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The Impact of the Community Reinvestment Act on Bank Branching Patterns

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I. INTRODUCTION

In order to help meet the credit needs of lower-income households and communities and increase home ownership, the U.S. government has long regulating private-sector activities. The Clinton administration's National Homeownership Strategy cites four fundamental benefits of homeownership: "Through homeownership, a family invests in an asset that can grow in value and generate financial security." "Homeownership enables people to have greater control and exercise more responsibility over their living environment." "Homeownership helps stabilize neighborhoods and strengthen communities." "Homeownership helps generate jobs and stimulate economic growth."

Given those benefits, the Community Reinvestment Act (CRA) was enacted by the Congress in 1977 to encourage federally insured banking institutions to help meet the credit needs of the communities they serve, especially in lower-income neighborhoods. There have been studies that consider the impact of the CRA on diverse outcome variables, such as different types of loans, loan application rejection rates, homeownership, housing prices, and etc. The studies provide mixed results about whether the CRA is actually effective or not, and hence, the CRA is still under considerable debate. This thesis extends the scope of CRA-related research to bank branching, an aspect of banking that has not received much attention, and investigates the impact of the CRA on branching patterns in CRA-targeted areas. Despite the advent of online banking, many households and small business customers still consider brick-and-mortar offices as the primary means to have access to financial services. Therefore, the impact of the CRA on branching patterns may influence consumers of financial services and consequently, the price and convenience of those services.

The CRA's impact on bank branching is not evident as there does not exist a universal rule for branching, and whether a bank complies with the Act depends on regulators' discretion. In mid 1990's, CRA regulations were strengthened, pushing banks further to perform CRA-qualified activities. Over the past 30 years, there have been substantial changes in the number of bank branches in the U.S., and there are many factors other than the CRA, such as the general performance of the economy, advances in technology, and mergers and acquisitions, that account for the trend in bank branching. In this thesis, I try to differentiate the CRA's impact on bank branching from those other factors.

I take advantage of a discontinuity in the CRA's eligibility rule in order to identify the CRA's impact on bank-branching patterns. The regulation identifies census tracts with a median family income (MFI) less than 80% of its metropolitan statistical area's (MSA's) median family income as low-and-moderate income (LMI) tracts, and seeks to increase credit opportunity in those areas. This rule provides the basis for a regression discontinuity model, with the threshold located at the point where the ratio of a census tract's MFI to its MSA's MFI is 0.80. Under the assumption that census tracts just below and above the cutoff line are identical except for CRA-eligibility, a difference in the outcome of the two nearby cohorts can be attributed to the CRA.

In order to conduct the regression discontinuity(RD) analysis, I use annual branch-level data for the period between 2004 and 2011 with the institution-level data from the Federal Deposit Insurance Corporation(FDIC) which provide information on the location of bank branches and the asset size of institutions. I also use the 2000 decennial census data that provides the median family income variables and census tract covariates. Because each observation in two data sets are at different levels of geography, I use the ZIP code-census tract crosswalk file to connect the two data sets. Due to the complicated nature of relating ZIP codes to census tracts, I experiment with the ZIP code-census tract crosswalk in pursuit of a true estimate for the impact of the CRA on bank branching patterns. Since a ZIP code contains many census tracts, and each of those census tracts may also be a part of multiple ZIP codes, I first keep the unit of observation to be at each ZIP code-census tract correspondence, and find that the number of branches in corresponding ZIP codes was greater in CRA-eligible census tracts near the threshold. Moreover, I find that the impact of the CRA is concentrated in medium MSAs. When I limit the analysis to branching activities of large banks, I still find a significantly positive discontinuity in the number of branches, but the estimate is smaller than the one in the full sample since there are fewer large banks than small banks.

I then keep only one observation per census tract in the data set to measure the magnitude of the CRA's impact on branching patterns in a census tract. While I find the discontinuity estimate in all MSAs to be negative, ranging from -0.08 to -0.01 banks, for the whole sample, I find it likely to be positive, ranging from -0.005 to 0.02 banks, in the subsample of large banks. This set of results indicates that while the CRA causes large banks to maintain more branches in LMI census tracts, it causes small banks to have fewer branches in those neighborhoods.

In the next section, I discuss CRA regulations and their different criteria used to evaluate banks' performances, and then review the history of the CRA. Section 3 surveys the previous literature that use the RD strategy to identify the effects of the CRA, and the literature that discuss bank branching. Section 4 describes the data used in my analysis in detail, and section 5 explains the regression discontinuity model. I present the results in section 6, and conclude the thesis by discussing the implications of my findings in section 7.

II. BACKGROUND

The Community Reinvestment Act was enacted in response to concerns that banking institutions were, in some instances, failing to adequately seek out and help meet the credit needs of viable lending prospects in all sections of their communities (Avery, Bostic and Canner, 2000). The CRA seeks to increase credit opportunities for low-to-moderate income neighborhoods in particular, and has made open redlining illegal. Redlining refers to the practice by which banks denied, or charged more for loans and other services in LMI neighborhoods. The CRA directs the four federal financial supervisory agencies (the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Office of the Comptroller of the Currency, and the Office of Thrift Supervision) to encourage the federally insured banks and thrifts they regulate to help meet community credit needs in a manner consistent with safe and sound operations so that the banks would not make high-risk loans that may generate losses.[1]

The CRA is likely to influence the behavior of a bank primarily through two mechanisms: an examination and ratings system and the formation of public opinion (Avery, Bostic and Canner, 2000). The regulators examine and assess the CRA performance of banks by categorizing banks into two broad types and establishing different criteria for evaluating their CRA performance. The first category is "large banks", retail banks with more than $250 million in assets. They are evaluated by implementing three tests: the lending, investment, and service tests. A large bank receives one of five ratings on each of these three tests: outstanding, high satisfactory, low satisfactory, needs to improve, or substantial non-compliance. The bank receives a numerical score on each of the three tests based on the

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[1] As of June 30, 2011, the Office of the Comptroller of the Currency (OTS) is no longer an active regulatory agency.

ratings and then its overall CRA rating is determined based on a combination of these numerical scores. The numerical scores for three tests are weighted so that the rating for the lending test is worth at least twice as much as that for the investment or service tests. The lending test evaluates the bank's home mortgage, small business, small farm, and community development lending. The investment test evaluates the bank's community development investments. Lastly, the service test evaluates the availability of an institution's system for delivering retail and community development banking services. The criteria include the bank's branch distribution by neighborhood income level, record of opening and closing branches by neighborhood income level, use of alternative systems for providing banking services such as ATMs, range of services provided, and extent of community development services (Marsico, 2001).

The second category is "small banks", the retail banks with $250 million or less in assets. CRA regulations contain five criteria to evaluate a small bank's lending record: loan-to-deposit ratio; percentage of loans in assessment area; record of lending to borrowers of different income levels, small businesses, and small farms; geographic distribution of loans; and responsiveness to complaints (Marsico, 2001). The small banks are not subject to investment and service tests. However, CRA regulations permit any bank to be evaluated for CRA compliance pursuant to its own strategic plan. A strategic plan, in writing, contains measurable goals and addresses lending, investment, and services. A bank that wishes to be evaluated according to the strategic plan option must seek comments from the local community group and then, submit its plan to its regulating agency.

The examination and ratings system induces banks to comply with CRA regulations because regulators take a bank's CRA record into account when considering the bank's applications for bank mergers or consolidations, for opening or closing branches, or for assuming the liabilities of another bank. The regulations state that bank's CRA performance may be the basis for denying an application or conditioning approval of an application on an improved CRA record (Marsico, 2001).

The CRA can also influence the behavior of banks through the formation of public opinion. In August 1989, the Congress amended the CRA to require each banking institution to allow public inspection of its examination ratings and supporting written evaluation (Avery, Bostic and Canner, 2000). Large retail banks are required to report the number of small business and small farm loans they made in each year according to the income level of the tract in which the business that received the loan is located. Large banks are also required to report the total number and dollar amount of their community development loans, information about home mortgage loans outside the metropolitan area in which the bank has a home or branch office or outside of any metropolitan area, and a list of all branches that opened and closed during the two previous years (Marsico, 2001). Such disclosure may influence public comments on an application for a merger or acquisition, or decisions made by potential depositors, who can choose to make deposits in banks with the highest CRA performance ratings.

The original CRA was passed in 1977 as part of a package of laws, including the Home Mortgage Disclosure Act (HMDA) and the Equal Credit Opportunity Act (ECOA), intended to improve credit availability and homeownership opportunities in LMI neighborhoods (Berry and Lee, 2007). However, the original Act included little direction about the specific criteria for assessing a bank's compliance to the Act. Moreover, external scrutiny of banks' lending records was limited because CRA ratings were not made public (Apgar and Duda, 2003). Therefore, the Act had little power during the first decade after it was passed. However, in 1989, the Financial Institutions Reform, Recovery and Enforcement

Act of 1989 (FIRREA) was enacted in response to the savings and loan crisis of the 1980s. The revised Act required the regulators to write evaluation reports that were divided into confidential and public sections. The publicly disclosed data included banks' CRA performance evaluations and ratings. The regulation replaced a complicated numeric system with a simple four-tier rating system: outstanding, satisfactory, needs to improve, or substantial noncompliance. CRA regulators also began to strengthen the enforcement of the Act, and 1989 marked the first denial of a merger application on CRA grounds, when regulators blocked Continental Bank's acquisition of Grand Canyon Bank of Scottsdale (Berry and Lee, 2007). However, the CRA enforcement regime created great dissatisfaction among the banks it regulated, the residents of redlined neighborhoods, and the regulators. They all agreed that the CRA was enforced in an arbitrary and inconsistent manner (Marsico, 2005).

In 1993, President Clinton asked regulators to reform and strengthen the CRA. Changes were issued in 1995 and were fully phased in by 1997. Additionally, the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 (IBBEA) repealed restrictions on interstate banking. IBBEA also listed the CRA as a consideration when determining whether to allow interstate branching by out-of-state banks, thereby strengthening the enforcement of CRA regulations. The 1995 reforms eliminated the criteria that evaluated bank efforts, and changed the focus of CRA evaluation from process to performance. The reform instituted a more uniform, objective, and quantitative performance measures for CRA ratings with a three-part test of lending, investment, and services. The 1995 reforms also allowed banks to get CRA credit for lending to LMI borrowers regardless of their location, and to choose whether the activities of their affiliated mortgage companies would be included for CRA evaluation (Berry and Lee, 2007). The last financial regulatory reform in the 1990s that indirectly strengthened the CRA was the Gramm-Leach-Bliley Financial Modernization Act of 1999 (GLBA), which removed barriers in the market among banking companies, securities companies, and insurance companies, and allowed any one institution to act as any combination of the three types. A banking institution wishing to expand its service had to follow the CRA regulation.

