No
Bank fixed effects	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.1
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares.

Table VII – Geography of branch pruning, Baseline results

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
High productivity branch	-0.032***	-0.031***	-0.031***	-0.044***
	(0.007)	(0.006)	(0.006)	(0.007)
Branch's size (log)	-0.120***	-0.146***	-0.148***	-0.142***
	(0.006)	(0.007)	(0.007)	(0.008)
Branch's age (log)	-0.091***	-0.041***	-0.044***	-0.011
	(0.009)	(0.010)	(0.010)	(0.013)
M&A	0.116***	0.048***	0.051***	0.002
	(0.009)	(0.014)	(0.012)	(0.011)
Distance to closest branch of the same bank	-0.061***	-0.061***	-0.063***	-0.108***
	(0.005)	(0.006)	(0.005)	(0.007)
Distance to closest branch of competitors	-0.059***	-0.047***	-0.050***	-0.015**
	(0.006)	(0.006)	(0.006)	(0.007)
Constant	0.728***	0.677***	0.401***	0.669***
	(0.029)	(0.030)	(0.092)	(0.037)
Observations	30619	30619	30619	30619
Adjusted R-squared	0.098	0.234	0.246	0.373
Prob>F	0	0	0	0
LMA-bank fixed effects	No	No	No	Yes
LMA fixed effects	Yes	No	Yes	No
Bank fixed effects	No	Yes	Yes	No

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares.

Table VIII – Geography of branch pruning, non-linear effects of branch distance

	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5
High productivity branch	-0.045***	-0.041***	-0.045***	-0.043***	-0.045***
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
Branch's size (log)	-0.141***	-0.117***	-0.142***	-0.136***	-0.135***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Closest same bank branch in 1 km	0.189***		0.188***		
	(0.011)		(0.011)		
Closest same bank branch between 1 and 3 km	0.059***		0.058***		
	(0.009)		(0.008)		
Closest same bank branch between 3 and 5 km	0.020**		0.021***		
	(0.008)		(0.008)		
Closest same bank branch between 5 and 15 km	-0.010				
	(0.015)				
Closest same bank branch between 15 and 30 km	0.004				
	(0.026)				
Competitor bank branch in 1 km		0.072***	0.029**		
		(0.018)	(0.012)		
Competitor bank branch between 1 and 3 km		0.041**	0.033**		
		(0.019)	(0.014)		
Competitor bank branch between 3 and 5 km		0.002			
		(0.019)			
Competitor bank branch between 5 and 15 km		-0.019			
		(0.042)			
Competitor bank branch between 15 and 30 km		-0.019			
		(0.044)			
Average distance among branches of the same bank (5km radius)				-0.236***	
				(0.014)	
Average distance among branches of the competitors (3km radius)				-0.028***	
				(0.010)	
Number of branches of competitors (3km radius)					0.029***
					(0.004)
Number of branches of the same bank (5km radius)					0.021***
					(0.006)
Constant	0.417***	0.390***	0.392***	0.660***	0.377***
	(0.013)	(0.019)	(0.015)	(0.021)	(0.013)
Observations	30621	30682	30621	30682	30682
Adjusted R-squared	0.373	0.352	0.374	0.367	0.363
Prob>F	0	0	0	0	0

*** p<0.01, ** p<0.05, * p<0.1
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table IX – Geography of branch pruning, core and periphery

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
High productivity branch	-0.044***	-0.044***	-0.044***	-0.044***
	(0.006)	(0.006)	(0.006)	(0.006)
Branch's size (log)	-0.137***	-0.138***	-0.137***	-0.138***
	(0.006)	(0.006)	(0.006)	(0.006)
Periphery	-0.029***	-0.090***	-0.041***	-0.099***
	(0.008)	(0.018)	(0.010)	(0.020)
Periphery *Same bank branches distance (5km radius)	-0.170***		-0.171***	-0.170***
	(0.019)		(0.019)	(0.019)
Core *Same bank branches distance (5km radius)	-0.251***		-0.251***	-0.251***
	(0.013)		(0.013)	(0.013)
Average distance among branches of the competitors (3km radius)	-0.029***	-0.031***		
	(0.009)	(0.009)		
Periphery * Competitors branches distance (3km radius)			-0.010	-0.015
			(0.015)	(0.015)
Core * Competitors branches distance (3km radius)			-0.040***	-0.040***
			(0.011)	(0.011)
Average distance among branches of the same bank (5km radius)	-0.232***		-0.232***	
	(0.012)		(0.012)	
Constant	0.667***	0.681***	0.672***	0.685***
	(0.019)	(0.019)	(0.019)	(0.019)
Observations	30682	30682	30682	30682
Adjusted R-squared	0.367	0.367	0.367	0.367
Prob>F		0	0	0

