Bank Adaptation to Neighborhood Change
Mortgage Lending and the Community Reinvestment Act

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Harvard Joint Center for Housing Studies

Raphael W. Bostic
Federal Reserve Bank of Atlanta
summary of findings

A mismatch between CRA eligibility and neighborhood’s actual status
- Fixed CRA eligibility vs. Changes in neighborhood status
- Banks’ incentive to gather and use their own private information

Research question and findings
- Do lending patterns among institutions covered by the CRA vary systematically across CRA-eligible locations such that those doing better during the decade receive increasingly more credit?
- Is there evidence that points to particular mechanisms as being important drivers for the patterns?
  (1) Learning and adaptation
  (2) Information revelation and self-reinforcement
- Providing evidence of strategic responses of banks to fair lending regulation
summary of findings

A mismatch between CRA eligibility and neighborhood’s actual status
- Fixed CRA eligibility vs. Changes in neighborhood status
- Banks’ incentive to gather and use their own private information

Research question and findings
- Do lending patterns among institutions covered by the CRA vary systematically across CRA-eligible locations such that those doing better during the decade receive increasingly more credit? YES, especially in the 2000s
- Is there evidence that points to particular mechanisms as being important drivers for the patterns?
  1. Learning and adaptation YES. Banks serve the most rapidly improving areas more intensively when the areas are within their assessment areas
  2. Information revelation and self-reinforcement Probably NO. The effects found did not increase over time
- Providing evidence of strategic responses of banks to fair lending regulation
introduction

**CRA eligibility:** determined in part by the median income of a census tract relative to the one in surrounding area (i.e. under 80 percent of metropolitan area)

**Unintended consequences of the mismatch between CRA eligibility and neighborhood’s actual status**
- CRA eligibility is determined using the most recent decennial Census
- The designation remains fixed for an entire decade (e.g. Census 1990: 1992 – 2002; Census 2000: 2003 – 2011)
- BUT neighborhoods change over the course of a decade

**Research question**
- Do lending patterns among institutions covered by the CRA vary systematically across CRA-eligible locations such that those doing better during the decade receive increasingly more credit?
- If variation is observed, is there evidence that points to particular mechanisms as being important drivers for the patterns?
definition of moving up tracts

Moving up tracts: tracts identified as low- and moderate-income (LMI) in a particular Census but not in the successive Census
NYC

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**Moving up tracts:** tracts identified as low- and moderate-income (LMI) in a particular Census but not in the successive Census

- **stayer**
- **moving-up, 80 to 119%**
- **moving-up, 120+%**
- **non-CRA eligible tract**
SF – LMI tracts with moving up tracts

Moving up tracts: tracts identified as low- and moderate-income (LMI) in a particular Census but not in the successive Census

- Grey: stayer
- Yellow: moving-up, 80 to 119%
- Green: moving-up, 120+% non-CRA eligible tract
- Light grey: non-CRA eligible tract
DC – LMI tracts with moving up tracts

**Moving up tracts:** tracts identified as low- and moderate-income (LMI) in a particular Census but not in the successive Census

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- stayer
- moving-up, 80 to 119%
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## Incidence of Neighborhood Changes

### Incidence of neighborhood changes, 1990 to 2000 and 2000 to 2010

<table>
<thead>
<tr>
<th></th>
<th>LMI</th>
<th>Non-LMI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In 2000:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In 1990:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LMI</td>
<td>12,184</td>
<td>1,921</td>
<td>14,105</td>
</tr>
<tr>
<td>(%)</td>
<td>(86.4%)</td>
<td>(13.6%)</td>
<td>(100.0%)</td>
</tr>
<tr>
<td>Non-LMI</td>
<td>3,271</td>
<td>28,705</td>
<td>31,976</td>
</tr>
<tr>
<td>(%)</td>
<td>(10.2%)</td>
<td>(89.8%)</td>
<td>(100.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>15,455</td>
<td>30,626</td>
<td>46,081</td>
</tr>
<tr>
<td><strong>In 2000:</strong></td>
<td></td>
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</tr>
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<td>18,799</td>
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*Note:* The CRA-eligible census tract, or low-and moderate-income (LMI) tract, is defined as the tract with median family income that is at or below 80% of the surrounding area’s median family income. The tracts in this table is restricted to those within metropolitan statistical areas or metropolitan divisions. For those census tracts that had experienced changes in their boundary over time, we estimated weighted averages of median family income of those census tracts using block-level population as weights.
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shift in lending towards moving up tracts