In 2001, the four federal regulating agencies that enforce the CRA began a review of the regulation, and issued amendments from 2004 to 2005. The regulators included a new type of banks, called "intermediate small banks." These are the banks with assets of $250 million to $1 billion, and they were allowed to opt for examination as either a small bank or a large bank. Moreover, in order to address abusive lending practices that are inconsistent with providing credit in a safe and sound manner, the regulators included a provision against predatory lending, stating that predatory lending will adversely affect a bank's CRA evaluation.

Even though the reforms went a long way toward making CRA evaluations quantitative and objective, there is no hard-and-fast rule that translates a bank's share of lending to LMI communities into a rating on the lending test (Berry and Lee, 2007). Bank examiners are allowed discretion in evaluating a bank's performance and thus, translating lending, investment, and service into ratings is not formulaic.

III. LITERATURE REVIEW

There have been substantial changes in the number of bank branches over the past few decades. While the number of banking offices rose from 58,912 to 81,182 between 1975 and 1985, the number fell to 76,054 in 1995 (Avery, Bostic, Calem and Canner, 1999). After this brief stall, the rise has been continuous until 2009, when the number peaked at 99,540. After 2009, however, the number of bank branches has gradually declined to 97,327 as of June 2012. This aggregate trends, however, masks the differences across neighborhoods with different characteristics. Avery, Bostic, Calem and Canner (1999) study the association between consolidation and changes in levels of bank branching, and writes that the trends in branching are the consequence of the interrelation of many factors. While changes in population, income, and business activity, bank consolidation, and deregulation of various aspects of banking are a few of those factors, they claim that the CRA is also a factor that impacts bank branching patterns because the regulating agencies take a bank's record of opening and closing offices into account when evaluating CRA performance. Since there are many factors that impact trends in bank branching, in this thesis, I need to decipher which part of the trends is due to the CRA.

Many studies have already examined the impact of the CRA on bank activities relevant to the criteria of the lending test. Among them, Avery, Calem, and Canner (2003), Berry and Lee (2007), and Bhutta(2008) used regression discontinuity designs to measure the impact of the CRA on extra mortgage loan approvals. Avery, Calem and Canner (2003) were the first ones to use a variation of the regression discontinuity strategy (Golyaev, 2012). In Avery, Calem and Canner (2003)'s approach, they first estimate regression equations for changes in the amount of lending, restricting the sample to census tracts with the TM just above 0.80 (between 0.81 and 0.90) in 1990. Then, they use the estimated regression equations to predict changes in the amount of lending for a cohort of census tracts with the income ratio just below 0.80 (between 0.70 and 0.79) in 1990. This step removes the impact of any initial differences in census tract or MSA characteristics for the two cohorts from the outcome measures for the CRA-eligible cohort and expresses outcomes for the CRA-eligible group as differences relative to the CRA-ineligible group in the same MSA (Avery, Calem and Canner, 2003). However, their tests provide mixed results that could be used as an evidence for very different views on the impact of the CRA. The results that show that the CRA contributes to favorable outcomes for lower-income neighborhoods are not robust.

When the process is reversed so that the first step estimates the regression for changes in the CRA-eligible cohort and the second step predicts the changes for the census tracts just above the 0.80 threshold, those census tracts that are not CRA-eligible do no worse than would be predicted.

Berry and Lee (2007) also use a regression discontinuity design based on a cutoff at TM=0.80 to test the impact of the CRA on credit supply to low and moderate income (LMI) borrowers. They look for a discontinuity in loan rejection rates and find no significant discontinuity in loan rejection rates at the LMI threshold. They find loan rejection rates to be lower for banks operating in their CRA assessment areas, but this difference holds for both LMI and non-LMI loans. They conclude that it is possible that the CRA has influenced other outcomes or that its effects have been concentrated on particular sub-populations.

Bhutta (2008) takes an approach similar to that of Berry and Lee (2007), and finds a significant impact of the CRA on loans. Bhutta uses a regression discontinuity model at the cutoff (TM=0.80) to find that the CRA's effect on bank lending is approximately 3% on average across all MSAs from 1994 to 2002. By separating the samples by the size of MSAs, Bhutta finds no impact of the CRA for small and medium MSAs, while he finds the discontinuity to be 7% in large MSAs. He speculates that the effect of the CRA is entirely concentrated in large MSAs because the banks in those areas are under stricter scrutiny. Moreover, when Bhutta separates the sample by two sets of years, the CRA's effect on bank lending was approximately 4% in 1994-1996, and 8% in 1997-2002. This result is consistent with the reform of the regulations in 1997, which strengthened the enforcement of the CRA. In this thesis, I use a regression discontinuity model that is most similar to that in Bhutta (2008).

While the impact of the CRA on lending has attracted considerable research interest, the impact on bank branching has received very little attention. Many studies on the impact of the existence of brick and mortar offices on the provision of banking services have been conducted, but there has been little prior research examining the importance of the CRA on bank branching patterns. Kwast, Starr-McCluer and Wolken (1997) use the 1992 Survey of Consumer Finances (SCF) and the 1993 National Survey of Small Business Finances (NSSBF) to examine the extent to which households and small businesses use geographically local banking services. They find that 97.5 percent of households, and 92.4 percent of small businesses use local institutions (including ATMs) located within 30 miles.

Brevoort and Hannan (2004) use CRA data from 1997 to 2001 for nine metropolitan areas to find the impact of the distance between the center of the census tract and the nearest bank branch on within-market lending. Employing a probit model to predict the likelihood of a bank making a loan to at least one firm in each census tract in the metropolitan area, they find that distance is negatively associated with the likelihood of a loan being made, and that the association is stronger for smaller banks than for larger ones. Moreover, although not as robust as the previous results, distance between borrower and lender became even more negatively associated with the probability of a loan being made over time. This trend is consistent with theories that increasing competition from large banks has caused small banks to concentrate more on local markets, where they have informational advantages (DeYoung, Glennon and Nigro, 2004).

Marshall (2004) also writes about the importance of a physical network of bank branches. The reduction of the bank branch network in poorer areas creates difficulties for retail businesses handling cash in those areas and results in customers going elsewhere for their retail banking taking their spending power with them (Marshall, 2004). Consequently, a reduction in retailing demand could reduce retail presence, property values, and new investment by financial institutions. In the end, the neighborhood without a bank branch might face urban degeneration and decline. The studies above have established that branching patterns are important for the provision of financial services and for the socioeconomic development of a neighborhood, despite the advent of automated teller machines (ATMs) and online banking. Therefore, it is worthwhile to study the impact of the CRA on bank branching in LMI.

IV. DATA

My main empirical strategy is to use a sharp regression discontinuity (RD) in the CRA eligibility rule in order to identify the effects of the CRA on branching patterns of banking institutions. . According to the regulations, Census tracts with a median family income at least 50% but no more than 80% of its MSA median family income qualify as "low-and-moderate" income (LMI) neighborhoods that should be targeted by banks. Then, the tracts with this income ratio (TM) no more than 0.80 would be CRA-eligible, whereas the tracts with the value of TM higher than 0.80 would be CRA-ineligible. Therefore, the impact of the CRA at the cutoff can be identified by a jump in the outcome variable at TM = 0.80.

To investigate the impact of the CRA on branching patterns I use data that are derived from information drawn from different sources. For the income ratio variable, I replicate the method used by the regulators. The regulators used the 1990 Census and 1993 MSA definitions to calculate the cutoff ratio that applied between 1994 and 2002. In that period of time, except for the few newly formed MSAs, almost all census tracts had a constant ratio. In 2003, the 2000 Census and 1993 MSA definitions were used to re-calculate the ratio. Then, from 2004 to 2011 the regulators used 2000 Census and 2004 MSA definitions, which changed significantly from the 1993 MSA definitions. Therefore, in this thesis, I focus on the period from 2004 to 2011. I use the 2000 decennial census data to determine the census tract median family incomes, and data from the HMDA website for MSA median family incomes. Then, I use the 2004 MSA definitions delineated by the Office of Management and Budget (OMB) to map via unique numbers assigned to each county. I limit my analysis to neighborhoods in MSAs as I do not have enough data for a non metro area-county crosswalk. I also use census tract-level characteristics from the 2000 decennial census as control variables. These demographic characteristics include the population in the census tract, percentage of owner-occupied housing units, median age of residents, and the percentage of African American and Latino residents. I merge these variables with the income ratio data that I created via census-tract codes and create a tract-level dataset.

I use annual branch-level and institution-level data for the period between 2004 and 2011 from the Federal Deposit Insurance Corporation's(FDIC) Summary of Deposits (SOD). SOD conducts an annual survey of branch office deposits for all FDIC-insured banking institutions, and provides me with the five-digit ZIP code variable corresponding to the address of each bank branch. Since each banking institution is given a unique ID, called CERT, I merge the branch-level data set and the institution-level data set to relate a bank's institution-level characteristics, such as asset size and type of institution, with its branches. and other characteristics of the institutions and their branches.

While the income ratio variable is based on the census tract, bank branch location is based on ZIP codes. The difficulty of relating United States Postal Services (USPS) zip codes to census tracts has been a challenge for many researchers since there is no correlation between U.S. Postal Service zip Codes and Census Bureau geographies. Zip codes were set up for the convenience of mail delivery, not for statistical analysis, and cut across state, city, county, and census tract lines in many cases. Due to this nature of zip code boundaries, the Census Bureau does not provide a crosswalk file showing the relationship between zip codes and census tracts. In this thesis, there is no strict preference between the two levels of geography. Implementing a census tract-level analysis would allow us to capture the effect of the CRA more clearly in that the regulators use the census tract-level CRA-eligibility data, and that census tract boundaries are drawn to make each tract economically and demographically homogenous. However, I do not have data on the exact number of branches for each census tracts. Moreover, census tracts are relatively small and therefore, there are many census tracts that have no bank offices yet are near business districts, which serve them, with easy access to banking services. In contrary, zip codes are large enough (an average of 20,000 residents apiece in urban areas) to encompass both residential neighborhoods and the business areas that serve them (Avery, Bostic, Calem and Canner, 1999). Hence, zip code is likely to be the relevant geographic unit for banking institutions when making branching decisions. However, the disadvantages of a zip code-level analysis are that there is no zip code-level CRA-eligibility data provided, and that zip code boundaries do not necessarily correspond to divisions by socioeconomic characteristics.

