



WORKING PAPERS

Col·lecció d'Economia E19/397

Mergers, branch consolidation and financial exclusion in the US bank market

Joan Calzada
Xavier Fageda
Fernando Martínez-Santos



UNIVERSITAT DE
BARCELONA

Mergers, branch consolidation and financial exclusion in the US bank market

Abstract: We analyze the role of bank mergers as determinants of the evolution of branch presence at the county level. Panel regressions based on county-level branch density are used to study differences across urban versus rural counties as well as pre- and post-crisis. The results indicate that bank mergers contributed to the increase of branches in the pre-crisis period and to its reduction in the post-crisis period, but the expansion effect of the mergers before the crisis mainly took place in metropolitan counties. Additional results show that broadband penetration has contributed to the reduction in the number of branches after the crisis and that branch closures are associated with an increase in the share of unbanked and underbanked households at the county level.

JEL Codes: L16, L22, G21, G34, G38.

Keywords: Bank branches, Mergers, Competition, Broadband, Financial Exclusion, United States.

Joan Calzada
Universitat de Barcelona

Xavier Fageda
Universitat de Barcelona

Fernando Martínez-Santos
Universidad San Pablo CEU

Acknowledgements: We thank participants at the Jornadas de Economía Industrial (Madrid), Encuentros de Economía Aplicada (Cartagena) and EARIE (Barcelona) for useful comments and suggestions. The usual disclaimer applies.

1. Introduction

Over the past decades, the US banking market has undergone a notable process of consolidation that has reduced the number of banking entities and transformed their branch networks. The liberalization of the market, initiated with the *Riegle-Neal Act* of 1994, favored the expansion of bank entities into other states and contributed to the increase in the number of bank branches. This situation was reversed, however, after the 2007–2008 financial crises and the Great Recession. Between 2008 and 2016, six per cent of branches were lost nationally, a situation that has continued apace in subsequent years. Urban areas have suffered high levels of closure and rural ‘banking deserts’ have become familiar features on the landscape. All in all, this process has raised concerns that a growing number of households and business might be losing adequate access to financial services. Branch closures increase consumers’ financial services costs, such as cashing checks, obtaining loans or simply opening deposit accounts. On the one hand, they are forced to travel longer distances to contract the services; and, on the other, staff re-organizations mean customers lose the personal advisory services they could expect from their traditional bank tellers. An additional problem is that this process of ‘financial exclusion’ may be more intense in areas with higher proportions of low-income families and minorities, groups that frequently have limited mobility and lower rates of Internet access (Sinclair, 2001; Carbo et al. 2007; Degryse and Ongena, 2005; Ergungor, 2010; Nguyen, 2014).¹

This article examines the transformation of the brick-and-mortar branch structure in the United States banking system in the period 2000–2014. We seek to analyze the factors affecting the presence of bank branches in different geographical areas of the country, before and after the Great Recession. The first part of the paper focusses on the impact of mergers during the period examined, showing that they led to an expansion of branch networks in the pre-crisis period and to branch closures after the crisis. The second part of the paper discusses on the consequences of branch closures for financial exclusion.

¹ Financial exclusion can also affect social capital and economic growth at the local level. Bruhn and Love (2014), for example, show that improved access to financial services had pronounced effects on real economic outcomes for low-income households in Mexico.

Bank branches play a fundamental role in the functioning of the banking sector. Despite the technological evolution and the widespread adoption of on-line banking, brick-and-mortar offices remain a primary mechanism of contact between customers and financial agents (FDIC, 2018). Bank branches allow customers to perform those activities that have not yet been replaced by on-line banking, such as cash transactions, obtaining financial advice and contracting services such as credit facilities and insurance products. In this context, the closure of branches in certain locations worsens the access of consumers to their entities and may exclude them from using some financial services. Banks also lose with the closures as their employees have fewer incentives to generate soft information, although this can partly be offset by reduction of the premises costs and with introducing more rigid practices for screening customers.

The commercial strategy of banking entities has changed notably in recent decades. Before the Great Recession, US banks opted to expand their retail networks so as to increase their efficiency and reduce risks. The 1994 *Riegle-Neal Interstate Banking and Branching Efficiency Act* promoted unrestricted nationwide banking and branching activities, and favored the use of mergers to gain access to new markets.² In the '90s, non-bank competitors (such as supermarkets) emerged as an alternative means for providing financial services. In this context large banks sought the *Riegle-Neal Act* as an opportunity to expand into other states to gain scale, become more diversified and consolidate their position (Elfakhani et al., 2003; and Allen et al., 2015). Another important factor that transformed the sector in these years was the adoption of digital technologies, which reduced banks' operating costs and improved their information systems. Those banks that could not afford the expense of investing in new technologies became targets for acquisition.

The path of evolution taken by the sector shifted notably during the Great Recession. After 2007, a series of regulations were introduced to prevent future crises. These measures limited the entry of new banks, which in previous years was an important mechanism for replacing

² The US banking industry has undergone a number of waves of mergers of varying intensity. According to Elfakhani et al. (2003), "Banking analysts agree that increasing competition, deregulation, technological advancements, bank failures, cost savings, and the desire to form one-stop financial centres are among the major factors driving the continuing consolidation trend."

bank failures in many local markets. Moreover, the reduction in the banks' profitability due to the reduction in the demand and the low interest margins favored the continuation of mergers in the sector. In contrast to the expansion mergers of the pre-crisis period, these mergers led to branch closures that helped banks to reduce costs and adjust to the competitive pressure of on-line banking.³

The aim of this paper is to examine the factors influencing the deployment of bank branches in the US, before and after the 2008 financial crisis. For the pre-crisis period we consider the years from 2000 to 2007, which are characterized by significant economic expansion. For the post-crisis period we examine the years of economic crisis and subsequent recovery up to 2014. Our analysis draws on a rich dataset for 3,090 counties in the 50 states of the United States and the District of Columbia. Information about bank branches at the county level has been obtained from the Federal Deposit Insurance Corporation (FDIC). County-level demographic and socio-economic variables are taken from the US Census Bureau.

Our empirical analysis focuses on the impact of mergers on the banks' branching policy. A key feature of our identification strategy is that the merger decisions taken by bank entities are exogenous to the idiosyncratic situation of the counties before the mergers. In this sense, we only consider mergers between banks of different states (inter-states mergers) and mergers between banks that belong to the same state but with headquarters in different counties (intra-states/inter county mergers).

The results indicate a positive effect of mergers on the number of bank branches when we consider the whole period 2000-2014, but when we split the period in the pre and the post-crisis period we obtain interesting heterogeneous effects. Before 2008, mergers had an overall positive effect on bank density, but while mergers in metropolitan counties increased the number of branches, those in micropolitan and rural counties decreased it. This implies that the "consolidation process" that has experienced the market in the last decades was complemented in these years with a number of "expansion mergers", which were especially important in

³ Allen et al. (2009) analyze the effects of market structure in the diffusion of e-banking in Canada for the period 1998–2006. They show that banks have more incentives to reduce the number of branches and to promote e-banking in regions where competition is intense.

metropolitan counties. This situation changed with the financial crisis. After 2008, inter-state bank mergers had a negative impact on branch density in all counties, with a stronger effect in micropolitan and rural counties. Moreover, intra-state/inter county mergers did not affect the number of branches. Another interesting result to emerge from our analysis is that broadband penetration contributed to the reduction of branch density. This is can be a consequence of the generalization of on-line banking, but it is important to remark that broadband penetration is low in non-core counties and in counties with a higher proportion of vulnerable population. Finally, the paper concludes with a discussion of the effects of branch closures on financial exclusion. We show that after 2008 the share of unbanked and underbanked households at the county level was positively associated with branch closures and negatively related with the presence of community banks, which are characterized as having a closer relationship with costumers.

Several papers have analyzed the branching strategy of banking entities in the US. While some authors have focused on the effects of branch competition on prices (Sapienza, 2002), others have considered its implications for service quality (Focarelli and Panetta, 2003; Panetta et al., 2009), firm-bank relationships (Karceski et al., 2005; Panetta et al., 2009), consumer bankruptcies (Allen et al., 2016) and for the efficiency and the stability of bank entities (Calomiris, 2000; and Aguirregabiria et al., 2016). There is also a group of papers examining the determinants of branch expansion and new charter formation. Amel and Liang (1997) analyze bank entry in over 2,000 US banking markets in the period 1977–1988, showing the relevance of population growth and the incumbent profits. Adams and Amel (2007) study bank entry from 1994 to 2008, obtaining that local market demand and past entry are positively associated with entry, and that incumbent branch expansion and small bank presence deter entry. Cohen and Mazzeo (2010) assess the competitive consequences of the sectorial reforms in the nineties that allowed banks to spread across multiple markets. They examine competition in 1,882 rural markets for 2005. They show that while competition from traditional single-market banks and saving banks is associated with smaller branching networks, all types of institutions tend to have more branches when competing with multimarket banks in order to be more competitive.

Our paper contributes to this literature by showing the heterogeneous impacts of mergers in branch deployment. We distinguish between two groups of mergers; inter-state mergers in

which the merging entities have their headquarters in different states, and intra-state/inter-county mergers in which the merging entities have their headquarters in the same state, but in different counties. We examine the impact of these two types of mergers in the pre and post-crisis periods and we also look at the differential effects in three types of counties; metropolitan, micropolitan and rural counties.

Our paper is also closely related to the literature analysing the effects of branch deployment on financial exclusion. Branches can alleviate information frictions by collecting soft information about the neighborhoods in which they operate and about their customers. In this sense, Celerier and Matray (2018) exploit the staggered interstate branching deregulation in the US after the *Riegle-Neal Act* as an exogenous shock on bank competition, and show how the competition resulting from these regulations reduced the share of unbanked households, benefiting lower-income households and those living in rural areas. Following this argument, in the second part of our paper we examine the impact of branch closings after the 2008 crisis and we obtain that they are associated with higher shares of unbanked and underbanked consumers. This is also in line with the literature showing that the distance between lenders and borrowers determines the availability and terms of credit, especially in low-income neighborhoods (Degryse and Ongena, 2005; Agarwal and Houswald, 2010; Ergungor, 2010; Brown, 2016; Allen et al., 2012; Martin-Oliver, 2019).

The literature has also examined the relationship between mergers and banking exclusion. Allen et al. (2015) analyze how a merger between Toronto Dominion and Canada Trust in 2000 affected consumer bankruptcy. They find that local markets affected by a merger exhibited a temporary increase in consumer bankruptcy rates post-merger, which is explained by the replacement of the target management and loan officers that can typically act as the depositaries of soft information. Finally, two recent works use mergers as an exogenous variation in local market to explore the effect of bank branches in small business lending.⁴ Nguyen (2019)

⁴The effects of banks characteristics on small business lending have been also studied in other papers. Some show that stronger bank-borrower relationships are associated with better treatment for borrowers, in terms of lower interest rates and reduced collateral requirements (Berger and Udell, 1995), increased credit availability (Petersen and Rajan, 1995, Cole, 1998) and more protection against interest rate shocks (Berlin and Mester, 1998). Other papers have examined how lending practices differ between large and small banks, obtaining that small banks rely more on soft information (Cole, 2004; Berger et al. 2005).

analyzes the level of lending to small firms in neighborhood exposed to the merge of large banks in the period 1999-2012. She shows that branch closings that follow mergers between large banks lead to prolonged declines in local small business lending, indicating that borrowers who lose access to credit have difficulty obtaining credit from other banks. Jagtiani and Maingi (2019) investigate the impact of mergers affecting community banks on local small business lending in the period 2002-2014. They obtain that relative to counties where the acquirer bank had operations before the merger, local small business lending declined significantly more in counties where only the target bank had operations before the merger. This implies that the absence in the county of community banks has led local business to a credit gap that has not been filled by the rest of the banking sector.⁵

The rest of the paper continues as follows. Section 2 describes the main episodes in the US banking market before and after the Great Recession. Section 3 establishes the main hypothesis of our paper. Section 4 describes the dataset, outlines the main market trends, and explains our empirical strategy. Section 5 presents the results of our analysis. Section 6 discusses the effects of branch closures on financial exclusion. Finally, Section 7 concludes.