Share of LMI lending to moving up tracts

Source: Authors’ analysis based on the 1995–2011 HMDA LAR files.

Note: The sample is restricted to the conventional home purchase loan originations for purchasing one-to-four family homes in the neighborhoods in MSA/MDs. The sample include loan origination records reported by banking institutions that are supervised by OCC, FRS, FDIC, and OTS/CFPB, and the loans purchased by reporting institutions and those with preapproval requests are excluded.
shift in lending towards moving up tracts

Share of LMI lending to moving up tracts

Source: Authors’ analysis based on the 1995–2011 HMDA LAR files.

Note: Dots represent the sample averages within intervals of 0.1 in median family income of a census tract as a share of area median income (AMI). The solid line is from a fourth-order polynomial in AMI share fitted separately for observations above and below the 80 percent threshold. The dotted line is the 95 percent confidence interval. Regression models include county fixed-effects with robust standard errors.
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two possible channels explaining the pattern

(1) **Learning and adaptation:** banking institutions observe the neighborhoods changes as they are occurring and incorporate them into their loan decision process
- Probability of default for a mortgage loan can be affected by neighborhood characteristics (Campbell et al. 2011; Harding et al. 2009; Ioannides 2003; Chan et al. 2013)
- Strategic behavior by financial institutions to comply with regulatory requirements (Evanoff and Segal 1997; Bostic et al. 2005; Avery and Brevoort 2015)

(2) **Information revelation and self-reinforcement:** previous loan origination patterns shape subsequent ones and mortgage lending has positive impacts on neighborhoods
- Positive association between previous and current lending activities, by information externalities and economies of scale (Lang and Nakamura 1993; Blackburn and Vermilyea 2007; Harrison 2001; Calem 1996; Ling and Wachter 1998; Avery et al. 1999)
- Contribution of lending activities to neighborhood improvements (Avery et al. 2003; Fitzgerald and Vitello (2014)
method and data – empirical model

Loan decision-making model

\[ y_{ijklm} = \psi x_{ijklm} + \omega_n_{kl} + BankFE_j + CountyFE_i + YearFE_m + \epsilon_{ijklm} \]

Base model

- \( y_{ijklm} \): 1 = approved; 0 = denied
- \( X_{ijklm} \): a vector of applicant attributes
- \( N_{kl} \): the most recent decennial census data on neighborhood characteristics
- \( BankFE_j, CountyFE_i, YearFE_m \): institution-, year-, or location-specific heterogeneity
method and data – empirical model

Loan decision-making model

\[ y_{ijklm} = \psi x_{ijklm} + \omega n_{kl} + BankFE_j + CountyFE_i + YearFE_m + \alpha M_{kl} + \beta (M_{kl} \times Assess_{jklm}) + \gamma s_{jkl} + \epsilon_{ijklm} \]

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(1) Learning and adaptation hypothesis

\( M_{kl} \) (reference group: stayer, LMI) – whether banks strategically shift lending towards improving neighborhoods

(1) moving-down

(2) moving-up, 80 to 119%

(3) moving-up, 120+%  

(4) stayer, non-LMI
method and data – empirical model

Loan decision-making model

\[ y_{ijklm} = \psi X_{ijklm} + \omega N_{kl} + BankFE_j + CountyFE_i + YearFE_m \]
\[ + \alpha M_{kl} + \beta (M_{kl} \times Assess_{jkklm}) + \gamma S_{jkl} + \epsilon_{ijklm} \]