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.

The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table X – Geography of branch pruning and broadband diffusion

	Eq. 1	Eq. 2	Eq. 3
High productivity branch	-0.044***	-0.044***	-0.044***
	(0.006)	(0.006)	(0.006)
Branch's size (log)	-0.139***	-0.138***	-0.139***
	(0.006)	(0.006)	(0.006)
Broadband low diffusion *Same bank branches distance (5km radius)	-0.090**		-0.090**
	(0.040)		(0.040)
Broadband medium diffusion *Same bank branches distance (5km radius)	-0.184***		-0.184***
	(0.029)		(0.029)
Broadband high diffusion *Same bank branches distance (5km radius)	-0.242***		-0.242***
	(0.012)		(0.012)
Average distance among branches of the competitors (3km radius)	-0.021**		
	(0.009)		
Broadband low diffusion * Competitors branches distance (3km radius)		-0.003	-0.002
		(0.019)	(0.019)
Broadband medium diffusion * Competitors branches distance (3km radius)		-0.027	-0.027
		(0.023)	(0.023)
Broadband high diffusion * Competitors branches distance (3km radius)		-0.023**	-0.023**
		(0.011)	(0.011)
Average distance among branches of the same bank (5km radius)		-0.231***	
		(0.012)	
Broadband medium diffusion	0.115***	0.049***	0.130***
	(0.042)	(0.018)	(0.046)
Broadband high diffusion	0.181***	0.069***	0.193***
	(0.036)	(0.016)	(0.040)
Constant	0.490***	0.594***	0.478***
	(0.038)	(0.023)	(0.040)
Observations	30654	30654	30654
Adjusted R-squared	0.367	0.367	0.367
Prob>F	0	0	0

*** p<0.01, ** p<0.05, * p<0.1
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise. The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table XI – Geography of branch pruning and investment in ICT

	Eq. 1	Eq. 2	Eq. 3
High productivity branch	-0.043***	-0.043***	-0.043***
	(0.006)	(0.006)	(0.006)
Branch's size (log)	-0.134***	-0.135***	-0.134***
	(0.007)	(0.007)	(0.007)
Medium-low level of ICT *Same bank branches distance (5km radius)	-0.237***		-0.238***
	(0.018)		(0.018)
Medium-high level of ICT *Same bank branches distance (5km radius)	-0.218***		-0.218***
	(0.018)		(0.018)
Average distance among branches of the competitors (3km radius)	-0.028***		
	(0.010)		
Medium-low level of ICT * Competitors branches distance (3km radius)		-0.015	-0.014
		(0.015)	(0.015)
Medium-high level of ICT *Competitors branches distance (3km radius)		-0.033**	-0.033**
		(0.015)	(0.015)
Average distance among branches of the same bank (5km radius)		-0.236***	
		(0.014)	
Constant	0.643***	0.657***	0.640***
	(0.021)	(0.021)	(0.021)
Observations	30682	30682	30682
Adjusted R-squared	0.365	0.367	0.365
Prob>F	0	0	0

*** p<0.01, ** p<0.05, * p<0.1
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table XII – Geography of branch pruning and bank size