2. The US banking market before and after the Great Recession

Banking deregulation has been an important determinant for the deployment of bank branches since the end of the 1990s. In 1927, the *McFadden Act* implicitly prohibited commercial banks from interstate branching. In the following years, bank holding companies were created to circumvent the law and they acquired branches across states, but such practices were terminated with the *Bank Holding Company Act* of 1956. These policies had resulted in a banking system composed largely of thousands of small, independent banks. According to McCord et al. (2015), in the period 1960–80, there were between 12 and 13 thousand independent banks in the United States.⁶

⁵ More generally, the relevance of soft information for small firms lending is discussed in Petersen and Rajan (1994), Berger and Udell (1995), and Cole (1998).

⁶ Copeland et al. (1995) record two waves of mergers in this period, in the mid-1960s and in the late 1980s extending until 1998. Elfakhani et al. (2003) explain that since then such waves have been frequent.

This situation was to change in 1994, when the *Interstate Banking and Branching Efficiency Act (Riegle-Neal Act)* permitted bank holding companies to enter other states and operate branches. Initially, the Act allowed states to set up certain barriers to protect their banks, but this measure was later relaxed.⁷ In 1999, the *Gramm-Leach-Bliley Act* promoted the integration of the commercial and investment functions of these entities.⁸ These decisions enhanced competition and led to the consolidation of the sector through mergers and acquisitions (Chaddock, 1994; Vives, 2016). One consequence of these reforms was a reduction in the number of banks, with the smaller, weaker entities being acquired by other institutions to gain economies of scale. During these years the number of banks continued to decrease and fell to around 10,000 by 2000. On the other hand, the consolidation of the sector led to a reduction of bank offices until 1993 and since then the number of branches increase until 2009, reaching a peak of nearly 100,000 offices (FDIC, 2012).

The *Riegle-Neal Act* eliminated many of the restrictions on the acquisition of interstate banks and permitted the creation of “interstate branches”. It authorized the creation of Bank Holding Companies that could acquire banks anywhere in the United States and diversify their assets. The objective of the reform was to increase the efficiency of financial institutions, permitting the conversion of their banking subsidiaries into bank branches and, thus, eliminating indirect costs (McLaughlin, 1995).

After 2007, the failure to detect the financial crisis led to the implementation of a series of mechanisms to prevent future problems in the sector. The *Dodd-Frank Act* of 2010 aimed to protect consumers, discipline banks, avoid bank bailouts and create banks that were “too big to fail”. This generated a series of reforms of the securities market, the regulation of derivatives and the reform of rating agencies (Vives, 2016 and 2019). The Act requires the Federal Reserve System to impose stricter controls on supervised and unregulated banks (shadow banks) that

⁷ The liberalization of the sector was initiated in the ‘70s, when the *Depository Institutions Deregulation and Monetary Control Act* of 1980 and the *Garn-St. Germain Depository Institutions Act* of 1982 promoted competition by eliminating the distinction between the banks and other financial institutions. These laws sought to favor competition and efficiency, but actually generated instability in the sector. More than 500 entities went bankrupt between 1980 and the beginning of the 1990s.

⁸ This measure reversed the *Glass-Steagall Act* of 1933 and allowed commercial and investment banking activities to be conducted within the same financial company (Bergia, 2014).

have assets valued at more than \$50 billion. In addition, it implemented reforms that affect the banking structure, by introducing a degree of separation between the banks' commercial and investment activities.

More recently, the digitalization of the economy has had a major disruptive impact on the traditional banking sector. On-line banking represents a cost saving compared to brick-and-mortar branches and has drastically changed the retail business. However, technological innovations have not yet eliminated the need for branch networks that can serve consumers, although the frequency of branch use has clearly fallen (FDIC, 2018).

Figure 1 shows the evolution in the number of banking institutions and branches in the US from 2000 to 2014. While the number of banking entities fell throughout the whole period, the number of branches increased until 2007 and then fell after the Great Recession. The reduction in the number of branches after the financial and economic crisis can be explained by the increasing consolidation of the banking sector and the increasing use of bank services via the Internet.

The fall in the total number of banks throughout the period represents a continuation of the trend that began in the 1980s, and these exit rates do not differ greatly from those recorded in previous periods. After 2007, the reduction in the number of banking entities is driven not by the increase in bank failures but by the lack of bank entry. As McCord et al. (2015) explain, from 2009 through 2013 bank entry fell to almost zero.⁹ Likewise, branch expansion into new geographic markets, which was a relevant form of bank entry in previous years, has also declined dramatically.

Adams and Gramlich (2014) maintain that the decline in new bank entry is due in large part to low bank profitability. The Fed's policy of keeping the federal funds rate near zero since 2008

⁹ Adams and Gramlich (2014) show that the number of new bank charters in the United States has declined in recent years. From 1990 to 2008, over 2,000 new banks were formed, more than 100 per year. From 2009 to 2013, only seven new banks were formed, fewer than 2 per year. Tranfaglia (2018) examines spatial patterns in bank branch closures within the Philadelphia, Chicago and Baltimore metropolitan areas in the period 2010–2016. She shows evidence of branch closure clustering at short distances (2-5 km) in both Chicago and Philadelphia MSAs, but not in Baltimore. Banks tend to maintain their branches in urban areas and reduce their presence in quasi-urban and rural areas.

has pushed lending rates down, which has kept the net interest margin relatively small. The reduction in bank entry can also be explained by the weak demand for banking services and by the implementation of new banking regulations (e.g. *Dodd-Frank Act* and FDIC regulations) that reduced the profitability of *de novo* banks.

3. Mechanisms and hypothesis

This section establishes the main hypothesis examined in our empirical analysis. Our first objective is to study the effect of mergers on bank branches in the period from 2000 to 2014. Following the literature we can identify two types of mergers that took place in this period. First, “expansion mergers” were used as a mechanism to enter in new markets, allowing banks to expand their activity, reduce costs, and diversify their assets (McLaughlin, 1995, Aguirregabiria et al. 2016). After the 1994 Riegle-Neal Act, banks used inter-state and intra-state mergers to expand their commercial networks and to attract consumers from their competitors (Cohen and Mazzeo, 2010). Our hypothesis is that “expansion mergers” intensified competition in local markets and lead to the creation of new branches. Moreover, we expect these mergers to be more relevant in metropolitan counties where banks were better able to exploit scale economies and competition was stronger.

Second, “consolidation mergers” have been used by banks to increase market power and to reduce costs. Our hypothesis is that these mergers offset “expansion mergers” after 2008 and implied a net reduction of branch density. After the 2008 crisis, the Federal Reserve’s policy of keeping the federal funds rate near zero pushed lending rates down, which kept the net interest margin relatively small. This situation, coupled with the demand reduction (e.g. loans and deposit-taking services) and the implementation of new banking regulations (e.g. *Dodd-Frank Act* and FDIC regulations) reduced the profitability of banks and give rise to mergers aimed at reducing premises costs and improving efficiency. After a merge, the branches of the buyer and the target entities overlap in some neighborhoods and these geographic redundancies can lead to branch closures. We expect the reduction in the number of branches to be more important in metropolitan counties and for large banks, as in these cases branch duplications in local markets is more likely.

The second objective of the paper is to analyze whether branch closures have increased financial exclusion. Specifically, we want to examine whether the number of branches in local markets and the size of the banks affects consumers' access to financial services. The theoretical model of Stein (2002) shows that small banks are at a comparative advantage in evaluating household loans and investments projects of small-business. On the one hand, employees of small entities are closer to the consumers and have stronger incentives to generate soft information. On the other hand, the interests of the managers of small banks are more aligned with those of the shareholders and might dedicate more effort to build soft-information. By contrast, larger and hierarchic entities perform better when "hard information" can be easily examined and passed along inside the bank entity. The employees of these entities can be more effective in dealing with consumers that can be assessed by means of standardized measures (income statements, credit rating, balance sheet, etc.) but they have fewer incentives to generate "soft information". Several recent works have analyzed the relevance of bank size (Berger et al. 2005), the distance to the branch offices (Nguyen, 2019), and the presence of community banks (Kowalik, 2014; Berger, Cerqueiro, and Penas, 2014; Jagtiani, Kotliar, and Maingi, 2016; and Jagtiani and Maingi, 2019), on the access to credit by small business.

Following the predictions of these works, the hypotheses we test in the second part of the paper are two-fold. First, we examine whether the reduction of bank branches at the county level increased the percentage of the population that is unbanked or underbanked. We expect branch closures to increase financial exclusion, as consumers have to travel longer distances to visit their branch and bank employees have less valuable soft information about consumers. Second, we want to analyze whether community banks are effective in reducing financial exclusion. Community banks are small entities with a reduced number of branches that carry out the traditional banking functions of lending and deposit gathering on a local scale, and are characterized by local ownership and local decision making. These entities are considered to be "relationship" bankers and we expect their presence in a county to be associated with a lower prevalence of unbanked and underbanked consumers.¹⁰

¹⁰ Most studies define community banks as those that have a maximum asset size of \$1 billion. FDIC (2012) considers a wider definition around criteria related to traditional lending and deposit gathering activities and limited geographic scope. As a result, they identify 7,658 FDIC-insured community banks operating within 6,914 separate banking organizations (or 94 percent of all banking organizations). This definition captures 330 banks

4. Data, trends and methods

4.1 Data

We draw on a dataset for 3,090 counties in the 50 states of the United States and the District of Columbia for the period 2000–2014.¹¹ The information has been obtained from the *Summary of Deposit (SOD)* and *the Reports of Structure Changes (ROC)* provided by the Federal Deposit Insurance Corporation (FDIC). The SOD data are collected for all institutions insured by the FDIC, including commercial banks and savings and loans associations, and describe the financial situation (deposits and assets) and bank specificities (type of financial service, address, bank affiliation, etc.) at branch-level. The ROC data also describe the non-financial activities of all entities insured by the FDIC, capturing institutional and structural changes including mergers, failures and new offices of financial entities.

Our analysis is conducted at the county level and, for this reason, we aggregate local branch information. Specifically, we calculate the number of branches, inter-state and intra-state mergers and bank entries and exits affecting each county and calculate market concentration by using banks' deposits in each county. County-level demographic and socio-economic variables are taken from the US Census Bureau. The Census also provides the counties' land area used in calculating population densities. Data for broadband penetration – a proxy for internet banking – is obtained from the Center for Policy Informatics at Arizona State University, which for the period we study has collected information for 328 counties (most of them metropolitan counties).