In order to merge the census-tract level and zip code-level datasets, I use a census tract to zip code crosswalk file produced from the Missouri Census Data Center's MABLE program.[2] A zip code is larger than a census tract, on average, but it is not always the case that a zip code geographically contains just one census tract, or that a census tract is contained in just one zip code (multiple zip codes overlap in one census tract). Therefore, the crosswalk file also includes a variable to measure the number of people living in the intersection between the two related zip code and census tract, and an allocation factor variable that indicates what portion of the zip code is allocated within the census tract. The

[2] From the 2010 decennial census, the U.S. Department of Housing and Urban Development's (HUD's) Office of Policy and Research (PD&R) has released the USPS zip code-census tract crosswalk file.

file also provides a reverse allocation factor variable that indicates what portion of the census tract is allocated within the corresponding zip code. With these allocation factor variables, I can assign the probability of the existence of a bank branch in each census tract given that a branch exists in a corresponding zip code, or the expected number of branches in a census tract given the actual number of branches in a corresponding zip code.

An example of the relationship between zip code and census tract is given below in Table 1. Zip code 20640 consists of six distinct census tracts, and the number in parentheses indicates the portion of zip code 20640 in a census tract, and hence, these six values add up to 1. Moreover, each of those census tracts may also contain zip codes other than 20640, as shown in the last column of Table 1.

<table>
<tr><th>Zip Code</th><th>Census Tract</th><th>Zip Code</th></tr>
<tr><td rowspan="6">20640
(Zipname: Pisgah,
County: Charles MD)</td><td>24017850600 (0.006)</td><td>20640, 20646, 20675, 20677, 20695</td></tr>
<tr><td>24017850300 (0.137)</td><td>20640, 20646, 20658</td></tr>
<tr><td>24017850201 (0.053)</td><td>20640</td></tr>
<tr><td>24017850100 (0.132)</td><td>20640, 20607, 20616, 20646</td></tr>
<tr><td>24017850400 (0.118)</td><td>20640, 20662</td></tr>
<tr><td>24017850202 (0.555)</td><td>20640</td></tr>
</table>

Table 1: Example Zip Code-Census Tract Crosswalk

In this thesis, I also conduct the analysis using a subsample of branches of large banking institutions with $250 million or more in assets since the evaluation of "large banks" includes the criteria that tests banks' branch distribution, whereas the evaluation of "small banks" only checks the lending record. As mentioned earlier in the text, I also limit the sample to census tracts in MSAs due to the difficulty of matching non-MSAs with the counties. Moreover, I exclude census tracts with less than 100 housing units and census tracts with no owner-occupied units. Table 2 and 2b provide summary statistics of bank/branch variables and census tracts level variables for the whole sample and the subsample of large banks.

V. EMPIRICAL MODEL

My empirical strategy is to use a regression discontinuity (RD) analysis to identify the effects of the CRA on branching patterns of banking institutions. In a RD model, there are three main variables: an assignment variable, a treatment indicator variable, and an outcome variable of interest. I will let Z denote the assignment variable, and in this thesis, the income ratio (*TM*) is the assignment variable. Then, I will let T denote the treatment indicator variable, such that $T_i = 1[Z_i \leq 0.80]$, where i indicates the geographic level of observation (either zip code-level or census tract-level). Lastly, I will let Y be the outcome variable about bank branching on which I would like to estimate the effect of the treatment. Following the potential outcomes model, I will let Y_{1i} denote the potential outcome in an area i if i is treated (i is CRA-eligible), and let Y_{0i} denote the potential outcome in an area i if i is not treated (i is not CRA-eligible). In order to measure the effects of the CRA, I would like to find out Y_{1i} - Y_{0i}, but in reality, it is impossible to observe both outcomes for the same i and therefore, I use the RD design to find the average treatment effect of the CRA.

To employ the regression discontinuity model, I need to make an assumption that if the CRA has no impact,

$$\lim_{e \to 0}\{E[Y_i \mid Z_i = 0.80\text{-}e] - E[Y_i \mid Z_i = 0.80+e]\} = 0 \quad (1)$$

This continuity assumption states that the CRA-eligible area and the CRA-ineligible area that are close to the threshold have identical outcomes in expectation with the exception of the treatment by the CRA. Therefore, any substantive difference in outcomes for tracts near the cutoff will be due to the CRA treatment effect. Assuming that the characteristics of the areas are continuous at TM=0.80, I can identify the average treatment effect of the CRA by:

$$\lim_{e\to 0}\{E[Y_i \mid 0.80\text{-}e \leq Z_i \leq 0.80] - E[Y_i \mid 0.80 < Z_i < 0.80+e]\} \quad (2)$$

which can be rewritten as

$$\lim_{z\uparrow 0.80} E[Yi \mid Z=z] - \lim_{z\downarrow 0.80} E[Yi \mid Z=z] \quad (3)$$

Since Y_{1i} is observed if $Z_i \leq 0.80$, and Y_{0i} is observed if $Z_i > 0.80$,

$$E[Y_{1i} \mid Z=0.80]- E[Y_{0i} \mid Z=0.80] \quad (4)$$

Finally, I get the average treatment effect around the cutoff:

$$E[Y_{1i} - Y_{0i} \mid Z=0.80] \quad (5)$$

The linear regression specification I use to find this average treatment effect is:

$$Y_{it} = \beta_0 + \beta_1 T_i + \beta_2 Z_i + \delta X_{it} + \varepsilon_{it} \quad (6)$$

I also use a cubic regression to find the best fit to the data and identify the correct discontinuity estimate. The scatter plots in Graphs 1 to 3 do show that the observed data has a cubic shape. The cubic regression looks like the following:

$$Y_{it} = \beta_0 + \beta_1 T_i + \beta_2 Z_i + \beta_3 Z_i^2 + \beta_4 Z_i^3 + \delta X_i + \varepsilon_{it} \quad (7)$$

In both regression models, β_1 is the main coefficient of interest as it indicates the CRA treatment effect near the threshold. I test with different bandwidths around Z=0.80 and coefficients are estimated with and without MSA fixed effects. I use fixed effects because the bank branches would target the local communities. X_i is a vector of census tract controls. Because the census tract-zip code crosswalk does not provide a clear-cut relationship between the two levels of geography, I test my RD model on different levels of geography. Therefore, *i* indicates census tract, zip code, or both census tract and zip code, and *t* indicates year. Since a zip code may have many census tracts in it, to get the right standard errors, I cluster at the census-tract level.

VI. RESULTS

RD Estimates on the Number of Branches

I first run a set of regressions on the number of branches of banks of all size in a zip code *z* corresponding to a census tract *c*, and the results are shown in Table 3. I aggregate the number of branches of all banks in a zip code, and use it as the dependent variable for each census tract that is wholly or partially located in that zip code. Therefore, the unit of observation is a zip code-census tract correspondence. Since a census tract can be a part of multiple ZIP codes, a single census tract may be observed many times with different dependent variable values. In order to resolve this issue, standard errors are clustered at the census tract level. According to the results in column 1 of Table 3, the effects of the CRA are not significant enough. When I include MSA fixed effects, shown in column 2 of Table 3, in order to control for both observed and unobservable differences across MSAs, the estimate decreases which implies that the MSA composition is not balanced between census tracts below the cutoff and those above it. Then, when I add census tract controls to the model in column 3, the standard error falls by approximately 14% whereas the point estimate does not change, implying that within a MSA, census tracts are comparable across the threshold.

In Column 4 of Table 3, I use a larger bandwidth, and I find the discontinuity at the threshold to be significant at the 5% level, but when I use the same bandwidth in a cubic RD model in Column 6, the estimate drops by half, and is no longer significant. In Column 7, by removing the restriction on the bandwidth, the estimate is approximately 0.55 and is significant. In Table 3, variations of the model show that the point estimate exists between about 0.2 and 0.6. Moreover, in order to examine the annual trend, I run separate regressions for each year from 2004 to 2011. In Columns 4 and 7 where the CRA effects are significant, whereas the estimate fairly consistently increases in column 4, the estimate rises and falls over the period between 2004 and 2011. In both columns, however, the estimate gets larger overall, and this trend of growth suggests growing importance of the CRA on banks' branching decisions.

Since the regulators conduct the service test only with the large banks with assets more than $250 million, the CRA directly impacts the branching decisions of large banks. Table 4 provides the results of the regressions identical to those in Table 3, but with the number of branches of only large banks. Similar to the results in Table 3, the point estimates are significant in Columns 4 and 7, but the estimate is cut to nearly 20% of the estimate from Table 3. This may be due to many reasons, but one of the reasons is that there are many more small banks than there are large banks. Among 27,598 banking institutions in my data set, there are 1912 large banks and 25686 small banks, so there are more observations that are assigned with a value of 0 for the dependent variable in the large bank sample. Whereas the average number of branches in a zip code for the regression sample of all banks is 6.99, with the standard deviation of 6.585, the mean for the sample of large banks is 2.031, with the standard deviation of 2.45. The mean of the sample of large banks is approximately 30% of that of the whole sample. Therefore, even though the point estimate of the sample of large banks is smaller, this result does not imply that the impact of the CRA on the branching behavior of larger institutions is weaker than the impact on that of smaller banks.

In addition, the regulators do not evaluate branching activities of small banks, but the CRA may indirectly influence small banks' branching decisions through the lending evaluation criteria for small banks. Brevoort and Hannan (2004) find a negative association between distance and loans, and association is stronger for smaller banks than for larger ones according to their research. Hence, the CRA may have impacted branching activities of small banks through requiring lending in assessment areas of small banks, and the estimates in Table 3 incorporate this indirect impact of the CRA on small banks in addition to the impact on large banks.

I also find interesting results when I compare Column 7 of Table 3 and Table 4. In both tables, the discontinuity at the cutoff is significant and it gets larger over the period of 2004-2011: from 0.55 to 0.58 in Table 3, and from 0.10 to 0.14 in Table 4. The two tables differ from each other as to which direction the estimate changes from year *t* to year *t+1*. When the discontinuity shrinks or grows from year *t* to year *t+1* in Table 3, it tends to get larger or smaller in Table 4. In Table 3, the estimate gradually increases from 2005 to 2009, and it suddenly drops in 2010. Since 2010 is the report year, this drop in the estimate has actually happened in 2009. In Table 4, on the contrary, the estimate decreases from 2005 to 2009, but it increases in 2010. I speculate that these reversions of trend were due to the 2008 Financial Crisis. It is also worth noting that the total number of bank branches in the U.S. started to decline in 2009. As banks were shutting down some of their offices in 2009, the large banks may have chosen to close a non-CRA-eligible branch as opposed to an eligible one given that the two branches are similar in other aspects. Then, this sort of branching decision by large banks would have caused the discontinuity to increase from that of the former year. The decline in the estimate in 2010 for the whole sample implies that small banks made branching decisions different from large banks after the 2008 Financial Crisis. However, with the current results, the impact of the CRA on the branching behavior of large banks is not clearly differentiated from the impact on small banks. I can accomplish the differentiation to some degree by using the change in the number of banking offices from year *t* to year *t+1* as the dependent variable instead of the number of offices in year *t*.