	Eq. 1	Eq. 2	Eq. 3
High productivity branch	-0.044***	-0.043***	-0.044***
	(0.006)	(0.006)	(0.006)
Branch's size	-0.137***	-0.136***	-0.137***
	(0.007)	(0.007)	(0.007)
Largest and large banks*Same bank branches distance (5km radius)	-0.139***		-0.290***
	(0.025)		(0.017)
Medium-sized banks*Same bank branches distance (5km radius)	-0.113***		-0.140***
	(0.025)		(0.025)
Small and minor banks*Same bank branches distance (5km radius)	-0.115***		-0.113***
	(0.026)		(0.025)
Mutual Banks*Same bank branches distance (5km radius)	-0.025**		-0.115***
	(0.010)		(0.026)
Average distance among branches of the competitors (3km radius)	-0.044***		
	(0.006)		
Largest and large banks*Competitors branches distance (3km radius)		-0.026*	-0.021
		(0.015)	(0.015)
Medium-sized banks*Competitors branches distance (3km radius)		-0.072***	-0.070***
		(0.025)	(0.025)
Small and minor banks*Competitors branches distance (3km radius)		-0.001	-0.001
		(0.021)	(0.021)
Mutual Banks*Competitors branches distance (3km radius)		-0.026	-0.027
		(0.018)	(0.018)
Average distance among branches of the same bank (5km radius)		-0.236***	
		(0.014)	
Constant	0.650***	0.661***	0.650***
	(0.021)	(0.022)	(0.021)
Observations	30682	30682	30682
Adjusted R-squared	0.369	0.367	0.369
Prob>F	0	0	0

*** p<0.01, ** p<0.05, * p<0.1
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table XIII – Geography of branch pruning and Mutual Banks

	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6
High productivity branch	-0.039***	-0.039***	-0.038***	-0.038***	-0.038***	-0.039***
	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)
Branch's size (log)	-0.048***	-0.047***	-0.048***	-0.048***	-0.049***	-0.048***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
Average distance among branches of the same bank (5km radius)	-0.082***	-0.076***				
	(0.026)	(0.029)				
Average distance among branches of competitor mutual bank (3km radius)	-0.023					
	(0.018)					
Average distance among branches of competitor mutual bank (1km radius)		-0.015				
		(0.033)				
Number of branches of the same bank (5km radius)			0.023**	0.015	0.018*	0.022**
			(0.011)	(0.011)	(0.011)	(0.011)
Number of branches of competitor mutual bank (3km radius)			0.028**			
			(0.012)			
Number of branches of competitor mutual bank (1km radius)				0.044*		
				(0.025)		
Number of branches of competitors (3km radius)					0.009	
					(0.006)	
Number of branches of competitors (1km radius)						0.004
						(0.005)
Constant	0.240***	0.229***	0.128***	0.143***	0.130***	0.137***
	(0.037)	(0.040)	(0.018)	(0.018)	(0.019)	(0.017)
Observations	3813	3813	3813	3813	3813	3813
Adjusted R-squared	0.232	0.231	0.232	0.231	0.230	0.229
Prob>F	0	0	0	0	0	0

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise. The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table XIV - Robustness checks: Municipality-Bank joint Fixed Effects

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
High productivity branch	-0.051***	-0.050***	-0.051***	-0.051***
	(0.014)	(0.015)	(0.014)	(0.014)
Branch size (log)	-0.163***	-0.152***	-0.164***	-0.163***
	(0.012)	(0.012)	(0.012)	(0.012)
Largest and large banks*Same bank branches distance (5km radius)			-0.272***	
			(0.060)	
Medium-sized banks*Same bank branches distance (5km radius)			-0.218***	
			(0.082)	
Small and minor banks*Same bank branches distance (5km radius)			-0.165*	
			(0.087)	
Mutual Banks*Same bank branches distance (5km radius)			-0.133	
			(0.086)	
Largest and large banks*Competitors branches distance (3km radius)			-0.100*	
			(0.056)	
Medium-sized banks*Competitors branches distance (3km radius)			-0.109	
			(0.096)	
Small and minor banks*Competitors branches distance (3km radius)			0.039	
			(0.069)	
Mutual Banks*Competitors branches distance (3km radius)			-0.086	
			(0.059)	
Average distance among branches of the same bank (5km radius)	-0.240***			
	(0.043)			
Average distance among branches of the competitors (3km radius)	-0.079**			
	(0.038)			
Number of branches of competitors (3km radius)		0.022*		
		(0.012)		
Number of branches of the same bank (5km radius)		0.017		
		(0.021)		
Broadband low diffusion *Same bank branches distance (5km radius)				0.015
				(0.154)
Broadband medium diffusion *Same bank branches distance (5km radius)				-0.208
				(0.129)
Broadband high diffusion *Same bank branches distance (5km radius)				-0.241***
				(0.045)
Broadband low diffusion * Competitors branches distance (3km radius)				0.181
				(0.172)
Broadband medium diffusion * Competitors branches distance (3km radius)				-0.025
				(0.087)
Broadband high diffusion * Competitors branches distance (3km radius)				-0.095**
				(0.041)
Constant	0.739***	0.438***	0.736***	0.727***
	(0.045)	(0.027)	(0.044)	(0.044)
Observations	30682	30682	30682	30654
Adjusted R-squared	0.205	0.199	0.205	0.206