Finally, we analyze the effect of branch closures on financial exclusion with the use of an additional FDIC dataset, *“The National Survey of Unbanked and Underbanked Households”* (NSUUh). This is a biennial survey that was first conducted in June 2009 and which incorporates supplementary questions to those contained in the *“Current Population Survey”*

that might have been excluded with the standard definition. In this paper we consider community banks as those banks with either 3 or more branches and a number of assets that are less than 1 billion dollars

¹¹ Our analysis excludes eight overseas states: these are American Samoa, Federal States of Micronesia, Guam, Marshall Islands, Northern Mariana Islands, Palau, Puerto Rico, and Virgin Islands. The dataset also excludes branches that do not hold any deposits and entities that are not for commercial use or which provide a limited customer service. These offices represent around 4% of the FDIC dataset.

conducted by the US Census Bureau. We use the NSUOH for the years 2009, 2011, 2013 and 2015, and combine these data with the SOD. Our dataset contains 317,036 observations, corresponding to 112,892 households living in 368 counties (most of them metropolitan counties) in the period 2009–2015. Note that these data are aggregated at the county level so in the end we have 1,093 observations for our analysis of unbanked households and 899 observations for our analysis of underbanked households.¹²

4.2 Basic trends

Figure 1 shows the number of bank entities and branches in the period 2000–2014. Between 2000 and 2009 the number of bank entities decreased at an annual rate of 2.24%, and between 2009 and 2014 at a rate of 3.85%. By contrast, the number of branches increased between 2000 and 2009 at an annual average rate of 1.92% and decreased afterwards at a rate of 0.82%. Notice that since the financial crisis of 2008 the total population in the United States increased by 4.5%, which means that the average number of inhabitants served by each bank branch increased by approximately 10% (Table A1).¹³

The number of bank branches varies markedly across counties. Figure 2 shows that in 2014 about one third of counties had five branches or fewer, and almost one in four had between six and ten branches. Yet, about 15% of the counties had more than 30 branches. These differences in the number of branches make evident the differences in the counties' relative rates of profitability.

Following the Office of Management and Budget (OMB), we classify counties as either metropolitan (urban) or non-metropolitan counties (rural). In turn, the latter can be divided into two categories: micropolitan and non-core counties. Metropolitan counties are those that include at least one urban core of 50,000 people or more. Micropolitan counties are those with an urban core of 10,000 to 50,000 people and non-core counties are those with an urban core

¹² The NSUOH provides weights to account for the representativeness of all the households used in our analysis.

¹³ Maudos and Vives (2019) analyze the banking system of the European Union during this period. They explain that the 2007-2009 crises ended an expansion period of the banking system and initiate a restructuring process that lead to many mergers and acquisitions. Between 1997 and 2017, the number of credit institutions was reduced by 43% and the number of bank branches by 17%.

population of fewer than 10,000 people. In 2014, there were 1,217 metropolitan counties in our sample, 646 micropolitan counties, and 1,311 non-core counties.

Figure 3 shows the evolution in the average number of branches per 10,000 inhabitants in the three types of counties. The evolution of branch density is similar for all counties. In the pre-crisis period from 2000 to 2007, there was a growth in branch density, which was more intense in rural counties. In the post-crisis period from 2008 to 2014, there was a decline in branch density, which was weaker in rural counties.

Mergers have had a relevant impact on the presence of bank branches at the county level. Following the *Riegle Neal Act* of 1994, bank entities engaged in both intra- and inter-state mergers aimed at gaining scale and geographically diversifying their risks. After the financial crisis of 2008, banks used mergers to consolidate their position in an environment of weak demand and strong competition. Figure 4 shows that the number of metropolitan counties affected by mergers has been particularly high (798 counties in 2014, representing the 62 % of the total), but mergers have also affected a high number of non-core counties (62% of micropolitan counties and 42% of rural counties), which is especially relevant for competition taking into account that they have a smaller number of branches. Also notice that in the whole period 831 counties were affected by one merger, 449 by two mergers, and 545 by more than two mergers.

Figure 5 shows the bank entities classified according to the number of branches they operate. Panel A shows the situation in 2000 and panel B in 2014. In 2000, more than 50% of bank entities were community banks that had one or two branches (31.7% of the entities had only one branch and 19.1% had two). On the opposite side, only five entities had more than 1,000 branches: Wells Fargo Bank (1,013), the U.S. Bank (1,068), SunTrust Bank (1,109), First Union National Bank (2,323) and Bank of America (4,463). By 2014, the number of entities with just one branch had fallen by a half (around 2,500 entities). Moreover, 11 entities had more than 1,000 branches: KeyBank National Association (1,021), TD Bank, National Association (1,322), Fifth Third Bank (1,346), SunTrust Bank (1,504), Regions Bank (1,667), Branch Banking and Trust Company (1,832), PNC Bank (2,810), U.S. Bank (3,190), Bank of America (5,052), JPMorgan Chase Bank (5,595), and Wells Fargo Bank (6,247).

4.3 Empirical Strategy

The first objective of our empirical analysis is to determine the effect of mergers in the deployment of bank branches before and after the 2008 financial crisis. To do this, we take advantage of the panel structure of our dataset to estimate a county fixed effects model that allows controlling for the omitted variables that are correlated with the variables of interest and which do not change over time. The county fixed effects model focuses on the within variation of the data so that it controls for the effect of time-invariant variables, such as state fixed effects. Furthermore, our model includes year dummies to control for time shocks that are common across counties.

The variable of interest of our model is *Branch Density*_{kt}, which is the number of bank branches per inhabitant in county *k* in year *t*. This variable allows us to account for differences in the counties' population size. Our dataset contains a high number of small banks with very few branches, which means the distribution of the variable *Branch Density*_{kt} is highly skewed (to the right). For this reason, we apply natural logarithms to this variable to obtain a distribution that is less asymmetric and which conforms to normality.¹⁴

Branch density is determined by local market competition, the banks' commercial strategy, and the size of the market. Taking this into account, we can estimate the following model for county *k* in year *t*:

$$\begin{aligned} \text{Log_Branch Density}_{kt} = & \beta_0 + \beta_1 \text{Mergers}_{kt} + \beta_2 \text{De Novo Banks}_{kt} + \beta_3 \text{Bank Failures}_{kt} + \beta_4 \text{Lag HHI Deposit}_{kt} \\ & + \beta_5 \text{Saving \& Loans}_{kt} + \beta_6 \text{Lag Total Deposits}_{kt} + \beta_7 D^{\text{metro}}_{kt} + \beta_8 D^{\text{micro}}_{kt} + \beta_9 \text{Density Pop}_{kt} + \beta_{10} \text{Income}_{kt} \\ & + \beta_{11} \text{Unemployment}_{kt} + \beta_{12} \text{Year}_t + \beta_{13} \text{County}_t + \varepsilon_{kt} \end{aligned} \tag{1}$$

We use three variables that reflect the impact of mergers in local markets. First *Mergers* captures the number of bank entities in a county that have been affected by a merger or an acquisition. To address the possibility that the mergers decisions are not exogenous with

¹⁴ Figure 1A in the Appendix shows the distribution of the dependent variable with and without the log transformation, confirming that the log transformation corrects the problem of skewness.

respect to the counties' local economic conditions, our analysis focusses on *Inter-States Mergers* (the merging entities have their headquarters in different states) and *Intra-States/Inter-County* (the merging entities have their headquarters in the same state, but not in the same county). Out of the total number of mergers in the study period 28.9% are *Inter-States Mergers* and 52.1% are *Intra-States/Inter-County* mergers. As explained in section 3, the type of mergers we examine might respond to different objectives, including the expansion into other markets and market consolidation. An essential aspect of our identification strategy is that the mergers decisions form part of the banks' general competitive strategy and are not the response of the specific situation of local markets. For this reason our analysis does not consider *Intra-County Mergers*.

Equation (1) also includes the variables *Bank Failures* and *De Novo Banks*, which reflect the impact of the general economic situation on the market structure. As we have seen, the crisis forced some entities out of the market and limited the creation of new entities. The closure of a bank should reduce the number of branches in the affected counties, unless this effect is offset by other entities.

We consider other control variables to reflect competition in local markets. First, *Lag HHI Deposits* is a Herfindahl index that measures the concentration of bank deposits at the county level. We expect a higher concentration of deposits to imply a smaller presence of bank branches. To account for the possible endogeneity of this variable, we include it in the model with a lag. Second, different types of banks might have different commercial policies. To reflect this situation, the model includes the variable *Saving & Loan*, which is the percentage of savings and loan institutions in the county. Savings and loan banks are locally oriented and place stronger emphasis on residential mortgages, whereas commercial banks tend to concentrate more on businesses and on unsecured credit services such as credit cards.

Other variables are used to capture the size and profitability of local markets. *Lag Total Deposits* represents the total deposits kept by local residents. The existence of a large number of deposits in the county should induce banks to create new branches to compete more effectively against rivals. The potential endogeneity of this variable is treated by including it with a lag. We also classify counties as *Metropolitan*, *Micropolitan* and *Non-core* to reflect

their size, with *Non-core* being the baseline case. This variable should also be related to the characteristics and preferences of the county's inhabitants (profession, education, number of investments, proximity to businesses, etc.).

Finally, a set of variables represents the socio-economic characteristics of the population living in each county. *Density Population* is the ratio between a county's population and its area. *Income* is the median income in the county. *Unemployment* represents the percentage of population in the county that is unemployed.

The estimation of the model in equation (1) may present problems of heteroscedasticity and temporal autocorrelation in the error term. In all regressions, the Wooldridge test for autocorrelation in panel data reveals that a problem of serial autocorrelation may exist. Furthermore, the Breusch-Pagan/Cook-Weisberg test shows that heteroscedasticity problems may also be present. To deal with this situation, we estimate the fixed effects model with Driscoll and Kraay standard errors, which assume that the error structure is heteroscedastic and autocorrelated up to two year lags.

All tables in the next section report the mean variance inflation factor (VIF) of the explanatory variables. Multicollinearity can exaggerate estimates of the variance parameter and distort its statistical significance, even, in the most extreme cases, resulting in parameter estimates of implausible magnitude. In this regard, all tables report a VIF value below 5, an accepted reference in the literature.¹⁵

Table 1 shows the descriptive statistics of the variables used in the empirical analysis. We observe that non-core counties have a much smaller number of branches, but a higher number of branches per inhabitant. More generally, non-core counties are poorer, less dense, with a greater proportion of older people, and a more concentrated market. These counties also have lower broadband penetration.

¹⁵ VIFs are widely used to examine the degree of multicollinearity between explanatory variables. Several rules of thumb for VIFs have been used as a sign of severe multicollinearity. The one typically considered in Econometrics textbooks is 10, although a commonly used value is 5.

5. Results

5.1. General results

This section examines the factors determining the presence of bank branches in the US counties, focusing on the effect of mergers in the pre-crisis and the post-crisis period. Table 2 presents the main results of our analysis for the whole period 2000–2014. Results in specification I show that mergers had a positive and significant impact on branch density. In particular, each merger led to a 0.3% increase in the counties' branch density. Specification II obtains similar results when we distinguish between inter-states mergers and intra-states/inter-county mergers, which increased branch density by 0.3% and 0.4%, respectively. These findings imply that if an average metropolitan county with 220.000 inhabitants and a branch density of 3,2 was exposed to 3 mergers, it will experience an increase in the number of branches from 70 to around 71. Notice that this is the net result of the mergers for the whole period and does not reflect the heterogeneous effects of the mergers across time and for different types of counties.