In Table 5, the discontinuity at the cutoff is estimated separately for census tracts grouped in three by the size of the MSA they are located in. Large MSAs are those with population more than 2 million, medium MSAs are those with population between 500,000 and 2 million, and small MSAs are those with population fewer than 500,000. I expected the estimate for the large MSAs to be significant and the strongest among the three groups because institutions in large cities are more likely to face pressure of CRA regulations. While large, multi-MSA banks dominate the credit and banking markets in cities of all sizes, regulators tend to focus on these banks' activity in the largest cities to help conserve regulatory resources (Bhutta, 2008). Moreover, community groups that partake in negotiations of CRA agreements are active in large cities. However, the results in Table 5 show that in large MSAs, no significant effect of the CRA is found both in the entire sample and in the sample of large banks. Instead, Table 5 indicates that the CRA's effect is mostly concentrated in medium MSAs. Column 7 shows that the discontinuity in the number of branches is significant in small MSAs when I use a non-bandwidth cubic RD model with MSA fixed effects, year fixed effects, and census tract covariates. Therefore, additional research in the relationship between the size of the metropolitan area and the branching patterns is needed in order to fully explain the results of Table 5.

Falsification Test for the Discontinuity

Graphs 1 through 4 show the results of the falsification test where I set the CRA-cutoffs to be at various different values of TM. Graphs 1 to 3 display the estimated discontinuities at TM=0.8, 0.75, and 0.85 using a baseline cubic regression discontinuity model without any fixed effects or controls. I find a positive discontinuity at TM=0.80, the actual CRA-eligibility cutoff, as expected. However, a significantly positive discontinuity also appears at TM=0.75, a point where there should not be a discontinuity. Since graphs 1 to

3 are results of a baseline RD model, in Graph 4, I use a cubic RD model with year and MSA fixed effects, and census tract covariates to estimate discontinuities at various cutoffs from TM=0.65 to TM=0.95. Graph 4 shows significantly positive discontinuities at TM=0.70, 0.75, and 0.80. At other imaginary cutoff points, the estimated discontinuity is close to zero. According to Bhutta(2008), there is a rapid change of pre-existing tract characteristics around TM=0.75, whereas there is none at the CRA cutoff. This may be why the falsification test in Graph 4 yields statistically significant discontinuities at TM=0.75 and TM=0.70.

Moreover, the shape of the cubic lines in graphs 1 to 3 is against my expectation. I expect there to be more branches in census tracts with higher CRA ratios which are higher-income neighborhoods, but the graphs show a negative association between the number of branches and a neighborhood's income level. This may be because neighborhoods with no branch are counted repeatedly when calculating the mean number of branches for each level of TM values. In the sample of large banks, there are 15174 observations, whose value of TM is between 0.6 and 0.7, that do not have a branch in a corresponding zip code, whereas there are 49665 observations, with TM between 0.9 and 1.0, that do not have a branch. These observations without a branch, by being over-counted, may pull down and underestimate the mean value for the number of branches at each TM. Hence, I cannot conclude that there is a negative relationship between the income level of census tracts and the number of branches. In order to avoid redundant counting and find a more accurate relationship between the two variables of interest, I conduct my analysis at the census tracts level. Whereas the results so far show that banks have built more brick-and-mortar offices in CRA-targeted neighborhoods, the results from the following census tracts level analysis provides the magnitude of the CRA's impact on bank branching.

Census Tracts Level Analysis

To implement a census tracts level analysis, I manipulate the data set so that I have only one observation per census tract. I multiply the number of branches in a zip code by the allocation factor to predict the number of branches in each census tract that corresponds with the zip code. Then, I add up those predicted numbers by census tract for each year. For instance, let a census tract, *c*, be a part of zip codes z_1 and z_2 in year *t* where z_1 have b_1 branches, and z_2 have b_2 branches. Then, if a_1 is *c*'s portion of z_1, and a_2 is *c*'s portion of z_2, by adding (a_1*b_1) with (a_2*b_2), I can predict the number of branches in the census tract, *c*, at year *t*. In this manner, I keep a single observation per census tract and use the predicted number of branches in a census tract as the dependent variable for the RD regressions.

Graph 5 displays the discontinuity of predicted number of branches in a census tract at TM=0.80 for the sample of large banks. I use a baseline RD model without any controls or fixed effects, and find a statistically significant and positive discontinuity as expected. In addition, the scatter plot in Graph 5 indicates a positive association between the number of branches in a census tract and the median family income (MFI) of a census tract relative to the MFI of its metropolitan statistical area (MSA). As opposed to Graphs 1 to 3, Graph 5 implies that the number of branches in a neighborhood is positively related with the neighborhood income level. The positive association is more likely to be true since both variables are at the census tract level, and each census tract is observed only once in the data set that is used to draw Graph 5.

Graph 6 provides results of another falsification test that examines whether there are statistically significant discontinuities in the predicted number of branches of large banks at non-CRA cutoffs. Most of the discontinuity estimates away from the cutoff at TM=0.80 are located close to the zero line. The estimated discontinuity is positive and significant only at TM=0.80, as opposed to the results from Graph 4. Graph 4 indicates that discontinuities in the census tracts level data are not generated easily and thus, allows me to interpret the estimated discontinuity at TM=0.80 as the causal effect of the CRA.

Table 6 shows RD estimates for the CRA's effect on the predicted number of branches in a census tract. In the sample of all banks, I mostly find a statistically significant and negative discontinuity at the CRA cutoff. In large MSAs, the discontinuity estimate is negative for every type of model specifications, indicating fewer predicted number of branches in CRA-eligible census tracts. In medium MSAs, the discontinuity estimate becomes significant when I use a cubic RD model, and it is either positive or negative depending on the bandwidth of the model. For small MSAs, I find mixed results depending on the bandwidth. The estimate changes its sign and becomes negative when I use a larger bandwidth. The discontinuity estimate is negative, ranging from about -0.08 to -0.02, in all MSAs, and ranges from -0.1 to -0.03 in large MSAs. For the sample of large banks in Table 6, in line with the results from Table 5, the discontinuity estimate is significantly positive in medium MSAs.

The negative discontinuity in the sample of all banks may be explained in context of bank competition. As large banks open more branches in CRA-eligible census tracts, the greater competition in the provision of banking services may cause small banks to exit or not enter those census tracts, since the small banks are not evaluated on having branches in LMI neighborhoods. The discontinuity is approximately 0.02 in all MSAs, and ranges from 0.01 to 0.06 in medium MSAs for the sample of large banks. However, the results from Table 6 are not definite for the dependent variable used in the models is not actually observed; it is only a prediction based on actual observations. Therefore, considering the measurement errors in the dependent variable, I use two other dependent variables in Tables 7 and 8 to run the set of regressions identical to those in Table 6, in order to provide a lower bound and an upper bound to the discontinuity estimate.

Table 7 provides discontinuity estimates for the CRA's effect on the probability that at least one branch exists in the census tract. The dependent variable for Table 7 is calculated by adding up the allocation factors of the corresponding zip codes with at least one branch in it. If a census tract, *c*, is a part of zip codes z_1, z_2 and z_3 in year *t*, where only z_1 and z_3 have bank offices in year *t*, I calculate the probability of the existence of a branch in *c* by adding up *c*'s portions in z_1 and z_3. Since there are many zip codes with more than one branch, estimates in Table 7 provide a lower bound for the effect of the CRA on branching patterns at the census tract level. In the sample of all banks, the discontinuity estimate is significant and negative, ranging from -0.04 to -0.01. Likewise, the discontinuity is significantly negative in both large and medium MSAs, and the effect of the CRA is stronger in medium MSAs than in large ones. For the sample of large banks, the significant discontinuity estimate is about -0.005 in all MSAs, and ranges from -0.01 to -0.007 in large MSAs. The estimates are not very significant in medium MSAs, ranging from -0.0027 to 0.01, but we need to note that the discontinuities in Table 7 are underestimates of the true effect.

Table 8 shows the CRA's effect on the prediction of whether a branch exists in a census tract. The dependent variable is a dummy variable, given a value of 1 if at least one of a census tract's corresponding zip codes contains at least one branch, and 0 otherwise. Since the dependent variable is likely to overestimate the number of branches in a census tract, Table 8 provides an upper bound to the discontinuity estimates. For the entire sample, the significant discontinuity estimate ranges from -0.01 to -0.005 in medium MSAs. In the sample of large banks, the effect of the CRA is significant and positive, ranging from 0.012 to 0.02. I also find significant discontinuities in medium MSAs, ranging from 0.03 to 0.07.

Integrating the results from Tables 6, 7, and 8, the discontinuity estimate in all MSAs ranges from -0.08 to -0.01 for the whole sample, and ranges from -0.005 to 0.02 in the sample of large banks. Thus, the estimate is negative for the whole sample, and is very likely to be positive for the subsample of large banks. Moreover, the discontinuity estimate is negative in large MSAs, and highly likely to be negative in small and medium MSAs for the sample of all banks. In comparison, for the sample of large banks, while the estimate is negative in large MSAs, it is positive in medium MSAs, ranging from 0.01 to 0.07, and it is ambiguous for small MSAs, since the estimate ranges from -0.018 to 0.03.

VII. DISCUSSION

Through the Community Reinvestment Act, the U.S. government and the regulators of banks strongly encourage the regulated banking institutions to make loans, to invest, and to provide banking services to low and moderate income (LMI) communities. The regulators enforce the Act by rating a bank's performance in accordance with CRA regulations and referring to those ratings when the bank files an application for a merger or a new branch opening. I found that a substantial body of literatures had investigated the effect of the CRA on banks' lending activities, but I could not find any literature that looked into a direct association between the CRA and branching patterns in LMI neighborhoods. Therefore, I study the impact of the CRA on bank branching and find that the CRA is significantly related to branching patterns in neighborhoods.