(1) Learning and adaptation hypothesis

Assess_{jkklm} – whether there are any CRA incentives or not

\((M_{kl} \times Assess_{jkklm})\) – to distinguish between adaptation and consumer sorting

- move up effects in assessment area: adaptation + consumer sorting
- move up effects in non-assessment area: consumer sorting

(2) Information revelation and self-reinforcement

\(S_{jkl}\) – whether lending distributions in the first three years of each decennial period (e.g. 1990–1992 or 2000–2002) affect current decision making

- tract \(k\)'s share of mortgage loans originated by bank
- tract \(k\)'s share of mortgage loans originated by all institutions in the industry
method and data – HMDA sample

Data sources
- HMDA Loan Application Records (LAR)
  - From 1995 to 2002: Census 1990
  - From 2004 to 2011: Census 2000
- FFIEC Demographic Profiles, 1995 to 2011
- 1990 and 2000 Census; 2008-2012 American Community Survey 5-Year Estimates
- ZIP code level average credit score from Fair Isaac Corporation

HMDA Sample
- Depository institutions subject to the CRA (OCC, FRS, FDIC, and OTS/CFPB)
- Home purchase loans
- One-to-four family homes
- Owner-occupied as a principal dwelling
- Within metropolitan areas
- Exclude FHA, VA, and FSA/RHS loans; preapprovals
- Regression Discontinuity Design: (1) 70% \leq x < 90\%, (2) 75% \leq x < 85\%, and (3) 77% \leq x < 83\%
summarized results

Pooled cross-sectional, 1995–2002  (dependent variable: whether a loan application is approved)

<table>
<thead>
<tr>
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<th>All Tracts</th>
<th>[70%, 90%)</th>
<th>[75%, 85%)</th>
<th>[77%, 83%)</th>
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<tbody>
<tr>
<td>Learning and Adaptation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving down</td>
<td>-0.003 *</td>
<td>-0.007 **</td>
<td>-0.009 **</td>
<td>-0.009 *</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Moving up (80 to 119 %)</td>
<td>0.012 ***</td>
<td>0.011 ***</td>
<td>0.013 ***</td>
<td>0.009 *</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Moving up (120+ %)</td>
<td>0.051 ***</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.008)</td>
<td>(0.010)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Stayer, non-LMI</td>
<td>0.033 ***</td>
<td>0.004</td>
<td>0.006</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Assessment area × Moving up type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stayer, LMI</td>
<td>0.033 ***</td>
<td>0.018 ***</td>
<td>0.019 ***</td>
<td>0.022 ***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Moving down</td>
<td>0.038 ***</td>
<td>0.023 ***</td>
<td>0.025 ***</td>
<td>0.030 ***</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Moving up (80 to 119 %)</td>
<td>0.036 ***</td>
<td>0.016 ***</td>
<td>0.017 ***</td>
<td>0.023 ***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
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</tr>
<tr>
<td>Moving up (120+ %)</td>
<td>0.022 ***</td>
<td>0.025 **</td>
<td>0.029 **</td>
<td>0.038 **</td>
</tr>
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<td></td>
<td>(0.005)</td>
<td>(0.009)</td>
<td>(0.011)</td>
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<tr>
<td>Stayer, non-LMI</td>
<td>0.022 ***</td>
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<td>0.023 ***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.003)</td>
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<tr>
<td>Self-reinforcement</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>At industry-level (%)</td>
<td>0.885 ***</td>
<td>2.998 ***</td>
<td>2.493 ***</td>
<td>2.090 ***</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.192)</td>
<td>(0.282)</td>
<td>(0.372)</td>
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<tr>
<td>At lender-level (%)</td>
<td>0.001 ***</td>
<td>0.000 ***</td>
<td>0.000</td>
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</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
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<tr>
<td>Individual applicant char.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Neighborhood char. in Census 2000</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Banking Institution FEs</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>County FEs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Year FEs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.1104</td>
<td>0.1201</td>
<td>0.1205</td>
<td>0.1204</td>
</tr>
<tr>
<td>Number of observations</td>
<td>19,565,711</td>
<td>2,969,746</td>
<td>1,498,142</td>
<td>873,504</td>
</tr>
</tbody>
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Note: * p < 0.05, ** p < 0.01, *** p < 0.001.
### Summarized Results