Table A2 in the Appendix examines the same regressions than in Table 2 but using the log of the total number of branches as dependent variable. We find similar results than before although now the variable of inter-sates mergers loses its statistical significance. Hence, during the period inter states mergers have a significant impact in terms of branch density but not in terms of the total number of branches.

Other interesting results in Table 2 are that the entry of new entities in the county had a positive effect on the number of branches, but that bank failures did not have a significant impact. The variable *Lag HHI Deposits*, showing a marked concentration at the county level, presents a negative and significant coefficient, implying that competition was a key determinant of the banks' commercial strategy. Moreover, those counties with a stronger presence of *Saving & Loan* entities had a larger number of branches per inhabitant. Finally, we also obtain that branch density is lower in denser counties. In denser counties, each branch may provide services to a higher number of inhabitants. However, controlling for the rest of explanatory variables, rural counties have a lower branch density than the other two types of counties.

Table 3 divides the sample in two periods to identify the existence of different patterns for branch deployment before and after the 2008 financial crisis. The first column shows a positive effect of both types of mergers on branch density before 2008: one inter-states mergers increased branch density by 0.9% and one intra-states/intra-county merger by 0.7%. These results confirm the hypothesis that the “expansion mergers” that took place before 2008 increased competition in local markets and favored branch deployment. The second column reveals that after the crisis both types of mergers had a negative and significant impact on branch density: one inter-states merger reduced branch density by 1% and one intra-states/intra-county merger by 0.4%. These findings support the idea that market consolidation and cost reduction were key objectives underpinning the mergers of this period.

It is also worth mentioning that the lower branch density of rural counties in relation to the other two types of counties is only statistically significant after the crisis. This implies that branch consolidation has been relatively more intense in rural counties. We also observe a negative relationship between branch density and income in the period before the crisis, which became positive after the crisis. Again, banks adjusted their commercialization strategy after the crisis, reducing their presence in poorer counties.

5.2. Heterogeneous geographic effects

We next explore in greater detail the relevance of our merger and competition variables when dividing the sample into metropolitan, micropolitan and non-core counties. Table 4 shows that for the period 2000–2014 the positive effect of mergers on branch density was confined mainly to metropolitan counties. For micropolitan and non-core counties, inter-state mergers had a negative effect, while intra-state/ inter county mergers only had a negative and significant effect on rural counties. Hence, while banks used expansion mergers as a mechanism to gain size and to compete more fiercely for consumers in metropolitan counties, in the other geographical areas mergers led to the closure of branches and to the consolidation of the entities.

Table A3 in the Appendix repeats the analysis reported in Table 4 but using the log of the total number of branches as dependent variable. In this case, the variable of inter-states mergers for metropolitan counties loses its statistical significance.

Similar insights than in the previous tables are found for the competition and socio-economic variables. Thus, in all counties, the presence of de novo banks and savings and loan entities increased branch density and density of population had a negative impact. On the other hand, while deposits concentration had a negative effect on branch density in metropolitan counties, it had a positive and significant impact in micropolitan and non-core counties. Intense competition in micropolitan and rural counties may harm the efficiency in the deployment of the commercial network of banks.

Finally, Table 5 considers the effects of mergers for the different county types before and after the crisis. Before 2008, inter-states mergers and intra-states/inter-counties mergers generated an increase of branch density of 1% in metropolitan counties, while they implied a reduction of branch density of 1% and 2%, respectively, on rural counties. Inter-states mergers had a negative impact on branch density in micropolitan counties, while intra states/inter-county mergers had a positive effect on them. After 2008, inter-states mergers reduced branch density in all counties, but especially in micropolitan and rural, where one merger implied a 3% reduction of branch density. By contrast, intra-states/inter-county mergers had not effect on branch density. These results confirm our claim that before 2008 mergers in metropolitan counties increased branch density, but clarify that this result cannot be generalized to inter-states mergers in micropolitan and rural counties, where mergers had a consolidation impact and reduced branch density.

5.3. Large banks

The previous sections have examined the heterogeneous impacts of mergers across periods and for different types of counties. Next, we seek to complement this analysis by considering whether large banks could have different motivations to participate in mergers and if these mergers had a differentiated effect on branch density. Following the FDIC, we define large

banks as those having more than 1 billion assets, and we repeat the previous analysis focusing in those mergers in which the acquiring entity was a large bank.

Table 6 summarizes our results, which in essence are similar that those obtained before. If anything, we obtain that before 2008 mergers with the participation of large banks had a stronger effect for branch density than the rest of mergers. After the financial crisis, mergers of large entities entailed a smaller consolidation effect than the rest of mergers. We also obtain that the positive effect of mergers on metropolitan counties and the negative effect for the rest of counties is more intense when large banks participate in the mergers.

5.4. Broadband expansion and brick-and-mortar branches

In the last years, the growth in the use of on-line banking has reduced the visits of customer to brick-and-mortar branches and might have contributed to branch closures. We incorporate this situation in our analysis by accounting for broadband deployment at the county level, which we consider as an essential determinant for the use of on-line banking.

For this extension of the model we use a dataset from the Center for Policy Informatics at Arizona State University. The analysis covers 328 counties, most of them metropolitan, for which information on broadband penetration is available for the whole period. The results of our analysis are presented in Table 7, where the variable *Broadband Penetration* represents the percentage of the population in the county with access to high speed Internet. Column I shows that broadband penetration is negatively related to branch density when we consider the whole period. Column II and III then shows the effect of broadband penetration before and after the financial crisis of 2008, showing that after the crisis the presence of a high broadband penetration is associated with a smaller branch density. In terms of elasticities, a 1% increase in broadband penetration lead to a 3% decrease in branch density. Both when we consider the entire sample and when we focus on the period after the crisis. This analysis also confirms the positive impact of inter-states merger on branch density before 2008. After this year, the effect of this type of mergers on branch density is negative and non-significant and the effect of intra-state/inter county mergers was positive and significant. Recall that in this regression we are

using a subsample of counties (most of them metropolitan counties), which can distort the identification of the effect of mergers variables.

Our results suggest that during the market consolidation period banks were more likely to close branches in counties with a larger use of broadband Internet. This situation has important policy implications for the sector. First, banks might be more likely to close branches in counties in which consumers have a better access to on-line banking, although this can reduce the quality of the financial advice they offer. Second, consumers' access to broadband services might differ importantly within each county, which implies that after a branch closure some consumers might lose their access to banking services. In this regard, Table A4 in the Appendix presents an auxiliary regression in which we show that in the US broadband penetration is lower in rural, poorer and less populated counties. This analysis considers all counties in 2014, the only year for which broadband data is available at a national level.

6. Bank branches and financial exclusion

One implication of branch closures is that consumers might have increasing difficulties to obtain personalized advice and access to essential financial services. This section explores this issue by examining the impact of branch closures on financial exclusion. We use the FDIC's NSUUH dataset to analyze whether the reduction in branch density after 2008 increased the percentage of *Unbanked* and *Underbanked* households at the county level. The NSUUH defines "unbanked" households as those in which none of the members have a checking or savings account and "underbanked" households as those that have a checking or savings account but which obtain financial products or services outside insured banking institutions. In 2011 the share of unbanked and underbanked households was 8.2 and 20.5%, respectively, while in 2015 the percentages fell to 7 and 18.1%.¹⁶

¹⁶ For Underbanked we use a restrictive definition considering households that carried out "money orders" or "cash checking" in the past 12 months using an institution other than a bank. These two specific questions have been included in the FDIC surveys since 2011. The NSUUH includes additional questions relevant to underbanked households, but they were included after 2011 and, so, are unsuitable for our study.

Our analysis uses as control variables the same county attributes we have considered in the previous sections: namely, the county's median income, unemployment, population density, and a dummy variable for metropolitan counties. In addition, we consider the county' total population and two demographic variables representing about the population living in each county: *Population over 60* represents the percentage of population aged over 60 and *Minorites* is the percentage of minority ethnic groups in the county, accounting for the possibility that minority groups are excluded from financial services.¹⁷ Furthermore, we consider the share of community banks in the county to examine whether this type of banks may help in mitigating financial exclusion.

We first consider the impact of the number of county bank branches on the share of *Unbanked* households. Column I in Table 8 shows that the share of unbanked households in a county is negatively associated with the number of bank branches. This implies that those counties affected by a reduction in the number of branches since 2008 have been affected by an increase in the number of unbanked households.

One potential problem of this analysis is that the share of unbanked households and the number of bank branches could be simultaneously determined. Indeed, it could be argued that the share of unbanked households in a county affects the number of bank branches and that unobserved shocks may be correlated with the share of unbanked households and the number of branches. To address this issue of endogeneity, we implement an instrumental variables (IV) procedure in which we use the merger variables from the previous regressions as instruments of the bank branches variable. The results of the first stage regression (not reported here for the sake of simplicity) confirm that *Inter-State Merger* is a strong instrument as it is statistically significant at the 1% level with the expected negative sign. Column II in Table 8 presents the results of the IV estimation, which confirm the negative relationship between the share of unbanked households and the total number of bank branches. These results offer additional evidence that the fall in the number of branches may lead to financial exclusion. Note also that the

¹⁷ As in the previous regressions, the Wooldridge test for autocorrelation and the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity show that both problems need correcting. Hence, we estimate the fixed effects model with Driscoll and Kraay standard errors. Furthermore, the VIF suggests that multicollinearity is not a concern in our context.

consideration of the number of bank branches as exogenous leads to an underestimation of the impact of this variable on the share of unbanked households.

As expected, we also find that the share of unbanked households is lower in richer counties. Furthermore, the share of unbanked households may be higher in larger and less compact counties, although the effect of *Total Population* and *Density of Population* is diluted in the IV regression. Surprisingly, we find a negative effect of the variable that captures the percentage of people from minority ethnic groups, although its significance disappears in the IV regression.

Finally, Column III in Table 8 shows that the percentage of *Underbanked* households in a county is negatively associated with the number of bank branches. As before, this suggests that the counties most affected by the reduction in number of branches after 2008 have seen the number of underbanked households rise, meaning that the latter have to rely more on non-bank institutions to contract such services as “money orders” or “cash checking”.¹⁸ As expected, we also find that the percentage of underbanked households is higher in poorer counties and in counties with a higher proportion of vulnerable population. This percentage is also higher in denser and more populated counties. Finally, the percentage of underbanked households is lower in those counties where the share of community banks is higher. This is not surprising as community banks are characterized as having a closer relationship with costumers.

7. Conclusions

Our empirical analysis has shown that inter-state and intra-state/inter county bank mergers contributed to the increase in branch density before 2008. However, the impact of mergers was positive in metropolitan counties, mixed in micropolitan counties and negative in rural

¹⁸ Note that the bank branches variable should not be so greatly affected by the type of endogeneity problems we have discussed for unbanked households, as all underbanked households have a bank account. In spite of this, it remains possible that the presence of customers of this type reduces the profitability of the bank branches. Taking this into account, we also applied the IV regression in this case, but the merger variables are not strong instruments in this case making the estimation more imprecise.

counties. After 2008, expansion mergers were substituted by consolidation mergers, which had a negative effect on branch density in all types of counties.