The results from conducting the analysis at zip code-census tracts correspondence level show that the CRA causes banks to maintain more branches in CRA-eligible areas across all MSAs between 2004 and 2011 for both the whole sample and the subsample of large banks. I also find that the CRA's impact on bank branching is concentrated in medium MSAs, despite the fact that banks in large MSAs are likely to be heavily scrutinized by the regulators. In contrast to the estimate in medium MSAs, discontinuity estimates for large and small MSAs suggest no significant impact of the CRA on banking branching.

Since the zip code-census tracts correspondence level data has redundant observations of census tracts in the same year and different levels of geography for the dependent and independent variables, I conduct further analysis with the census tracts level data, in which there is a single observation per census tract each year. The results from the census tracts level analysis provides a lower bound and an upper bound to the magnitude of the CRA's impact on the number of branches in a census tract. In the sample of all banks, the results indicate that the CRA causes banks to have 0.01 to 0.08 fewer offices in the CRA-eligible census tracts across all MSAs. When the discontinuity is estimated separately for census tracts grouped in three depending on the size of its MSA, the estimate in large MSAs indicates that banks build fewer branches in CRA-eligible census tracts than in ineligible tracts near the eligibility cutoff. The estimates are also very likely to be negative in small and medium MSAs for the sample of all banks.

Focusing on branching activities of large banks, I find that the discontinuity estimate ranges from -0.005 to 0.02 branches and thus, it is highly likely that large banks maintain more branches, at most 0.02 more branches on average, in LMI neighborhoods across all MSAs. Separate discontinuity estimates by size of MSA indicates that the estimate is negative in large MSAs, ranging from about -0.02 to 0.01 branches, positive in medium MSAs, ranging from 0.01 to 0.07 offices, and ambiguous in small MSAs, as the estimates lie between -0.018 and 0.03.

While I find that the CRA causes large banks to have more offices in CRA-eligible census tracts, when I expand the sample to both large and small banks, the results indicate that the CRA causes there to be fewer branches in CRA-eligible census tracts. The service test criteria, which includes having offices in LMI areas, applies to large banks, but not to small banks, when evaluating banks' compliance to the CRA. I speculate that when a large bank and a small bank competes in an area, the small one has less incentive to maintain its branch in the market. Therefore, the greater competition in CRA-eligible census tracts may cause small banks to exit or not enter those areas. If so, the CRA causes small banks to retain fewer offices in LMI neighborhoods. It is not studied in this thesis whether greater number of branches of large banks in LMI neighborhoods is either efficient or optimal. Big banks have been dominating the U.S. banking system, and the CRA may be pushing the trend further by increasing the concentration in the banking sector, and disturbing the competitive environment of financial institutions. Additional data that measures the competitiveness or concentration is needed in order to explore these issues.

Since there is a lack of literature that emphasizes the relationship between the CRA and bank branching patterns in LMI neighborhoods, I believe that this thesis can be the basis for further discussion on the topic. I have not directly measured the treatment effect of the CRA on individual banking institution's branching decisions, due to the limitations of my data sets. In addition to the results from my local neighborhood level analysis, institution level analysis will add a new dimension to the studies on the impact of the CRA on bank branching in LMI neighborhoods and further clarify the relationship between the CRA and branching patterns.

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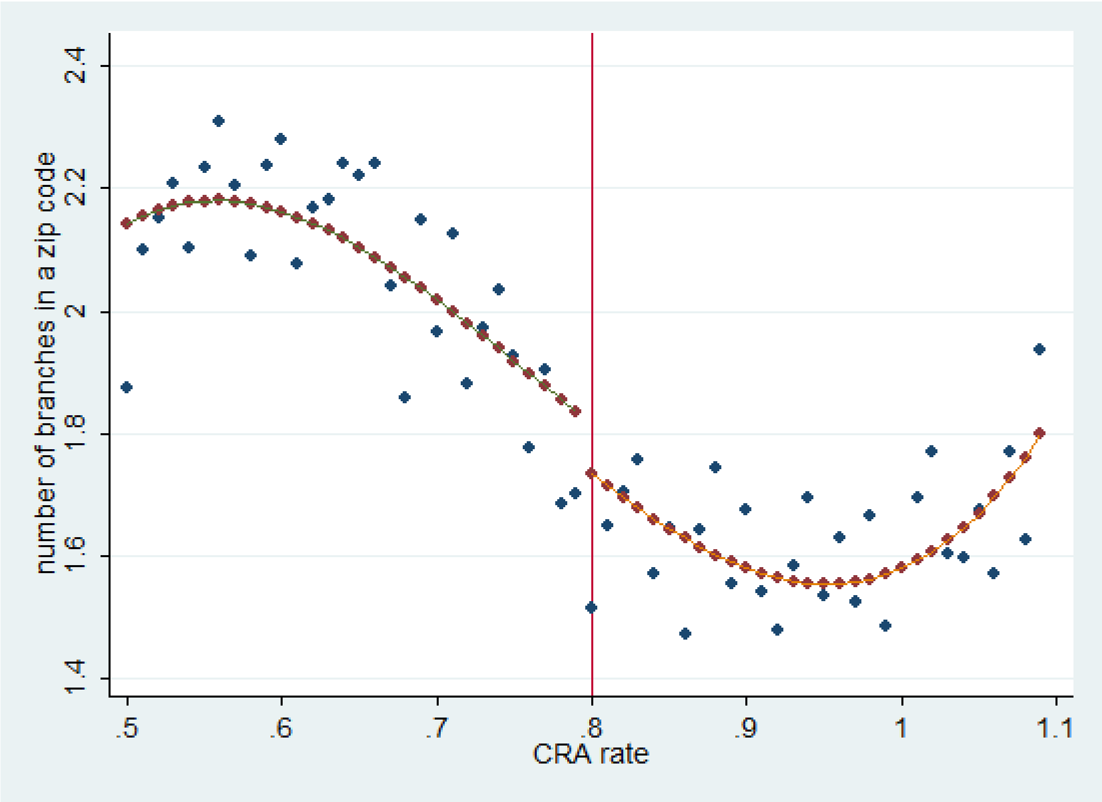
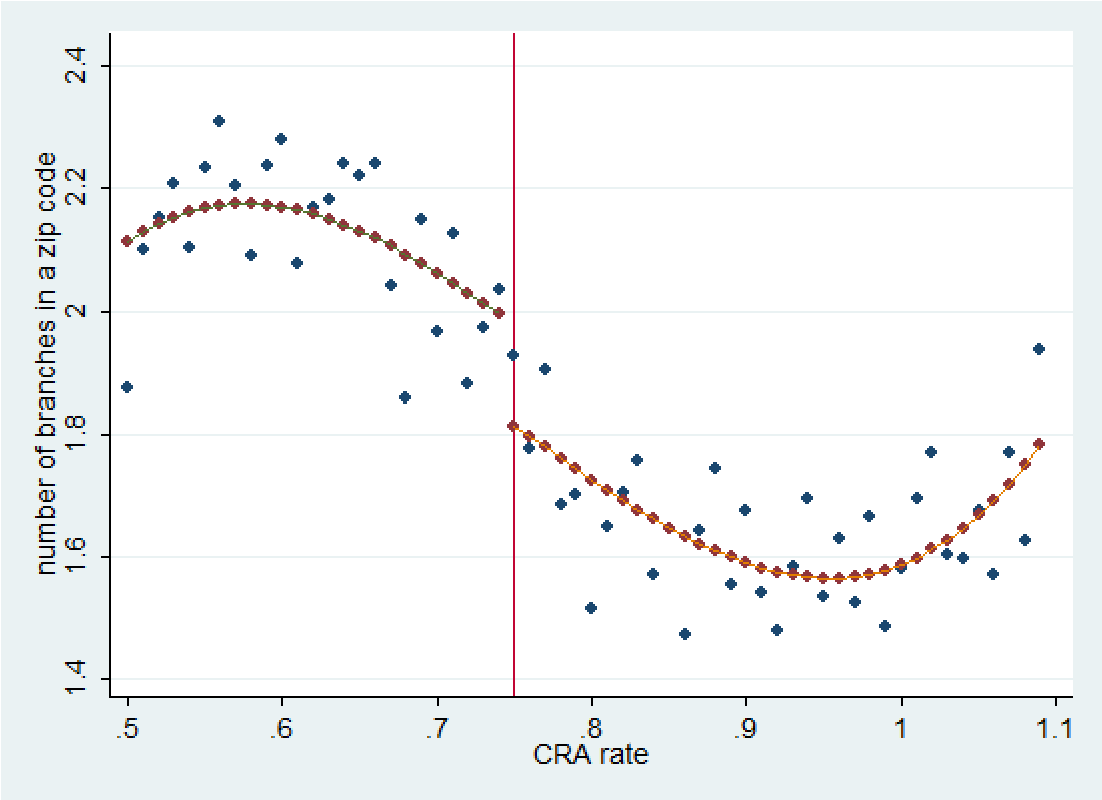
IX. TABLES AND GRAPHS

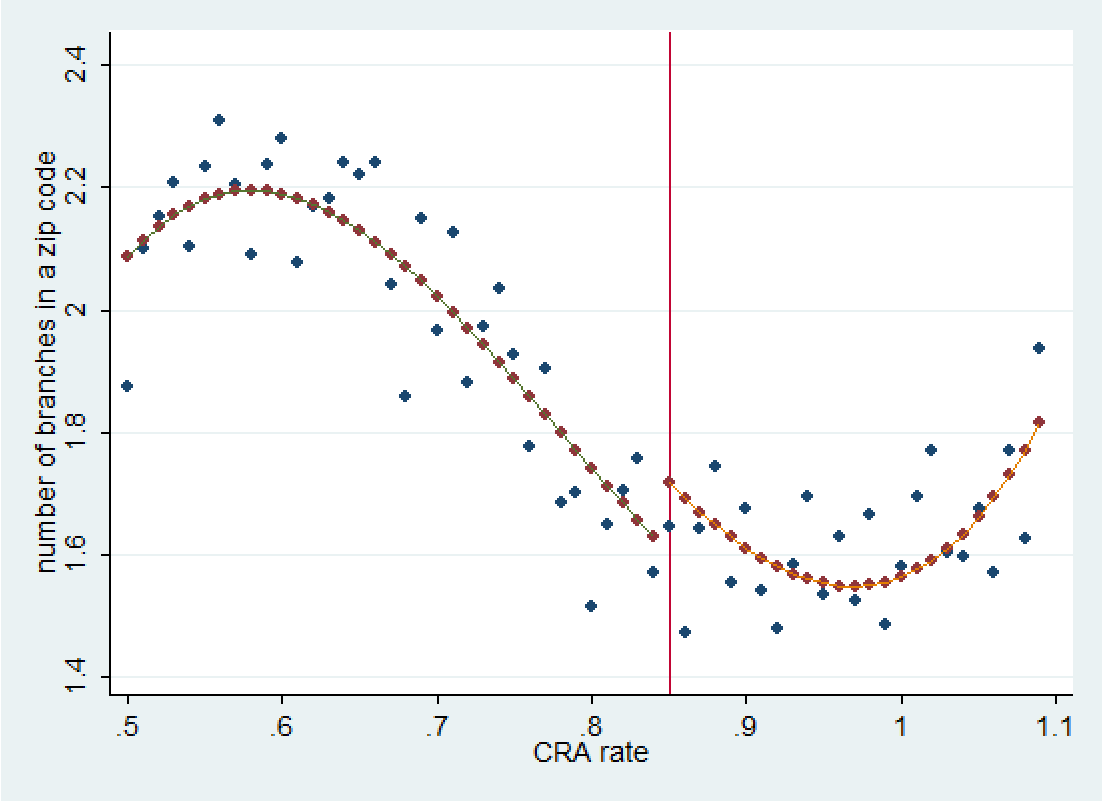
Graph 1. Discontinuity of Number of Branches of Large Banks at TM=0.80