**Pooled cross-sectional, 1995–2002** (dependent variable: whether a loan application is approved)

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<tr>
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<td>-0.007</td>
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<tr>
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<td>0.023</td>
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<tr>
<td>Moving up (80 to 119 %)</td>
<td>0.036</td>
<td>***</td>
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<td>0.023</td>
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<tr>
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<th>Self-reinforcement</th>
<th>At industry-level (%)</th>
<th><strong>Coef.</strong></th>
<th><strong>Sig.</strong></th>
<th>At lender-level (%)</th>
<th><strong>Coef.</strong></th>
<th><strong>Sig.</strong></th>
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</table>

**Individual applicant char.**
- Yes
- Yes
- Yes
- Yes

**Neighborhood char. in Census 2000**
- Yes
- Yes
- Yes
- Yes

**Banking Institution FEs**
- Yes
- Yes
- Yes
- Yes

**County FEs**
- Yes
- Yes
- Yes
- Yes

**Year FEs**
- Yes
- Yes
- Yes
- Yes

**Adjusted R-squared**
- 0.1104
- 0.1201
- 0.1205
- 0.1204

**Number of observations**
- 19,565,711
- 2,969,746
- 1,498,142
- 873,504

**Note:** * p < 0.05, ** p < 0.01, *** p < 0.001.
summarized results

Pooled cross-sectional, 1995–2002 (dependent variable: whether a loan application is approved)

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<tr>
<th></th>
<th>All Tracts</th>
<th>[70%, 90%)</th>
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<tr>
<td>Learning and Adaptation</td>
<td></td>
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<tr>
<td>Moving down</td>
<td>−0.003 **</td>
<td>−0.007 **</td>
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<tr>
<td>Moving up (80 to 119 %)</td>
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<td>0.013 ***</td>
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<tr>
<td>Stayer, non-LMI</td>
<td>0.033 ***</td>
<td>0.004</td>
<td>0.006</td>
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<tr>
<td>Assessment area × Moving up type</td>
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<tr>
<td>Moving up (120+ %)</td>
<td>0.022 ***</td>
<td>0.025</td>
<td>0.029</td>
<td>0.038 **</td>
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<tr>
<td>At industry-level (%)</td>
<td>0.885 ***</td>
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<td>At lender-level (%)</td>
<td>0.001 ***</td>
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<td>Yes</td>
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<tr>
<td>Banking Institution FEs</td>
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<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>County FEs</td>
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<tr>
<td>Year FEs</td>
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<td>1,498,142</td>
<td>873,504</td>
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Note: * p < 0.05, ** p < 0.01, *** p < 0.001.
## Summarized Results

### Pooled Cross-Sectional, 2004–2011
(dependent variable: whether a loan application is approved)

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<td>Moving down</td>
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<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
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</tr>
<tr>
<td>Moving up (80 to 119 %)</td>
<td>0.014 ***</td>
<td>0.007 ***</td>
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<tr>
<td>Moving up (120+ %)</td>
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</tr>
<tr>
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<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.007)</td>
</tr>
<tr>
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<td>(0.003)</td>
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<td>–0.000</td>
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<td>(0.002)</td>
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<tr>
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<td>0.002</td>
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<td>0.007 *</td>
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<td>Moving up (120+ %)</td>
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<td>0.021 **</td>
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<td></td>
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<tr>
<td>At industry-level (%)</td>
<td>1.292 **</td>
<td>4.830 ***</td>
<td>3.676 ***</td>
<td>3.963 ***</td>
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<td>(0.210)</td>
<td>(0.293)</td>
<td>(0.495)</td>
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<td>At lender-level (%)</td>
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<tr>
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<td>0.2017</td>
<td>0.2024</td>
<td>0.2040</td>
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<tr>
<td>Number of observations</td>
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<td>3,121,676</td>
<td>1,559,369</td>
<td>894,766</td>
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*Note: * p < 0.05, ** p < 0.01, *** p < 0.001.
summarized results