After the passing of the *Riegle-Neal Act* in 1994, the strategy of the incumbent banks to deploy new branches following mergers, in combination with the creation of new banking entities, contributed to a proliferation of bank branches. This trend took place against a backdrop of population growth and high demand for financial services. However, the Great Recession of 2008 was to reverse this pattern of the creation of new branches by the multi-state banks. Indeed, inter-state mergers led to fewer branches and made it more difficult for the banks' most vulnerable customers to access financial services. The banks' efficiency targets changed after the crisis, spurred, in all probability, by the desire to divert more customers to their online services.

Our analysis has also found that weak competition in local markets is a driver of the reduction in size of the banks' branch networks. This is consistent across the whole period examined, including both pre- and post-crisis periods. Bank entities in more concentrated markets may be better able to exert their market power and force customers either to travel longer distances to visit their brick-and-mortar office or to divert customers to their on-line channels (Allen et al., 2008). Others, however, may become unbanked and be left without access to financial services.

The disappearance of bank branches in *rural areas* has been accrued by the effect of mergers during all the period examined. This situation is not always offset by on-line banking, due to low rates of broadband penetration in these areas and the lack of digital skill for a part of the population. As a result, a part of the consumers are at risk of being marginalised from financial services. In addition, the loss of soft information may well have been detrimental for customers and have resulted in increased rates of consumer bankruptcy (Allen et al., 2016).

The main policy implications to be derived from our study are that public policies promoting bank competition and on line banking need to take into account the impact of these policies on financial inclusion. There is a large literature showing that the intensification of competition promotes access to banking services for low-income households; yet, in spite of this, market consolidation can create 'banking deserts' that negatively affect the access of the more

vulnerable population to financial services. Our analysis, conducted for a sub-set of metropolitan counties, has shown that the share of unbanked and underbanked households is negatively related to the number of bank branches per inhabitant. Improving Internet access in less-dense areas and offering financial advice to vulnerable households may be a necessary policy to mitigate the progressive reduction of bank branches.

References

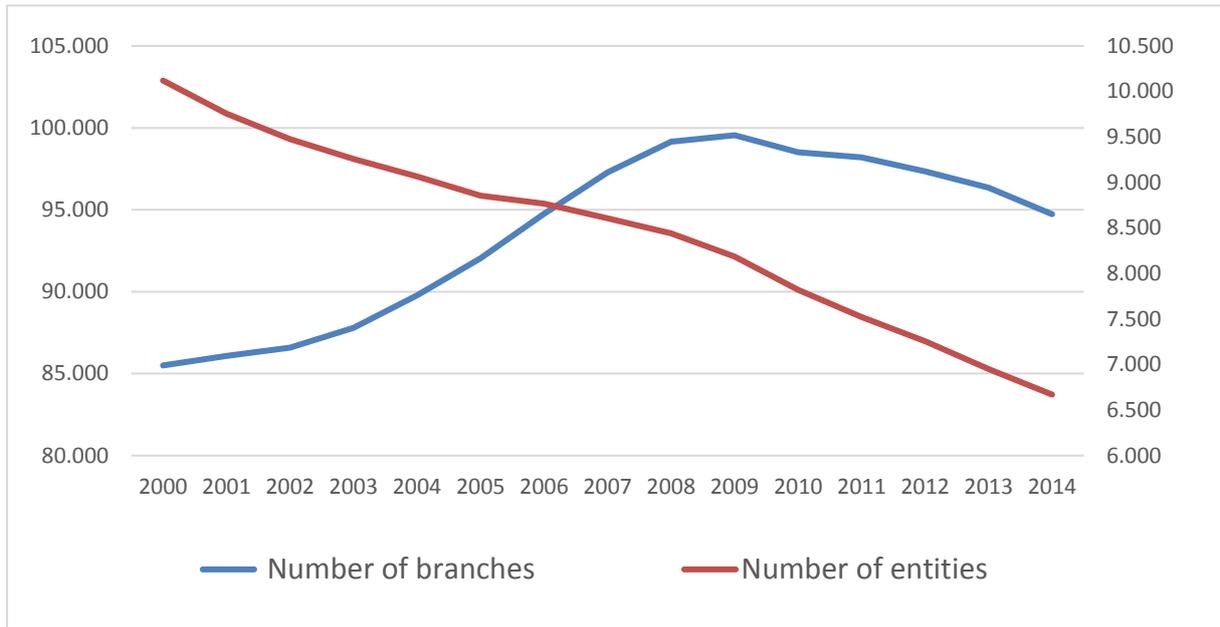
- Adams, R. M., and J. P. Gramlich (2014), “Where Are All the New Banks? The Role of Regulatory Burden in New Charter Creation,” Federal Reserve Board Finance and Economics Discussion Series No. 2014-113.
- Adams, Robert and Dean Amel. 2007. “The effects of past entry, market consolidation, and expansion by incumbents on the probability of entry”, Federal Reserve Board Working Paper Series.
- Agarwal, S. and R. Hauswald (2010). “Distance and private information in lending, Review of Financial Studies, 23, 2757-2788.
- Aguirregabiria, V., R. Clark and H. Wang (2016). “The Geographic Flow of Bank Funding: Branch Networks and Local-Market Competition”. Mimeo.
- Allen, J., R. Clark, and J. F. Houde (2008). “Market structure and the diffusion of e-commerce: Evidence from the retail banking industry”, Bank of Canada Working Paper No. 2008-32.
- Allen, F., Carletti, E., Cull, R., Qian, J., Senbet, L., and Valenzuela, P. (2014). “Improving access to banking—evidence from Kenya”. CEPR Discussion Paper No. DP9840. Center for Economic Policy Research, London.
- Allen, F., Demirgüç-Kunt, A., Klapper, L., and Martínez Peria, M. S. (2012). “The foundations of financial inclusion: Understanding ownership and use of formal accounts”, World Bank Policy Research Working Paper No. 6290.
- Allen, J., H. Evren Damar and D. Martínez-Miera (2016). “Consumer Bankruptcy, Bank Mergers and Information”, Review of Finance, 20, 1289-1320
- Amel, Dean F., and J. Nellie Liang (1997). “Determinants of Entry and Profits in Local Banking Markets”, Review of Industrial Organization, 12 (1), 59-78.
- Beck, T., Demirguc-Kunt, A. and Martínez Pería, M.S. (2007). “Reaching out: Access to and use of banking services”, Journal of Financial Economics, 85, 234-266.
- Berger, Allen N., Geraldo Cerqueiro, and María Fabiana Penas (2014). “Market Size Structure and Small Business Lending: Are Crisis Times Different from Normal Times?” Review of Finance, 1-39.
- Berger, A., N. Miller, M. Petersen, R. Rajan, and J. Stein, (2005). “Does function follow organizational form? Evidence from the lending practices of large and small banks”. Journal of Financial Economics, 76, 237-269.

- Berger A.N. and G.F. Udell (1995). "Relationship lending and lines of credit in small firm finance", *Journal of Business*, 68, 351-382.
- Berger, A. N. and G.F. Udell (2002). "Small business credit availability and relationship lending: The importance of bank organizational structure", *Economic Journal*, 112, F32 – F53.
- Berlin, M. and L. Mester (1998) . "On the profitability and cost of relationship lending", *Journal of Banking and Finance* 22, 873-897.
- Brown, M., B. Guin, and K. Kirschenmann (2016). "Microfinance Banks and Financial Inclusion", *Review of Finance*, 907-946.
- Bruhn, M. and Love, I. (2014). "The real impact of improved access to finance: Evidence from Mexico", *Journal of Finance*, 69, 1347–1376.
- Calomiris, C. (2000). "US Bank Deregulation In Historical Perspective". Cambridge, UK. Cambridge University Press.
- Carbo, S, E P.M., Gardener and P. Molyneux (2007). "Financial Exclusion in Europe". *Public Money & Management*, 27:1, 21-27.
- Celerier, C. and A. Matray (2018). "Bank-Branch Supply, Financial Inclusion and Wealth Accumulation", *Review of Financial Studies*, forthcoming
- Cole, R.A. (1998). "The importance of relationships to the availability of credit", *Journal of Banking and Finance*, 22, 959-977.
- Cole, R.A. (2004). "Cookie-cutter vs. character: the microstructure of small business lending by large and small banks". *Journal of Financial and Quantitative Analysis*, 39.
- Degryse, H. and Ongena, S. (2005). "Distance, Lending Relationships, and Competition", *Journal of Finance*, 60: 231-266.
- Dick, A. (2007). "Market Size, service quality, and competition in banking", *Journal of Money, Credit and Banking*, 39 (1), 49-81.
- Cohen AM, Mazzeo MJ (2007). "Market structure and competition among retail depository institutions". *Review of Economics and Statistics*, 89(1), 60-74.
- Cohen AM, Mazzeo MJ (2010). "Investment strategies and market structure: an empirical analysis of bank branching decisions". *Journal of Finance Services Research*, 38:1-21.
- Copeland, T., Koller, T. and Murrin, J. (1995). "Valuation: Measuring and Managing the Value of Companies", John Wiley & Sons, for McKinsey & Company.

- DeYoung, R., D. Evanoff, and P. Moynaux (2009). “Mergers and acquisitions of financial institutions: A review of the post-2000 literature”, *Journal of Financial Services Research*, 36, 87–110.
- Elfakhani, S., R.F. Ghantous and I. Baalbaki (2003). “Mega-mergers in the US banking industry”, *Applied Financial Economics*, 13, 609-622.
- Ergungor, O. E. (2010). “Bank Branch Presence and Access to Credit in Low- to Moderate-Income Neighborhoods”. *Journal of Money, Credit and Banking*, 42: 1321-1349.
- FDIC (2012). “DFIC Community Banking Study”. Federal Deposit Insurance Corporation.
- FDIC (2015). “Brick-and-Mortar Banking Remains Prevalent in an Increasingly Virtual World”, Federal Deposit Insurance Corporation.
- FDIC (2018), “2017 FDIC National Survey of Unbanked and Underbanked Households”, Federal Deposit Insurance Corporation. Division of Depositor and Consumer Protection ECONOMICINCLUSION.GOV.
- FDIC QUARTERLY (2017). “Factor Shaping recent trends in banking office structure for community and noncommunity banks”, Federal Deposit Insurance Corporation.
- Focarelli, D. and F. Panetta (2003). “Are mergers beneficial to consumers? Evidence from the market for bank deposits”, *American Economic Review*, 93, 1152–1172.
- Jagtiani, Julapa, Ian Kotliar, and Raman Maingi (2016). “Community Banking Mergers and Their Impact on Small Business Lending,” *Journal of Financial Services Research*, 27, 106–121.
- Jagtiani, J and R.Q. Maingi (2019). “How Important Are Local Community Banks to Small Business Lending? Evidence from Mergers and Acquisitions”. Federal Reserve Bank of Philadelphia, Working Paper, WP 18-18.
- Karceski, J., S. Ongena, and D. Smith (2005). “The impact of bank consolidation on commercial borrower welfare”, *Journal of Finance*, 60, 2043–2082.
- Kowalik, Michal (2014). “Can Small Banks Survive Competition from Large Banks?” Federal Reserve Bank of Boston, Work in progress.
- Love, I. and Martínez Pería M.S. (2012). “How bank competition affects firms’ access to finance”. World Bank Policy Research Working Paper 6163.
- Martin-Oliver, A. (2019). “Financial exclusion and branch closures in Spain after the Great Recession”, *Regional Studies*, 53 (4), 562-573 .

