2017 Policy Summit on Housing, Human Capital, and Inequality
Session B2: The Impacts of the Community Reinvestment Act on Residential Lending
Hilton Cleveland Downtown | June 22–23, 2017

Bank Adaptation to Neighborhood Change

Mortgage Lending and the Community Reinvestment Act

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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

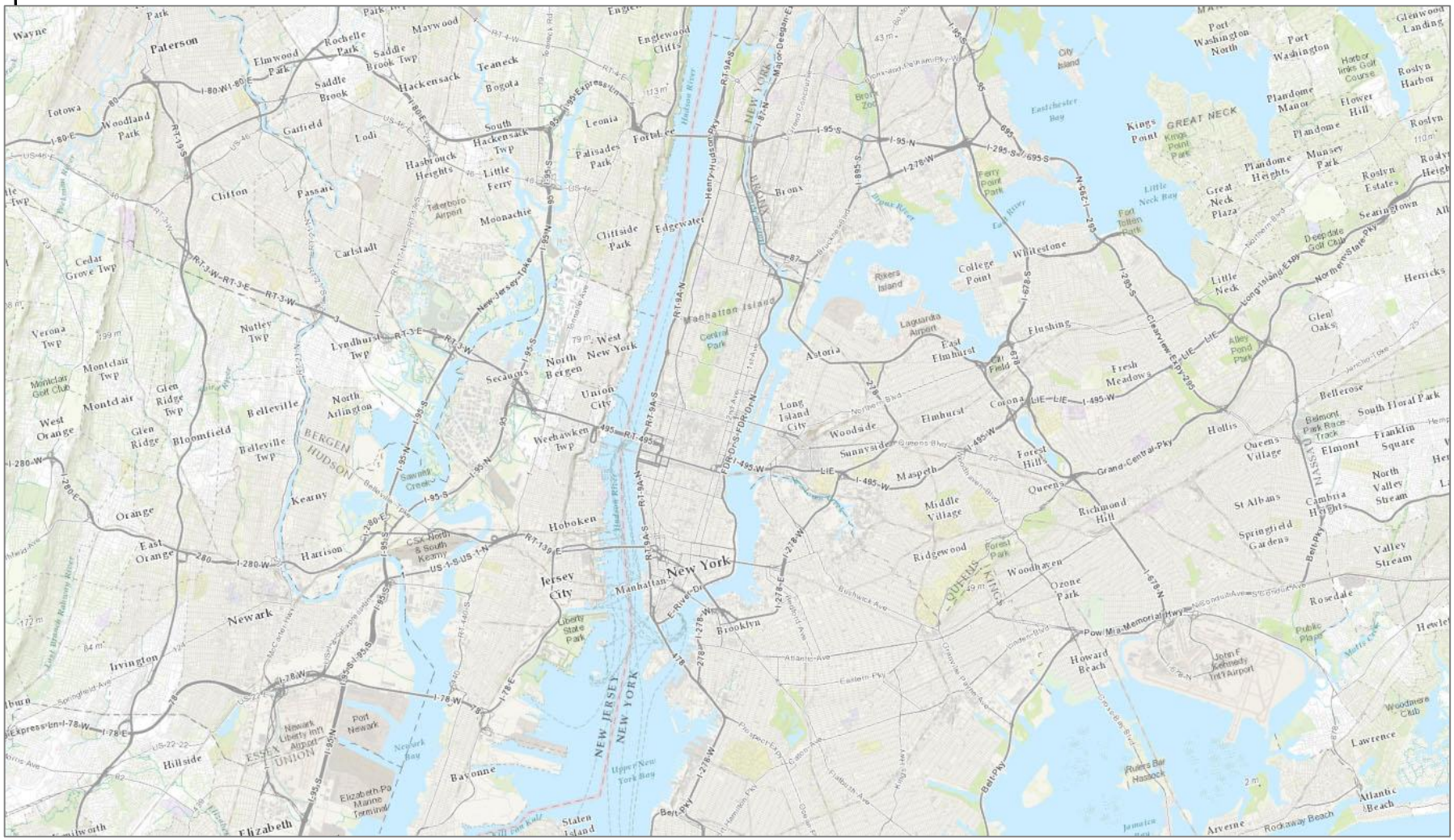
- Do lending patterns among institutions covered by the CRA vary systematically across CRA-eligible locations such that those doing better during the decade receive increasingly more credit?
- If variation is observed, is there evidence that points to particular mechanisms as being important drivers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