Pooled cross-sectional, 2004–2011 (dependent variable: whether a loan application is approved)

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<tr>
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</table>

<table>
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<tr>
<th>Assessment area × Moving up type</th>
<th>Stayer, LMI</th>
<th>Moving down</th>
<th>Moving up (80 to 119 %)</th>
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| Self-reinforcement | At industry-level (%) | Coef.      | Sig.       | Coef.      | Sig.       | Coef.      | Sig.       |
|                   | At lender-level (%)    | Coef.      | Sig.       | Coef.      | Sig.       | Coef.      | Sig.       |
|                   |                         |            |            |            |            |            |            |
|                   |                         | 1.292 ***  | (0.034)    | 4.830 ***  | (0.210)    | 3.676 ***  | (0.293)    |
|                   |                         | 3.963 ***  | (0.495)    |
| Individual applicant char.       | Yes          | Yes        | Yes        | Yes        | Yes          |
| Neighborhood char. in Census 2000 | Yes        | Yes        | Yes        | Yes        | Yes          |
| Banking Institution FEs          | Yes          | Yes        | Yes        | Yes        | Yes          |
| County FEs                     | Yes          | Yes        | Yes        | Yes        | Yes          |
| Year FEs                       | Yes          | Yes        | Yes        | Yes        | Yes          |
| Adjusted R-squared             | 0.1716      | 0.2017     | 0.2024     | 0.2040     |
| Number of observations         | 18,896,218  | 3,121,676  | 1,559,369  | 894,766    |

Note: * p < 0.05, ** p < 0.01, *** p < 0.001.
summarized results

Pooled cross-sectional, 2004–2011 (dependent variable: whether a loan application is approved)

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<tbody>
<tr>
<td>Moving down</td>
<td>0.004</td>
<td>***</td>
<td>-0.000</td>
<td></td>
<td>0.003</td>
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<td>0.001</td>
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Note: * p < 0.05, ** p < 0.01, *** p < 0.001.
### Summarized Results

Estimated coefficients for variables testing self-reinforcement hypothesis, 1995–2002 (dependent variable: whether a loan application is approved)

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**Note:** * p < 0.05, ** p < 0.01, *** p < 0.001.
### Summarized Results

**Estimated Coefficients for Variables Testing Self-Reinforcement Hypothesis, 1995–2002**
*(dependent variable: whether a loan application is approved)*

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*Note:* *p < 0.05, **p < 0.01, ***p < 0.001.*
summarized results

Estimated coefficients for variables testing self-reinforcement hypothesis, 2004–2011
(dependent variable: whether a loan application is approved)

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<td>0.001 ***</td>
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<td>5.676 ***</td>
<td>5.611 **</td>
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<td>47,282</td>
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<td>[77%, 83%]</td>
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Note: * p < 0.05, ** p < 0.01, *** p < 0.001.
summarized results

Estimated coefficients for variables testing self-reinforcement hypothesis, 2004–2011 (dependent variable: whether a loan application is approved)

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<th>Sig.</th>
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<td>***</td>
<td>1.102</td>
<td>***</td>
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<td>(0.564)</td>
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<td>(0.661)</td>
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<td>114,465</td>
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<td>61,219</td>
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</table>

**Note:** * p < 0.05, ** p < 0.01, *** p < 0.001.
model validity and robustness

(1) linear vs. non-linear specification?
- fourth-order polynomials for running variable (% AMI)
- virtually identical coefficients

(2) omitted variables (e.g. credit quality)
- Average FICO scores
- Magnitude of estimates slightly declines yet lending patterns are not changed

(3) definition of assessment area
- Actual assessment area boundaries (FFIEC’s CRA Disclosure Report)
- Magnitude of estimates is slightly larger and lending patterns are almost identical