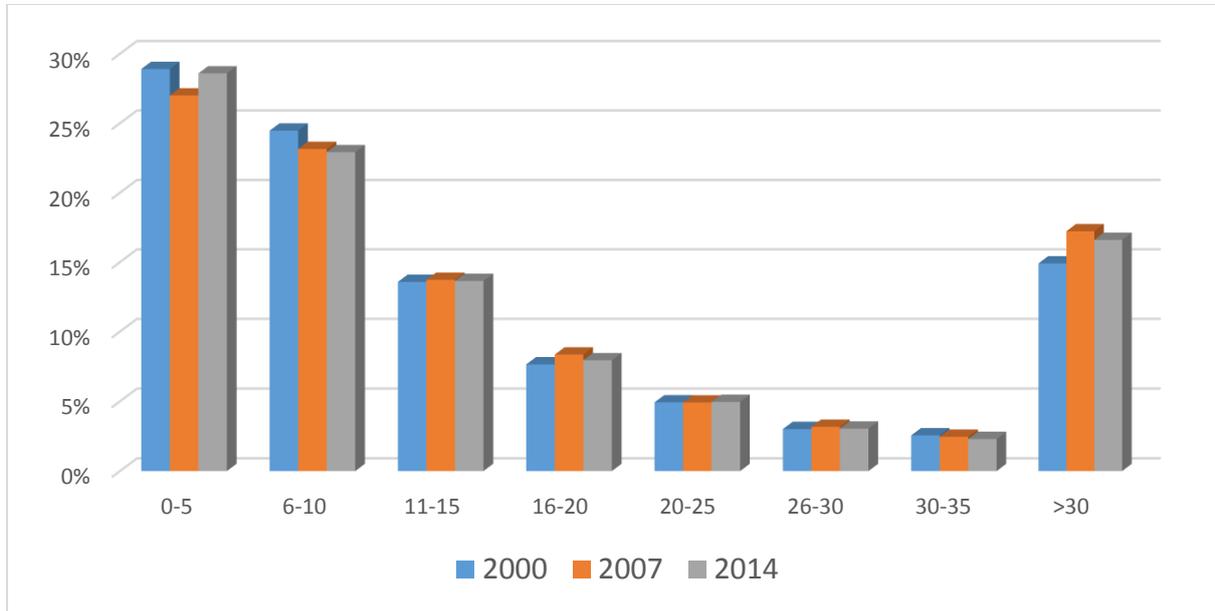
- McCord, R., E.S. Prescott, and T. Sablik (2015). “Explaining the Decline in the Number of Banks since the Great Recession”, Economic Brief, Federal Reserve Bank OF Richmond, EB15-03.
- Maudos, J. and X. Vives (2019). “Competition Policy in Banking in the European Union”, *Review of Industrial Organization*, 55:27-46.
- Nguyen, H.L.Q. (2014). “Do Bank Branches Still Matter? The Effect of Closings on Local Economic Outcomes”. Cambridge: Department of Economics, MIT.
- Nguyen, H.L.Q. (2019). “Are Credit Markets Still Local? Evidence from Bank Branch Closings”. *American Economic Journal: Applied Economics* 2019, 11(1): 1–32.
- Panetta, F., F. Schivardi, and M. Shum (2009). “Do mergers improve information? Evidence from the loan market”. *Journal of Money, Credit and Banking* 41 (4), 673–709.
- Petersen, M.A. and R.G. Rajan (1995). “The effect of credit market competition on lending relationships”. *Quarterly Journal of Economics*, 110, 407-443.
- Petersen, M.A. and R.G. Rajan (2002). “Does distance still matter? The Information Revolution in Small Business Lending”, *Journal of Finance*, 57 (6), 2533-2570.
- Sapienza, P. (2002). “The effects of banking mergers on loan contracts”. *The Journal of Finance*, 57, 329–367.
- Sinclair, S.P. (2001). “Financial Exclusion: An Introductory Survey”, Heriot Watt University, Edinburgh.
- Stein, J. (2002). “Information production and capital allocation: Decentralized versus hierarchical firms”. *Journal of Finance* 1891-1921.
- Tolbert, C. and K. Mossberger (2018). “U.S. Current Population Survey & American Community Survey Geographic Estimates of Internet Use, 1997-2016.”
- Tranfaglia, A. (2018). “Shrinking Networks: A Spatial Analysis of Bank Branch Closure. Federal Reserve Bank of Philadelphia”, WP 18-12.
- Vives, X. (2016). “Competition and Stability in Banking: The Role of Regulation and Competition Policy”, Princeton University Press.
- Vives, X. (2019). “Competition and stability in modern banking: A post-crisis perspective”, *International Journal of Industrial Organization*, 64, 55-69.
- White, L. (2015). “Antitrust and financial regulation in the wake of Philadelphia national bank: Complements, no substitutes”, *Antitrust Law Journal*, 80 (2), 413-430.

Figure 1. Bank entities and branches, 2000-2014



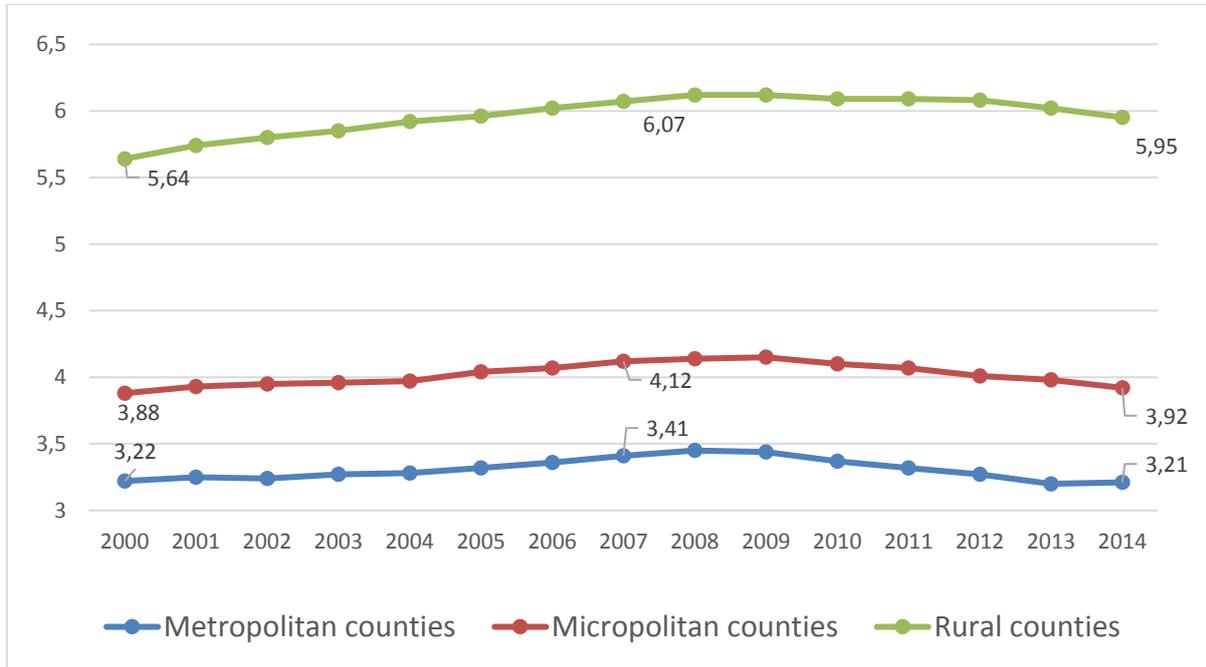
Source: Federal Deposits Insurance Corporation (FDIC)

Figure 2. Percentage of counties by number of branches



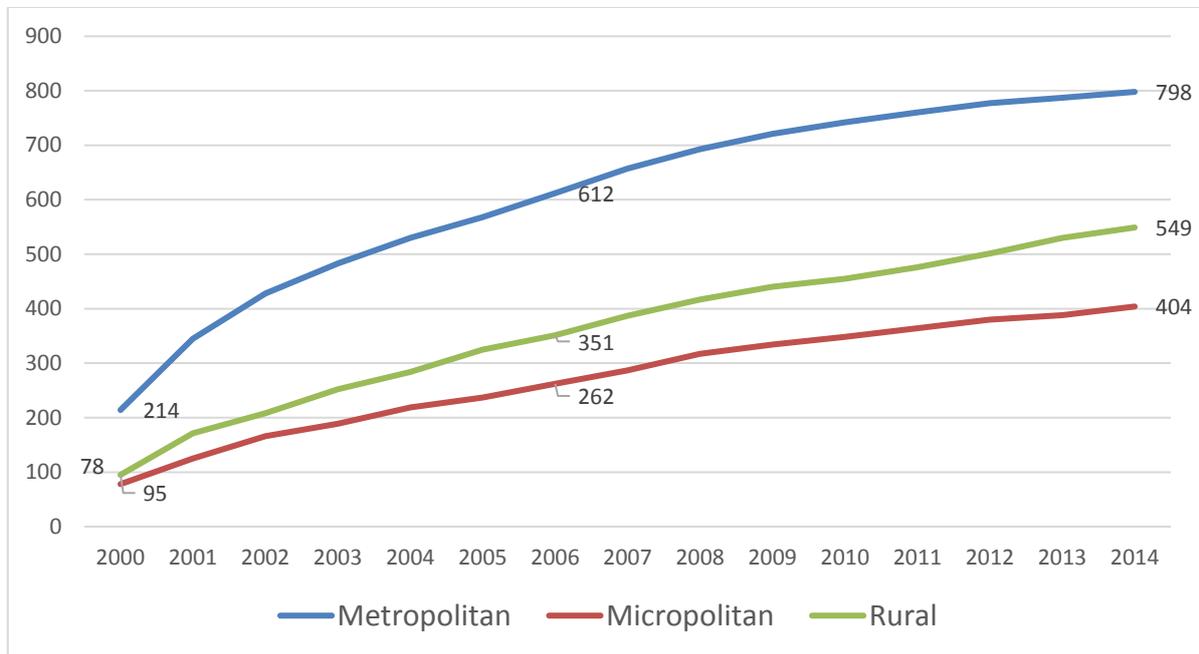
Source: Federal Deposits Insurance Corporation (FDIC)