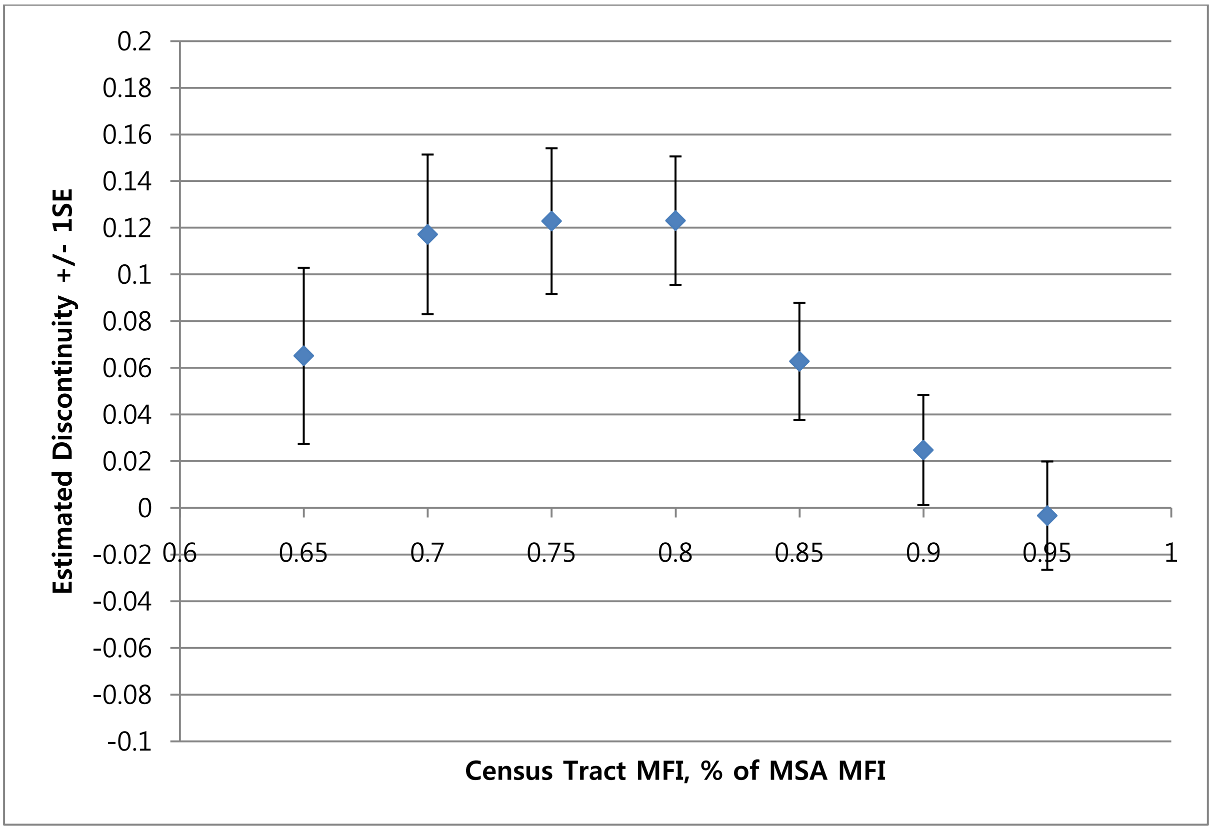
Graph 2. Discontinuity of Number of Branches of Large Banks at TM=0.75



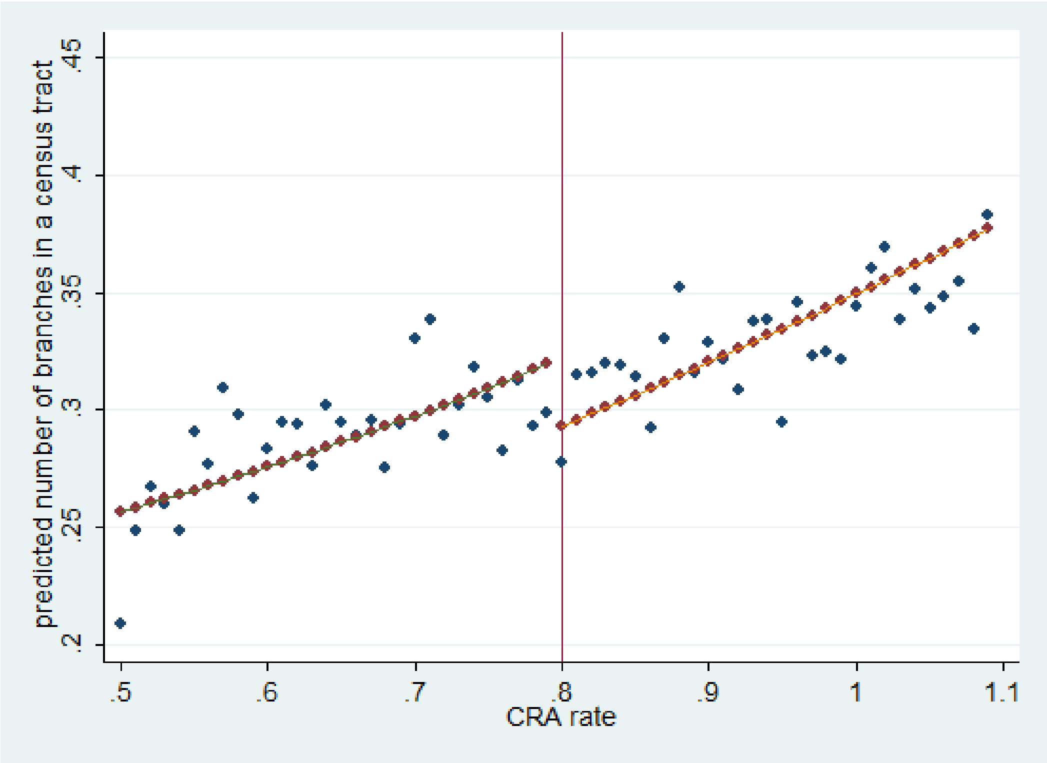
Graph 3. Discontinuity of Number of Branches of Large Banks at TM=0.85



Graph 4. Falsification Test: Discontinuity in the Number of Branches at Non-CRA Cut-offs



Graph 5. Discontinuity of Predicted Number of Branches in a Census Tract for Large Banks at TM=0.80



Graph 6. Falsification Test: Discontinuity in the Predicted Number of Branches in a Census Tract for Large Banks at Non-CRA Cut-offs