(4) role of FHA loans?
- Including the FHA loans (with FHA dummies)
- Results are largely unchanged
conclusion

Summary of findings
- Shifts in the CRA-eligible lending towards moving-up neighborhoods
- The improving neighborhoods do receive increasingly more credit, especially when they are within assessment areas of banking institutions, during the decade

Unintended consequences: strategic response of banking institutions
- A feedback loop whereby the regulated firms responded to the presence of the regulation
- Obviously, firms respond to the regulation in ways that maximize their interests such that there is an incidence

Implications
- Should CRA incentivize capital flows to all underserved areas or to those underserved communities that are showing the most progress?
- Now the CRA eligibility is determined every 5 years (ACS 5-year estimates) instead of every 10 (decennial Census). Would it be enough to resolve this issue?
- What does the finding mean for other place-based policies?
The conventional model might have been of a form:

\[ b_1 \times \text{Assess} + b_2 \times \text{mdown} + b_3 \times \text{mup80} + b_4 \times \text{mup120} + b_5 \times \text{nonLMI} + b_6 \times (\text{Assess} \times \text{mdown}) + b_7 \times (\text{Assess} \times \text{mup80}) + b_8 \times (\text{Assess} \times \text{mup120}) + b_9 \times (\text{Assess} \times \text{nonLMI}) \]

The issue that model has is that the coefficients from \( b_6 \) to \( b_9 \) do not directly capture the CRA effects. At that time, we might have shown the effects by doing additional joint statistical significance tests.

<table>
<thead>
<tr>
<th></th>
<th>(1) Assessment area</th>
<th>(2) Non-assessment area</th>
<th>Diff.: (1) – (2)</th>
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<td>( b_1 )</td>
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<tr>
<td>Moving-down</td>
<td>( b_1 + b_2 + b_6 )</td>
<td>( b_2 )</td>
<td>( b_1 + b_6 )</td>
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<tr>
<td>Moving-up, 80–119%</td>
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<td>( b_1 + b_7 )</td>
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<td>( b_1 + b_8 )</td>
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<tr>
<td>Stayer, non-LMI</td>
<td>( b_1 + b_5 + b_9 )</td>
<td>( b_5 )</td>
<td>( b_1 + b_9 )</td>
</tr>
</tbody>
</table>

Therefore, we directly measure and examine the difference between assessment area types within moving up status by using the following formula:

\[ c_1 \times \text{mdown} + c_2 \times \text{mup80} + c_3 \times \text{mup120} + c_4 \times \text{nonLMI} + c_5 \times (\text{Assess} \times \text{LMI}) + c_6 \times (\text{Assess} \times \text{mdown}) + c_7 \times (\text{Assess} \times \text{mup80}) + c_8 \times (\text{Assess} \times \text{mup120}) + c_9 \times (\text{Assess} \times \text{nonLMI}) \]

Now, with this slightly changed model, we can directly capture and present the effects:

<table>
<thead>
<tr>
<th></th>
<th>(1) Assessment area</th>
<th>(2) Non-assessment area</th>
<th>Diff.: (1) – (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stayer, LMI</td>
<td>( c_5 )</td>
<td>0</td>
<td>( c_5 )</td>
</tr>
<tr>
<td>Moving-down</td>
<td>( c_1 + c_6 )</td>
<td>( c_1 )</td>
<td>( c_6 )</td>
</tr>
<tr>
<td>Moving-up, 80–119%</td>
<td>( c_2 + c_7 )</td>
<td>( c_2 )</td>
<td>( c_7 )</td>
</tr>
<tr>
<td>Moving-up, 120+%</td>
<td>( c_3 + c_8 )</td>
<td>( c_3 )</td>
<td>( c_8 )</td>
</tr>
<tr>
<td>Stayer, non-LMI</td>
<td>( c_4 + c_9 )</td>
<td>( c_4 )</td>
<td>( c_9 )</td>
</tr>
</tbody>
</table>