Figure 3. Number of branches per 10,000 inhabitants, by type of county



Source: Federal Deposits Insurance Corporation (FDIC) and US Census Bureau

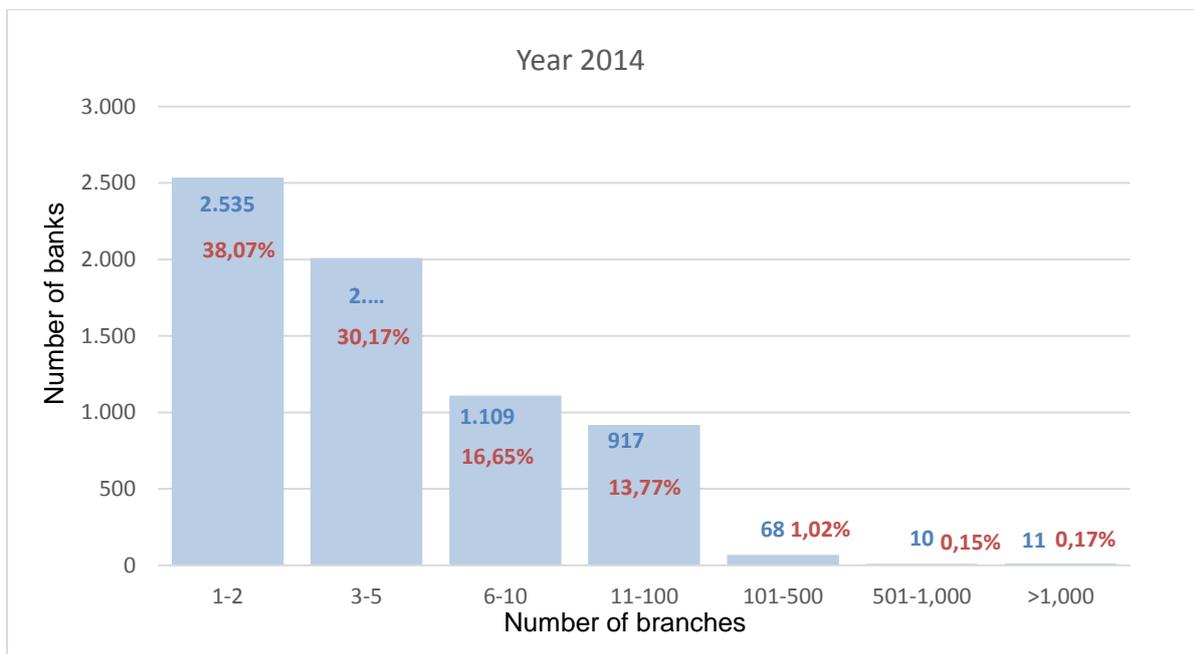
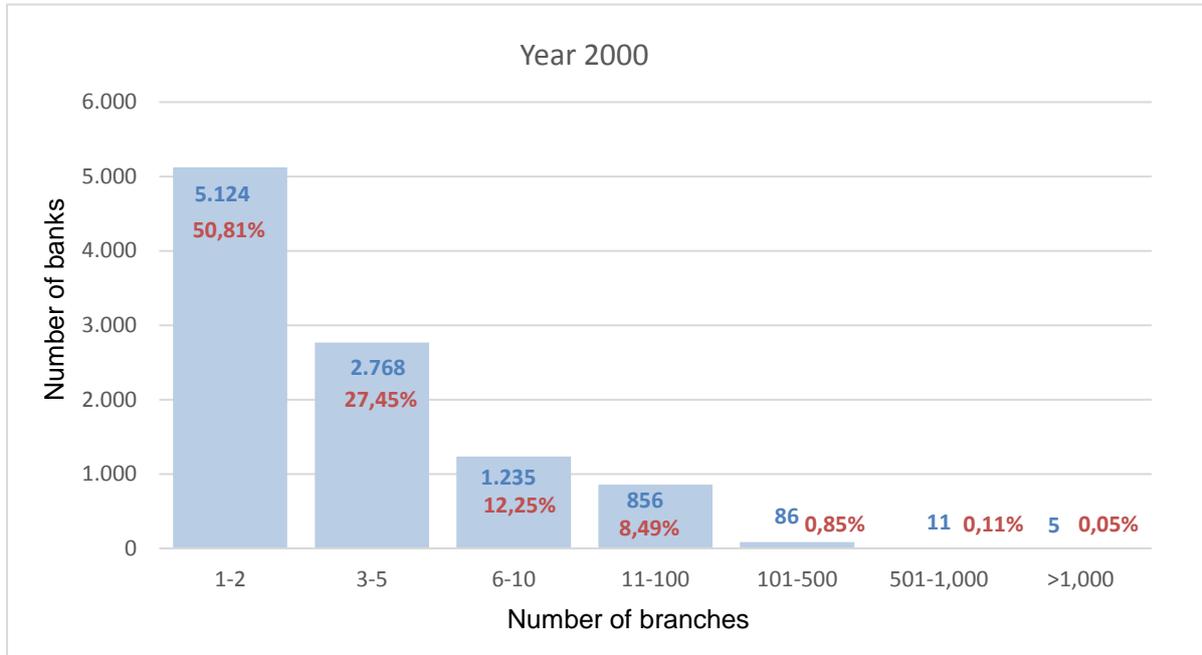
Figure 4. Accumulated number of counties affected by mergers



Source: Federal Deposits Insurance Corporation (FDIC) and US Census Bureau

Note: At 2014, the number of total counties in our sample is as follows: 1217 metropolitan counties, 646 micropolitan counties, 1311 rural counties

Figure 5: Distribution of the number of branches by bank entity



Source: Federal Deposits Insurance Corporation (FDIC)

Table 1. Descriptive statistics: types of counties. Period 2000-2014

Variables	All counties	Metropolitan counties	Micropolitan counties	Rural counties
Number of Branches	28.65 (72.62)	60.39 (111.36)	15.45 (10.15)	6.91 (5.53)
Number Branches per Inhabitant	0.0004 (0.0003)	0.0003 (0.0001)	0.0004 (0.0002)	0.0005 (0.0003)
Population (inhabitants)	97306.99 (310709.4)	220706.1 (483045.1)	42426.2 (28542.87)	14550.79 (12013.68)
Income (US dollars)	41206.72 (11116.31)	47327.81 (12417.55)	39551.19 (8731.73)	36573.66 (7968.50)
Unemployment rate	6.43 (2.78)	6.23 (2.51)	6.67 (2.77)	6.49 (2.98)
Density of Population (inhabitants per square mile)	206.98 (1216.04)	486.99 (1954.93)	66.41 (88.25)	27.16 (88.71)
Population over 60 Years	0.21 (0.05)	0.19 (0.05)	0.20 (0.04)	0.24 (0.05)
Minority Ethnic Groups	0.13 (0.16)	0.16 (0.14)	0.12 (0.15)	0.12 (0.17)
HHI Deposits	0.31 (0.20)	0.26 (0.19)	0.27 (0.17)	0.41 (0.22)
Deposits (US dollars)	2133637 (1.36+e07)	5125850 (2.19e+07)	600567.3 (578371.2)	228579.9 (384574.4)
Number of Mergers	0.121 (0.50)	0.231 (0.75)	0.079 (0.29)	0.043 (0.21)
Inter State Mergers	0.035 (0.22)	0.075 (0.33)	0.017 (0.13)	0.008 (0.09)
Intra State & Inter County mergers	0.063 (0.28)	0.106 (0.37)	0.05 (0.23)	0.031 (0.18)
New Entities	0.008 (0.10)	0.01 (0.15)	0.003 (0.05)	0.001 (0.04)
Saving & Loan Entities	0.09 (0.13)	0.11 (0.14)	0.10 (0.13)	0.06 (0.12)
Share Community banks	0.18 (0.23)	0.12 (0.16)	0.14 (0.18)	0.24 (0.28)
Broadband Penetration	54.50 (26.78)	73.66 (16.38)	58.28 (12.84)	52.82 (9.70)
Observations	46321	18308	9666	19682

Note: Mean values in 2000-2014, except the variable of broadband penetration that is for 2014. Standard errors in parenthesis

Table 2. Estimation results: baseline regression

Explanatory variables	Dependent variable: Log Branch Density	
	I	II
Mergers	0.003 (0.001)**	-
Inter States Mergers	-	0.003 (0.002)*
Intra State & Inter County Mergers	-	0.004 (0.002)*
New Entities	0.02 (0.003)***	0.02 (0.003)***
Bank Failures	1.45e-06 (9.83e-06)	2.29e-06 (8.45e-06)
Lag HHI Deposits	-0.64 (0.04)***	-0.64 (0.04)***
Saving & Loan Entities	0.0005 (0.0001)***	0.0006 (0.0001)***
Lag Total Deposits	0.15 (0.01)***	0.15 (0.001)***
D Metropolitan Counties	0.03 (0.01)**	0.03 (0.01)***
D Micropolitan Counties	0.04 (0.01)***	0.04 (0.01)***
Density of Population	-0.00009 (0.00002)***	-0.00009 (0.00002)***
Income	-4.84e-07 (5.74e-07)	-4.86e-07 (5.74e-07)
Unemployment rate	-0.002 (0.001)	-0.002 (0.01)
R ² (within)	0.14	0.14
F-test (Ho: Null joint significance)	3.04e+14***	6.71e+07***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)	41.05***	37.83***
Wooldridge test (Ho: no first-order autocorrelation)	1262.07***	1262.02***
Mean VIF	1.89	1.88
Number observations	43181	43181

Notes: All regressions include county and year fixed effects Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Table. 3 Estimation results: Regressions before and after the financial crisis

Explanatory variables	Dependent variable: Log Branch Density		
	Sample	2000-2007	2008-2014
Inter States Mergers		0.009 (0.001)***	-0.01 (0.001)***
Intra State & Inter County mergers		0.007 (0.001)***	-0.004 (0.001)***
New Entities		0.01 (0.001)***	0.004 (0.001)***
Bank Failures		-0.00004 (0.00001)***	-5.30e-06 (4.25e-06)
Lag HHI Deposits		-0.47 (0.07)***	-0.56 (0.05)***
Saving & Loan Entities		0.0005 (0.0001)***	0.0008 (0.0001)***
Lag Total Deposits		0.11 (0.01)***	0.17 (0.01)***
D Metropolitan Counties		0.05 (0.03)	0.05 (0.01)***
D Micropolitan Counties		0.03 (0.02)	0.06 (0.01)***
Density of Population		-0.0003 (0.00007)***	-0.0002 (0.00001)***
Income		-2.54e-06 (9,11e-07)***	2.81e-07 (1.56e-07)*
Unemployment rate		-0.0002 (0.0005)	0.0008 (0.0007)
R ² (within)		0.11	0.18
F-test (Ho: Null joint significance)		750999.28***	147.53***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)		33.00***	11.64***
Wooldridge test (Ho: no first-order autocorrelation)		516.76***	2364.84***
Mean VIF		1.72	1.76
Number of observations		21585	21596

Notes: All regressions include all control factors, country and year fixed effects. Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Table 4. Estimation results: different types of counties

Explanatory variables Sample	Dependent variable: Log Branch Density		
	Metropolitan counties	Micropolitan counties	Rural counties
Inter States Mergers	0.003 (0.001)**	-0.02 (0.005)***	-0.02 (0.003)***
Intra State/Inter County Mergers	0.007 (0.002)***	0.0006 (0.002)	-0.004 (0.001)**
New Entities	0.01 (0.001)***	0.03 (0.007)***	0.04 (0.01)***
Bank Failures	7.64e-07 (7.57e-06)	0.0003 (0.0003)	0.0004 (0.0007)
Lag HHI Deposits	-0.63 (0.06)***	0.14 (0.01)***	0.07 (0.009)***
Saving & Loan Entities	0.0004 (0.0002)**	0.0004 (0.0001)***	0.0005 (0.0002)***
Lag Total Deposits	0.22 (0.02)***	0.14 (0.01)***	0.07 (0.009)***
Density of Population	-0.00005 (0.00002)**	-0.006 (0.0005)***	-0.005 (0.001)***
Income	-5.70e-08 (4.83e-07)	-8.08e-07 (5.45e-07)	-8.44e-07 (4.83e-07)
Unemployment rate	-0.0009 (0.002)	-0.002 (0.001)	-0.002 (0.001)**
R ² (within)	0.20	0.19	0.15
F-test (Ho: Null joint significance)	1877677.88***	2677969.66***	2.07e+07***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)	610.76***	14.89***	5.21**
Wooldridge test (Ho: no first- order autocorrelation)	453.03***	1014.55***	458.22***
Mean VIF	1.90	1.80	1.77
Number of observations	16119	8942	18120