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


Paterson
Hackensack
Teaneck
Bogota
Fort Lee
Leonia
Palisades Park
Cliffside Park
Edgewater
Bronx
Manhattan Island
Central Park
Astoria
Long Island City
Flushing
Whitestone
College Point
Rikers Island
Laguardia Airport
East Elmhurst
Jackson Heights
Elmhurst
Corona
Woodside
Sunnyside
Maspeth
Forest Hills
Queens
Middle Village
Ridgewood
Woodhaven
Ozone Park
Richmond Hill
Jamaica
Hollis
Queens Village
St Albans
Springfield Gardens
Rosedale
Howard Beach
Far Rockaway
Arverne
Rockaway Beach
Lawrence
Atlantic Beach
Great Neck
Kings Point
Port Washington
Roslyn
Plandome
Bellerose
Franklin Square
Elmont
North Valley Stream
Valley Stream
Cambria Heights
Belmont Park Race Track
Hoboken
Jersey City
Newark
Bayonne
Elizabeth
Staten Island
Brooklyn
New York
Weehawken Twp
North Bergen
Secaucus
Union City
West New York
Guttenberg
Fairview
Cliffside Park
Fort Tilden Park
Jamaica Bay
Rockaway Inlet
Upper New York Bay
Newark Bay
Hudson River
East River
Harlem River
Long Island Sound
Eastchester Bay
Little Neck Bay
Flushing Bay