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise. The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include Municipality-Bank joint fixed effects.

Table XV - Robustness checks: A more stringent definition of branch closures

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
High productivity branch	-0.049***	-0.049***	-0.049***	-0.049***
	(0.006)	(0.006)	(0.006)	(0.006)
Branch's size (log)	-0.128***	-0.123***	-0.129***	-0.131***
	(0.006)	(0.006)	(0.006)	(0.006)
Largest and large banks*Same bank branches distance (5km radius)			-0.171***	
			(0.015)	
Medium-sized banks*Same bank branches distance (5km radius)			-0.116***	
			(0.024)	
Small and minor banks*Same bank branches distance (5km radius)			-0.107***	
			(0.024)	
Mutual Banks*Same bank branches distance (5km radius)			-0.096***	
			(0.023)	
Largest and large banks*Competitors branches distance (3km radius)			0.008	
			(0.015)	
Medium-sized banks*Competitors branches distance (3km radius)			-0.041*	
			(0.023)	
Small and minor banks*Competitors branches distance (3km radius)			-0.006	
			(0.019)	
Mutual Banks*Competitors branches distance (3km radius)			-0.011	
			(0.017)	
Average distance among branches of the same bank (5km radius)	-0.150***			
	(0.012)			
Average distance among branches of the competitors (3km radius)	-0.003			
	(0.010)			
Number of branches of competitors (3km radius)		0.012***		
		(0.003)		
Number of branches of the same bank (5km radius)		0.006		
		(0.005)		
Broadband low diffusion *Same bank branches distance (5km radius)				-0.099**
				(0.043)
Broadband medium diffusion *Same bank branches distance (5km radius)				-0.141***
				(0.034)
Broadband high diffusion *Same bank branches distance (5km radius)				-0.148***
				(0.012)
Broadband low diffusion * Competitors branches distance (3km radius)				-0.009
				(0.020)
Broadband medium diffusion * Competitors branches distance (3km radius)				-0.000
				(0.025)
Broadband high diffusion * Competitors branches distance (3km radius)				0.005
				(0.012)
Broadband medium diffusion				0.065
				(0.051)
Broadband high diffusion				0.087**
				(0.042)
Constant	0.508***	0.354***	0.504***	0.424***
	(0.018)	(0.013)	(0.018)	(0.043)
Observations	30682	30682	30682	30654
Adjusted R-squared	0.261	0.254	0.261	0.261

*** p<0.01, ** p<0.05, * p<0.1
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and no other branches from the same bank has been opened within 5 kilometers from the closed one and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.