Notes: All regressions include county and year fixed effects. Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Table 5. Estimation results: subsamples before and after the crisis & type of counties

Explanatory variables	Dependent variable: Log Branch Density						
	Sample	Metropolitan counties		Micropolitan counties		Rural counties	
	Sub-Sample	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
Inter States Mergers	0.01 (0.001)***	-0.004 (0.001)***	-0.006 (0.003)*	-0.03 (0.006)***	-0.02 (0.003)***	-0.03 (0.006)***	
Intra State & Inter County Mergers	0.01 (0.001)***	-0.001 (0.002)	0.005 (0.001)***	-0.001 (0.001)	-0.01 (0.001)***	-0.00005 (0.003)	
R ² (within)	0.15	0.26	0.17	0.32	0.13	0.10	
Number observations	8050	8069	4470	4472	9065	9055	

Note: All regressions include all control factors, county and year fixed effects. Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Table 6. Estimation results: mergers of big banks

Explanatory variables	Dependent variable: Log Branch Density						
	All	All	2000-2007	2008-2014	Metropolitan counties	Micropolitan counties	Rural counties
Mergers	0.004 (0.001)**	-	-	-	-	-	-
Mergers -Inter States	-	0.006 (0.002)**	0.012 (0.001)***	-0.009 (0.001)***	0.007 (0.001)***	-0.016 (0.004)***	-0.06 (0.006)***
Mergers - Intra State & Inter County	-	0.004 (0.003)	0.013 (0.002)***	-0.006 (0.003)*	0.007 (0.02)***	-0.001 (0.002)	-0.009 (0.004)**
R ² (within)	0.14	0.14	0.11	0.17	0.20	0.19	0.15
Number observations	43181	43181	21585	21596	16121	8947	18113

Note: All regressions include county and year fixed effects Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Table 7. Estimation results: broadband penetration

Explanatory variables	Dependent variable: Log Branch Density			
	Sample	All	2000-2007	2008-2014
Inter States Mergers		0.003 (0.0008)***	0.01 (0.001)***	-0.0005 (0.0009)
Intra State & Inter County Mergers		0.005 (0.001)***	0.001 (0.001)	0.004 (0.008)***
New Entities		0.003 (0.001)**	0.004 (0.001)***	-0.003 (0.004)
Bank Failures		-0.002 (0.007)	0.004 (0.007)	-0.01 (0.005)***
Lag HHI Deposits		-1.12 (0.17)***	-0.39 (0.09)***	-1.03 (0.20)***
Saving & Loan Entities		-0.0001 (0.0006)	0.0003 (0.0003)	0.003 (0.0004)***
Lag Deposits		0.28 (9.004)***	0.14 (0.03)***	0.29 (0.06)***
Density of Population		-8.86e-06 (0.00002)	-0.0003 (0.0001)**	-0.00007 (0.00002)***
Income		3.27e-07 (4.58e-07)	-3.41e-07 (1.19e-06)	1.01e-07 (3.06e-07)
Unemployment rate		0.003 (0.003)	0.002 (0.003)	0.002 (0.003)
Broadband Penetration		-0.06 (0.03)*	-0.09 (0.07)	-0.05 (0.01)***
R ²		0.33	0.27	0.41
F-test (Ho: Null joint significance)		12107.20***	16596.90***	11063.01***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)		617.27 ***	33.26***	615.82***
Wooldridge test (Ho: no first-order autocorrelation)		595.63***	71.76 ***	2493.68***
Mean VIF		2.79	2.42	1.90
Number of observations		3682	1529	2164

Note: All regressions include county and year fixed effects. Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*). Regressions in columns 1-4 are for 330 counties, while regression in column 5 is for all counties.

Table 8. Estimation results: unbanked and underbanked share regressions

Explanatory variables	Dependent variable: Share of Unbanked		Dependent variable: Share of Underbanked
	(I)	(II)	(III)
Number of Branches	-0.017 (0.004)***	-0.14 (0.06)**	-0.06 (0.01)***
D Metropolitan Counties	0.45 (0.29)	0.15 (1.09)	4.82 (1.78)***
Total Population	6.72e-06 (7.80e-07)***	4.44e-06 (8.36e-06)	0.00001 (6.60e-06)
Density of Population	-0.002 (0.0005)***	-0.002 (0.002)	0.01 (0.0004)***
Income	-0.00006 (1.71e-06)***	-0.00007 (0.00002)***	-0.000017 (6.10e-06)***
Unemployment rate	0.19 (0.09)**	0.20 (0.19)	0.17 (0.13)
Population over 60 years	-0.02 (0.15)	0.05 (0.68)	2.53 (0.18)***
Minority Ethnic Groups	-39.28 (8.33)***	-62.34 (59.03)	21.48 (18.00)
Share Community banks	-1.70 (3.71)	-0.23 (7.18)	-9.63 (4.03)***
R ² (within)	0.02	-	0.05
F-test	11.19***	2.04**	44.77***
(Ho: Null joint significance) Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)		131.51***	8.85***
Wooldridge test (Ho: no first-order autocorrelation)		828.117***	361.56***
Mean VIF		3.12	3.03
Underidentification test of all instruments(Kleibergen-Paap rk LM statistic)	-	6.81**	-
Hansen J statistic (overidentification test of all instruments)	-	0.29	-
Number observations	1093	1093	899

Notes: All regressions include county and year fixed effects. Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*). We use the variables Mergers Inter State and Mergers Intra-State & Inter-county as instruments for number of bank branches in the instrumental variables regression in specification (II). In the (unreported) instrumental variables regressions with the share of underbanked population as dependent variable, not a single explanatory variable is statistically significant.

Appendix

Table A1: Evolution of bank branches and population, 2000-2014

Year	Population	Variation Population (%)	Branches	Variation Branches (%)	Population/Branches	Variation Population/Branches (%)
2000	281,703,392	-	83,510	-	3,373	-
2001	284,498,464	0.99%	84,250	0.89%	3,377	0.11%
2002	287,153,664	0.93%	85,040	0.94%	3,377	0.00%
2003	289,633,696	0.86%	86,507	1.73%	3,348	-0.85%
2004	292,366,944	0.94%	88,874	2.74%	3,290	-1.74%
2005	295,104,224	0.94%	91,165	2.58%	3,237	-1.60%
2006	297,961,856	0.97%	93,907	3.01%	3,173	-1.98%
2007	300,810,432	0.96%	96,392	2.65%	3,121	-1.65%
2008	303,670,816	0.95%	98,241	1.92%	3,091	-0.95%
2009	306,347,424	0.88%	98,571	0.34%	3,108	0.54%
2010	308,877,408	0.83%	97,518	-1.07%	3,167	1.91%
2011	311,259,104	0.77%	97,143	-0.38%	3,204	1.16%
2012	313,640,096	0.76%	96,254	-0.92%	3,258	1.70%
2013	315,961,984	0.74%	95,254	-1.04%	3,317	1.80%
2014	317,879,264	0.61%	93,656	-1.68%	3,394	2.32%

Source: FDIC and US Census Bureau

Table A2. Estimation results: baseline regression

Explanatory variables	Dependent variable: Log Number of Branches	
	I	II
Mergers	0.001 (0.006)**	-
Inter States Mergers	-	-0.001 (0.001)
Intra State & Inter County Mergers	-	0.005 (0.002)***
New Entities	0.02 (0.003)***	0.02 (0.003)***
Bank Failures	0.00001 (8.17e-06)	0.00001 (7.30e-06)
Lag HHI Deposits	-0.75 (0.03)***	-0.75 (0.03)***
Saving & Loan Entities	0.0001 (0.0001)	0.0001 (0.0001)
Lag Total Deposits	0.23 (0.01)***	0.23 (0.001)***
D Metropolitan Counties	0.03 (0.01)**	0.03 (0.01)***
D Micropolitan Counties	0.04 (0.01)***	0.04 (0.01)***
Population	5.82-e07 (7.61e-08)***	5.90-e07 (7.62e-08)***
Density of Population	0.0001 (0.00003)***	-0.00009 (0.00002)***
Income	7.26e-08 (2.43e-07)	8.05e-08 (2.45e-07)
Unemployment rate	0.0005 (0.0009)	0.0005 (0.0009)
R ² (within)	0.28	0.28
F-test (Ho: Null joint significance)	9067439.07***	2.41e+07***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)	1336.52***	1309.11***
Wooldridge test (Ho: no first-order autocorrelation)	1046.15***	1046.28***
Mean VIF	2.01	1.97
Number observations	43181	43181

Notes: All regressions include county and year fixed effects Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Table A3. Estimation results (types of counties)

Explanatory variables Sample	Dependent variable: Log Number of Branches		
	Metropolitan counties	Micropolitan counties	Rural counties
Inter States Mergers	0.0002 (0.0008)	-0.02 (0.005)***	-0.02 (0.003)***
Intra State & Inter County Mergers	0.006 (0.002)***	-0.001 (0.002)	-0.006 (0.001)***
New Entities	0.02 (0.002)***	0.0005 (0.0005)***	0.04 (0.02)***
Bank Failures	0.004 (0.006)	0.01 (0.03)	-0.002 (0.01)
Lag HHI Deposits	-0.67 (0.09)***	-0.47 (0.09)***	-0.77 (0.06)***
Saving & Loan Entities	0.0003 (0.0003)	0.0002 (0.0001)	0.0005 (0.0001)***
Population	8.11e-07 (1.13e-07)***	2.28e-06 (8.64e-07)***	0.00001 (2.08e-06)***
Density of Population	0.0002 (0.0003)***	0.0005 (0.0003)**	0.001 (0.0006)
Income	1.78e-06 (6.79e-07)***	2.18e-06 (7.26e-07)***	9.61e-07 (1.50e-07)***
Unemployment rate	-0.002 (0.002)	-0.004 (0.001)**	-0.002 (0.0008)**
R ² (within)	0.27	0.16	0.16
F-test (Ho: Null joint significance)	490211.46***	3156973.48***	651283.88***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)	2806.75***	48.02***	2633.56***
Wooldridge test (Ho: no first-order autocorrelation)	381.35***	1108.69***	402.54***
Mean VIF	1.93	1.72	1.67
Number of observations	16119	8942	18120

Table A4. Estimation results: broadband penetration

Explanatory variables	
Sample	2014
D Metropolitan Counties	16.86 (0.76)***
D Micropolitan Counties	4.88 (0.57)***
Density of Population	0.0002 (0.0003)
Population	9.95e-06 (3.40e-06)***
Income	0.0002 (0.00002)***
Unemployment rate	-0.29 (0.10)***
R ²	0.41
F-test (Ho: Null joint significance)	321.98***
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)	336.71***
Mean VIF	1.25
Number of observations	3078

Notes: Standard errors in parentheses (robust to heteroscedasticity and autocorrelation). Statistical significance at 1% (***), 5% (**), 10% (*).

Figure 1A. Histograms dependent variable