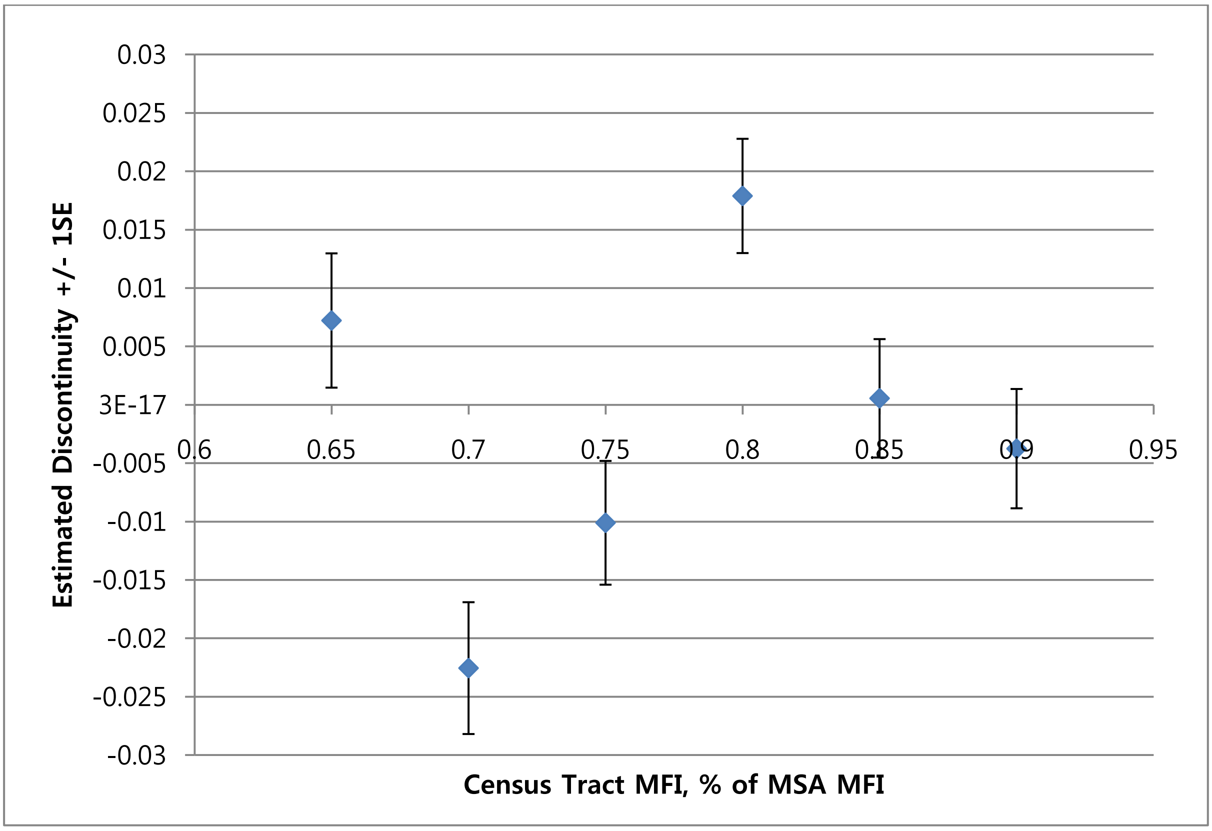


Table 2: Summary Statistics(ZIP Code-Census Tract Correspondence

	Entire Sample			Large Banks		
	Mean	Std. Dev	N	Mean	Std. Dev	N
Bank/Branch Variables						
Num. of branches	6.9907	6.5852	739,680	2.0308	2.4512	739,680
large MSA	8.0043	6.8688	318,080	2.7904	2.7429	318,080
medium MSA	6.5672	6.1003	203,840	1.7238	2.1844	203,840
small MSA	5.9066	6.3801	217,760	1.2089	1.8294	217,760
Bank Existence	0.8796	0.3255	739,680	0.6377	0.4807	739,680
large MSA	0.9260	0.2617	318,080	0.7855	0.4104	131,453
medium MSA	0.8765	0.3290	203,840	0.5931	0.4913	203,840
small MSA	0.8144	0.3888	217,760	0.4637	0.4987	217,760
Census Tract Variables						
(Statistics for the subsample of large banks are identical to those in the whole sample)						
CRA-Eligible Tract	0.2682	0.4430	739,680			
large MSA	0.3044	0.4602	318,080			
medium MSA	0.2825	0.4502	203,840			
small MSA	0.2020	0.4015	217,760			
TM	1.0208	0.3912	739,680			
large MSA	1.0499	0.4640	318,080			
medium MSA	1.0019	0.3693	203,840			
small MSA	0.9959	0.2747	217,760			
Census Tract Pop	4646.951	2278.726	739,680			
Median Age	36.0419	6.0649	739,680			
Black Percentage	13.0414	22.9624	739,680			
Latino Percentage	11.1635	18.4498	739,680			
Owner-Occupied Units Pctg.	67.7155	23.1996	739,680			

Table 2b: Summary Statistics(Census Tracts Level

	Entire Sample			Large Banks		
	Mean	Std. Dev	N	Mean	Std. Dev	N
Bank/Branch Variables						
Predicted Num. of branches	1.3686	1,3553	417,368	0.3722	0.4770	417,368
large MSA	1.3093	1.4566	201,976	0.4425	0.5460	201,976
medium MSA	1.3577	1.2728	113,592	0.3290	0.4126	113,592
small MSA	1.4984	1.2209	101,800	0.2812	0.3624	101,800
Prob. of Bank Existence	0.2283	0.2820	417,368	0.1318	0.1505	417,368
large MSA	0.1842	0.2080	201,976	0.1376	0.1465	201,976
medium MSA	0.2349	0.2746	113,592	0.1271	0.1449	113,592
small MSA	0.3086	0.3815	101,800	0.1256	0.1634	101,800
Branch exists in a corresponding ZIP	0.9800	0.1401	417,368	0.8275	0.3779	417,368
large MSA	0.9804	0.1386	201,976	0.8989	0.3015	201,976
medium MSA	0.9784	0.1453	113,592	0.7849	0.4109	113,592
small MSA	0.9808	0.1373	101,800	0.7333	0.4422	101,800
Census Tract Variables						
(Statistics for the subsample of large banks are identical to those in the whole sample)						
CRA-Eligible Tract	0.3100	0.4625	417,368			
large MSA	0.3316	0.4708	201,976			
medium MSA	0.3173	0.4654	113,592			
small MSA	0.2590	0.4381	101,800			
TM	1.0087	0.4107	417,368			
large MSA	1.0296	0.4636	201,976			
medium MSA	0.9946	0.3888	113,592			
small MSA	0.9829	0.3079	101,800			
Census Tract Pop	4446.742	2161.405	417,368			
Median Age	35.6081	6.4234	417,368			
Black Percentage	15.0385	24.8624	417,368			
Latino Percentage	13.0269	19.9150	417,368			
Owner-Occupied Units Pctg.	63.8031	24.1737	417,368			

Table 3. RD Estimates of CRA's Effect on Number of Branches of All Banks

(each zip code-census tract correspondence level)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1[TM≤0.80] in 2004 *Mean(5.8)*	0.2743 (0.2093)	0.234 (0.179)	0.232 (0.156)	0.3053*** (0.0945)	0.1854 (0.2056)	0.1602 (0.1237)	0.5527*** (0.0762)
1[TM≤0.80] in 2005 *Mean(5.9)*	0.2722 (0.2130)	0.213 (0.180)	0.2106 (0.1555)	0.2952*** (0.0951)	0.1970 (0.2047)	0.1451 (0.1244)	0.5311*** (0.0772)
1[TM≤0.80] in 2006 *Mean(6.1)*	0.2972 (0.2206)	0.223 (0.186)	0.2198 (0.1607)	0.2978*** (0.0983)	0.1809 (0.2114)	0.1523 (0.1286)	0.5393*** (0.0800)
1[TM≤0.80] in 2007 *Mean(6.2)*	0.3022 (0.2271)	0.215 (0.192)	0.2122 (0.1657)	0.3106*** (0.1013)	0.1963 (0.2180)	0.1536 (0.1325)	0.5534*** (0.0825)
1[TM≤0.80] in 2008 *Mean(6.3)*	0.3194 (0.2312)	0.243 (0.195)	0.2393 (0.1684)	0.3220*** (0.1031)	0.2146 (0.2214)	0.1686 (0.1348)	0.5617*** (0.0842)
1[TM≤0.80] in 2009 *Mean(6.3)*	0.2874 (0.2310)	0.215 (0.196)	0.2130 (0.1696)	0.3276*** (0.1035)	0.2027 (0.2235)	0.1658 (0.1355)	0.5705*** (0.0845)
1[TM≤0.80] in 2010 *Mean(6.2)*	0.2829 (0.2268)	0.211 (0.193)	0.2098 (0.1669)	0.3222*** (0.1018)	0.1938 (0.2202)	0.1503 (0.1334)	0.5595*** (0.0831)
1[TM≤0.80] in 2011 *Mean(6.2)*	0.2876 (0.2269)	0.209 (0.193)	0.2081 (0.1668)	0.3310*** (0.1017)	0.1810 (0.2199)	0.1398 (0.1333)	0.5785*** (0.0831)
MSA FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Tract Covariates	No	No	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.1	0.1	0.1	0.3	0.1	0.3	No
Model	Linear	Linear	Linear	Linear	Cubic	Cubic	Cubic
N	19988	19988	19988	55480	19988	55480	92460

Note: Robust standard errors, clustered by census tracts, are reported in parentheses.

Table 4. RD Estimates of CRA's Effect on Number of Branches of Large Banks

(each zip code-census tract correspondence level)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1[TM≤0.80] in 2004 *Mean(1.42)*	0.0736 (0.0700)	0.0737 (0.0565)	0.0698 (0.0500)	0.0530* (0.0300)	0.0828 (0.0649)	0.0371 (0.0393)	0.1032*** (0.0247)
1[TM≤0.80] in 2005 *Mean(1.66)*	0.0878 (0.0782)	0.101 (0.0614)	0.0965* (0.0540)	0.0728** (0.0325)	0.1129 (0.0697)	0.0503 (0.0425)	0.1281*** (0.0270)
1[TM≤0.80] in 2006 *Mean(1.68)*	0.0992 (0.0793)	0.107* (0.0622)	0.103* (0.0547)	0.0829** (0.0329)	0.1102 (0.0706)	0.0588 (0.0431)	0.1240*** (0.0275)
1[TM≤0.80] in 2007 *Mean(1.75)*	0.108 (0.0828)	0.109* (0.0639)	0.105* (0.0564)	0.0798** (0.0340)	0.1151 (0.0725)	0.0522 (0.0443)	0.1177*** (0.0286)
1[TM≤0.80] in 2008 *Mean(1.79)*	0.113 (0.0853)	0.111* (0.0653)	0.107* (0.0578)	0.0854** (0.0348)	0.1158 (0.0747)	0.0547 (0.0455)	0.1201*** (0.0292)
1[TM≤0.80] in 2009 *Mean(1.84)*	0.120 (0.0866)	0.102 (0.0657)	0.0992* (0.0582)	0.0797** (0.0354)	0.1160 (0.0752)	0.0350 (0.0460)	0.1182*** (0.0296)
1[TM≤0.80] in 2010 *Mean(1.95)*	0.0984 (0.0893)	0.0869 (0.0677)	0.0845 (0.0595)	0.0826** (0.0363)	0.1173 (0.0771)	0.0244 (0.0471)	0.1335*** (0.0302)
1[TM≤0.80] in 2011 *Mean(1.94)*	0.111 (0.0895)	0.0946 (0.0683)	0.0921 (0.0601)	0.0844** (0.0363)	0.1332 (0.0782)	0.0246 (0.0473)	0.1399*** (0.0301)
MSA FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Tract Covariates	No	No	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.1	0.1	0.1	0.3	0.1	0.3	No
Model	Linear	Linear	Linear	Linear	Cubic	Cubic	Cubic
N	19988	19988	19988	55480	19988	55480	92460

Note: Robust standard errors, clustered by census tracts, are reported in parentheses.