Table XVI - Robustness checks: Logit Model

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
High productivity branch	-0.349***	-0.347***	-0.349***	-0.346***
	(0.052)	(0.052)	(0.052)	(0.052)
Branch's size (log)	-1.484***	-1.486***	-1.495***	-1.506***
	(0.072)	(0.068)	(0.073)	(0.073)
Largest and large banks*Same bank branches distance (5km radius)			-2.283***	
			(0.119)	
Medium-sized banks*Same bank branches distance (5km radius)			-2.102***	
			(0.549)	
Small and minor banks*Same bank branches distance (5km radius)			-1.360***	
			(0.487)	
Mutual Banks*Same bank branches distance (5km radius)			-2.061***	
			(0.560)	
Largest and large banks*Competitors branches distance (3km radius)			-0.135	
			(0.113)	
Medium-sized banks*Competitors branches distance (3km radius)			-0.438	
			(0.449)	
Small and minor banks*Competitors branches distance (3km radius)			1.426***	
			(0.412)	
Mutual Banks*Competitors branches distance (3km radius)			0.168	
			(0.388)	
Average distance among branches of the same bank (5km radius)	-2.216***			
	(0.111)			
Average distance among branches of the competitors (3km radius)	-0.045			
	(0.102)			
Number of branches of competitors (3km radius)		0.282***		
		(0.034)		
Number of branches of the same bank (5km radius)		0.135***		
		(0.050)		
Broadband low diffusion *Same bank branches distance (5km radius)				-1.093*
				(0.582)
Broadband medium diffusion *Same bank branches distance (5km radius)				-1.932***
				(0.299)
Broadband high diffusion *Same bank branches distance (5km radius)				-2.221***
				(0.117)
Broadband low diffusion * Competitors branches distance (3km radius)				0.151
				(0.292)
Broadband medium diffusion * Competitors branches distance (3km radius)				-0.034
				(0.282)
Broadband high diffusion * Competitors branches distance (3km radius)				-0.029
				(0.119)
Broadband medium diffusion				1.163**
				(0.559)
Broadband high diffusion				1.556***
				(0.526)
Observations	15855	15855	15855	15843

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from logit models. All regressions include LMAs-Bank joint fixed effects.

Table XVII - Robustness checks: Within the same Labour Market Area

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
High productivity branch	-0.043***	-0.044***	-0.044***	-0.043***
	(0.006)	(0.007)	(0.006)	(0.006)
Branch's size (log)	-0.137***	-0.135***	-0.137***	-0.139***
	(0.007)	(0.007)	(0.007)	(0.007)
Largest and large banks*Same bank branches distance (5km radius)			-0.290***	
			(0.016)	
Medium-sized banks*Same bank branches distance (5km radius)			-0.142***	
			(0.025)	
Small and minor banks*Same bank branches distance (5km radius)			-0.108***	
			(0.025)	
Mutual Banks*Same bank branches distance (5km radius)			-0.118***	
			(0.026)	
Largest and large banks*Competitors branches distance (3km radius)			-0.008	
			(0.015)	
Medium-sized banks*Competitors branches distance (3km radius)			-0.059**	
			(0.024)	
Small and minor banks*Competitors branches distance (3km radius)			-0.011	
			(0.021)	
Mutual Banks*Competitors branches distance (3km radius)			-0.022	
			(0.017)	
Average distance among branches of the same bank (5km radius)	-0.220***			
	(0.014)			
Average distance among branches of the competitors (3km radius)	-0.022**			
	(0.010)			
Number of branches of competitors (3km radius)		0.028***		
		(0.004)		
Number of branches of the same bank (5km radius)		0.013**		
		(0.006)		
Broadband low diffusion *Same bank branches distance (5km radius)				-0.100**
				(0.050)
Broadband medium diffusion *Same bank branches distance (5km radius)				-0.191***
				(0.034)
Broadband high diffusion *Same bank branches distance (5km radius)				-0.240***
				(0.014)
Broadband low diffusion * Competitors branches distance (3km radius)				0.008
				(0.022)
Broadband medium diffusion * Competitors branches distance (3km radius)				-0.012
				(0.026)
Broadband high diffusion * Competitors branches distance (3km radius)				-0.016
				(0.012)
Broadband medium diffusion				0.126**
				(0.055)
Broadband high diffusion				0.187***
				(0.048)
Constant	0.632***	0.361***	0.648***	0.481***
	(0.022)	(0.013)	(0.020)	(0.049)
Observations	30682	30682	30682	30654
Adjusted R-squared	0.368	0.364	0.369	0.368

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
The dependent variable is an indicator variable that equals one if the branch closes between 2007 and 2014 and no other branches from the same bank has been opened within 5 kilometers from the closed one and zero otherwise.
The table reports the estimated coefficients and robust standard errors (in parentheses) clustered at the LMA-Bank level from linear probability models estimated using least squares. All regressions include LMAs-Bank joint fixed effects.