Table 5. RD Estimates of CRA's Effect on the Number of Branches by size of MSAs

(each zip code-census tract correspondence level)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
1[TM≤0.80] Entire Sample							
Large MSAs *Mean(7.1)*	-0.1276 (0.3294) N=63600	0.0771 (0.2866) N=63600	0.0429 (0.2574) N=63600	0.1123 (0.1566) N=174144	-0.0307 (0.3381) N=63600	0.1074 (0.2056) N=174144	-0.1024 (0.1227) N=318080
Med MSAs *(5.75)*	0.6064 (0.3749) N=46544	0.6513* (0.3337) N=46544	0.743*** (0.278) N=46544	0.385** (0.171) N=123808	0.9598* (0.375) N=46544	0.292 (0.222) N=123808	0.456*** (0.135) N=203840
Small MSAs *(5.3)*	0.3751 (0.4184) N=49760	-0.0244 (0.3568) N=49760	-0.160 (0.290) N=49760	0.3682** (0.179) N=145888	-0.3350 (0.3742) N=49760	0.0023 (0.234) N=145888	0.834*** (0.161) N=217760
1[TM≤0.80] Sample of Large Banks							
Large MSAs *(2.44)*	0.0247 (0.131) N=63600	0.126 (0.108) N=63600	0.103 (0.0963) N=63600	0.0642 (0.0588) N=174144	0.0605 (0.124) N=63600	0.0298 (0.0772) N=174144	-0.0199 (0.0472) N=318080
Med MSAs *(1.54)*	0.195 (0.145) N=46544	0.195* (0.110) N=46544	0.231** (0.0940) N=46544	0.123** (0.0577) N=123808	0.318** (0.125) N=46544	0.113 (0.0751) N=123808	0.145*** (0.0456) N=203840
Small MSAs *(1.1)*	0.0136 (0.112) N=49760	-0.0401 (0.0931) N=49760	-0.0659 (0.0811) N=49760	0.0712 (0.0507) N=145888	-0.0255 (0.101) N=49760	-0.0072 (0.0651) N=145888	0.205*** (0.0451) N=217760
MSA FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tract Covariates	No	No	Yes	Yes	Yes	Yes	Yes
Bandwidth	0.1	0.1	0.1	0.3	0.1	0.3	No
Model	Linear	Linear	Linear	Linear	Cubic	Cubic	Cubic

Note: Robust standard errors, clustered by census tracts, are reported in parentheses.

Table 6. RD Estimates of CRA's Effect on the Predicted Num. of Branches(Census tract-level)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
1[TM≤0.80] Entire Sample							
All MSAs *Mean* *(1.21)*	-0.0261* (0.0137) N=88632	-0.0103 (0.0128) N=88632	-0.0116 (0.0108) N=88632	-.022*** (0.0064) N=245264	0.0165 (0.0144) N=88632	-.0295*** (0.0084) N=245264	-.0775*** (0.0056) N=417368
Large MSAs *(1.4)*	-.102*** (0.0197) N=39840	-.0721*** (0.0186) N=39840	-.053*** (0.0153) N=39840	-.035*** (0.0092) N=111536	-.082*** (0.0203) N=39840	-.0158 (0.0121) N=111536	-.111*** (0.0079) N=201976
Med MSAs *(1.21)*	0.0147 (0.0249) N=25088	0.0214 (0.0240) N=25088	0.0356* (0.0203) N=25088	-0.0182 (0.0120) N=67352	0.173*** (0.0271) N=25088	-.041*** (0.0159) N=67352	-.0969*** (0.0108) N=113592
Small MSAs *(1.4)*	0.0648** (0.0280) N=23704	0.0663** (0.0261) N=23704	0.0031 (0.0222) N=23704	-.0300** (0.0130) N=66376	0.0128 (0.0302) N=23704	-.056*** (0.0173) N=66376	-.0581*** (0.0113) N=101800
1[TM≤0.80] Sample of Large Banks							
All MSAs *Mean* *(0.31)*	-0.0037 (0.0047) N=88632	0.0068 (0.0042) N=88632	0.0058 (0.0038) N=88632	0.0038* (0.0023) N=245264	0.018*** (0.0049) N=88632	-0.0014 (0.0030) N=245264	0.0021 (0.0020) N=417368
Large MSAs *(0.36)*	-0.022*** (0.0074) N=39840	-0.0018 (0.0068) N=39840	0.0020 (0.0059) N=39840	-0.0010 (0.0036) N=111536	0.0076 (0.0076) N=39840	0.0020 (0.0047) N=111536	-0.021*** (0.0031) N=201976
Med MSAs *(0.29)*	0.027*** (0.0088) N=25088	0.0284*** (0.0077) N=25088	0.036*** (0.0070) N=25088	0.016*** (0.0041) N=67352	0.058*** (0.0092) N=25088	0.0114** (0.0055) N=67352	0.0046 (0.0034) N=113592
Small MSAs *(0.255)*	-0.0081 (0.0082) N=23704	-0.0012 (0.0068) N=23704	-.0154** (0.0064) N=23704	-0.0031 (0.0041) N=66376	-0.0044 (0.0084) N=23704	-.018*** (0.0052) N=66376	.0076** (0.0034) N=101800
MSA FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tract Controls	No	No	Yes	Yes	Yes	Yes	Yes
Band-width	0.1	0.1	0.1	0.3	0.1	0.3	No
Model	Linear	Linear	Linear	Linear	Cubic	Cubic	Cubic

Note: Robust standard errors are reported in parentheses.

Table 7. CRA's Effect on the Probability of the Existence of a Branch (Census tract-level)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
1[TM≤0.80] Entire Sample							
All MSAs	-.0185***	-.0136***	-.0126***	-.017***	-.017***	-.0099***	-.0408***
Mean	(0.0043)	(0.0040)	(0.0037)	(0.0021)	(0.0052)	(0.0029)	(0.0015)
(0.24)	N=88632	N=88632	N=88632	N=245264	N=88632	N=245264	N=417368
Large	-.014***	-.0128***	-.008***	-.0049**	-.018***	-.009***	-.0089***
MSAs	(0.0047)	(0.0044)	(0.0041)	(0.0023)	(0.0055)	(0.0031)	(0.0016)
(0.19)	N=39840	N=39840	N=39840	N=111536	N=39840	N=111536	N=201976
Med	-.040***	-.0393***	-.045***	-.020***	-.046***	-.027***	-.036***
MSAs	(0.0084)	(0.0080)	(0.0073)	(0.0041)	(0.0104)	(0.0056)	(0.0029)
(0.25)	N=25088	N=25088	N=25088	N=67352	N=25088	N=67352	N=113592
Small	$-4.6*10^{-5}$	0.0134	0.0129	-.028***	0.0099	0.0049	-0.077***
MSAs	(0.0106)	(0.0101)	(0.0094)	(0.0054)	(0.0131)	(0.0071)	(0.0040)
(0.32)	N=23704	N=23704	N=23704	N=66376	N=23704	N=66376	N=101800
1[TM≤0.80] Sample of Large Banks							
All MSAs	-.007***	-.0047***	-.005***	-.0009	-0.0003	-.0046***	-.0051***
Mean	(0.0019)	(0.0018)	(0.0016)	(0.0010)	(0.0021)	(0.0013)	(0.0007)
(0.12)	N=88632	N=88632	N=88632	N=245264	N=88632	N=245264	N=417368
Large	-.0157***	-.0113***	-.010***	-.004***	-.0071**	-.009***	-.0080***
MSAs	(0.0026)	(0.0025)	(0.0022)	(0.0013)	(0.0028)	(0.0018)	(0.0010)
(0.12)	N=39840	N=39840	N=39840	N=111536	N=39840	N=111536	N=201976
Med	$-7.8*10^{-5}$	0.0013	0.0027	0.0029	0.0107**	0.0040*	-.0027*
MSAs	(0.0034)	(0.0033)	(0.0031)	(0.0018)	(0.0042)	(0.0024)	(0.0014)
(0.116)	N=25088	N=25088	N=25088	N=67352	N=25088	N=67352	N=113592
Small	$4.93*10^{-5}$	0.0011	-0.0042	-0.0012	-0.0013	-.0074***	-.0097***
MSAs	(0.0041)	(0.0038)	(0.0037)	(0.0022)	(0.0047)	(0.0028)	(0.0017)
(0.115)	N=23704	N=23704	N=23704	N=66376	N=23704	N=66376	N=101800
MSA FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tract Controls	No	No	Yes	Yes	Yes	Yes	Yes
Band-width	0.1	0.1	0.1	0.3	0.1	0.3	No
Model	Linear	Linear	Linear	Linear	Cubic	Cubic	Cubic

Note: Robust standard errors are reported in parentheses.

Table 8. RD Estimates of CRA's Effect on the Existence of a Branch (Census tract-level)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1[TM≤0.80] Entire Sample							
All MSAs *Mean* *(0.98)*	0.0007 (0.0020) N=88632	0.0010 (0.0020) N=88632	0.0010 (0.0020) N=88632	.0035*** (0.0011) N=245264	0.0049 (0.0027) N=88632	-0.0018 (0.0015) N=245264	-0.0009 (0.0009) N=417368
Large MSAs *(0.98)*	0.0023 (0.0030) N=39840	0.0030 (0.0030) N=39840	0.0028 (0.0030) N=39840	.0082*** (0.0017) N=111536	-.0010 (0.0041) N=39840	-.0035 (0.0023) N=111536	-.0041*** (0.0013) N=201976
Med MSAs *(0.98)*	-.0107*** (0.0035) N=25088	-.0104*** (0.0034) N=25088	-.0099*** (0.0034) N=25088	0.0013 (0.0021) N=67352	0.0072 (0.0047) N=25088	-.0016 (0.0027) N=67352	-.0048*** (0.0017) N=113592
Small MSAs *(0.98)*	0.0098** (0.0040) N=23704	.0105*** (0.0040) N=23704	0.0097** (0.0041) N=23704	-0.0024 (0.0023) N=66376	.0151*** (0.0054) N=23704	0.0005 (0.0031) N=66376	-0.0051** (0.0020) N=101800
1[TM≤0.80] Sample of Large Banks							
All MSAs *Mean* *(0.80)*	.0154*** (0.0056) N=88632	.0203*** (0.0049) N=88632	.0190*** (0.0048) N=88632	.0118*** (0.0028) N=245264	.0183*** (0.0064) N=88632	.0052 (0.0037) N=245264	-.0011 (0.0021) N=417368
Large MSAs *(0.88)*	0.0032 (0.0068) N=39840	0.0109* (0.0064) N=39840	0.0087 (0.0063) N=39840	0.0017 (0.0036) N=111536	0.0014 (0.0084) N=39840	-0.0054 (0.0049) N=111536	-0.013*** (0.0027) N=201976
Med MSAs *(0.76)*	.0297*** (0.0111) N=25088	.0430*** (0.0098) N=25088	.0499*** (0.0095) N=25088	.0044 (0.0056) N=67352	.0696*** (0.0131) N=25088	0.0109 (0.0074) N=67352	-.0092** (0.0043) N=113592
Small MSAs *(0.69)*	0.0124 (0.0123) N=23704	0.0118 (0.0106) N=23704	0.0031 (0.0102) N=23704	.0306*** (0.0058) N=66376	-0.0020 (0.0137) N=23704	0.0148* (0.0078) N=66376	.0130*** (0.0047) N=101800
MSA FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tract Controls	No	No	Yes	Yes	Yes	Yes	Yes
Band-width	0.1	0.1	0.1	0.3	0.1	0.3	No
Model	Linear	Linear	Linear	Linear	Cubic	Cubic	Cubic

Note: Robust standard errors are reported in parentheses.