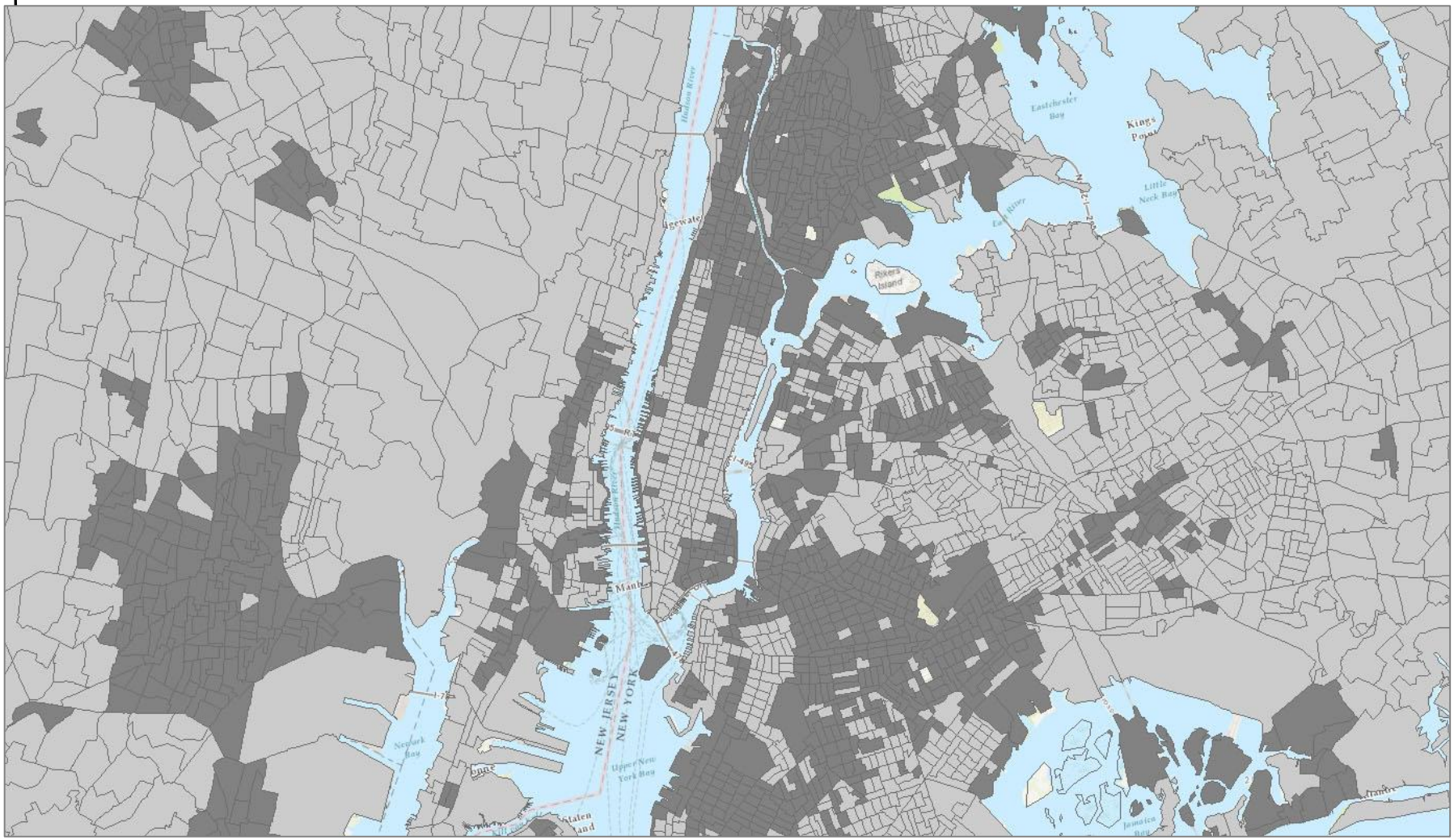
NYC – census tracts

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

Paterson
Newark
Elizabeth
Jersey City
Hoboken
Bayonne
Staten Island
Bronx
Flushing
Jamaica
Rockaway Beach
Lawrence
Hillside
Hyndhurst
Kearny
Secaucus
North Bergen
Bloomfield
Belleville
Montclair
Orange
East Orange
West Orange
Harrison
Hackensack
Passaic
Clifton
Teaneck
Bogota
Leonia
Fort Lee
Edgewater
Cliffside Park
Englewood Cliffs
Garfield
Lodi
Rochelle Park
Maywood
Saddle Brook
Totowa
Woodland Park
Wayne
Cedar Grove Twp
Verona Twp
Mountain Twp
Glen Ridge Twp
Glen Ridge
Belleville Twp
North Arlington
Lyndhurst Twp
Rutherford
Carlstadt
Moonachie
Little Ferry
Hasbrouck Heights
South Hackensack Twp
Palisades Park
Hudson River
New Jersey
New York
Manhattan
Upper New York Bay
Newark Bay
Liberty State Park
Port Newark
Newark Liberty Intl Airport
Elizabeth Port Marine Terminal
Kearny Marsh
Saw Mill Creek
Hackensack River
Passaic River
Hudson County
Essex County
Union County
Bergen County
Eastchester Bay
Little Neck Bay
Kings Point
GREAT NECK
Port Washington North
Port Washington
Roslyn Harbor
Flower Hill
Plandome
Plandome Manor
Plandome Heights
Munsey Park
Roslyn Estates
Roslyn Heights
Great Neck Plaza
Little Neck
Glen Oaks
Bellerose
Hollis
Queens Village
Elmont
Franklin Square
North Valley Stream
Valley Stream
Springfield Gardens
Laurelton
Cambria Heights
Rosedale
Richmond Hill
Forest Hills
Forest Park
Ridgewood
Maspeth
Woodside
Sunnyside
Astoria
Flushing
Corona
Lefrak City
Flushing Meadows
Fresh Meadows
Jamaica Hills
Jamaica Estates
Jamaica Bay
Howard Beach
John F Kennedy Intl Airport
Rockaway Beach
Far Rockaway
Inwood
Riker's Island
Rikers Island
Ferry Point Park
Throgs Neck Bridge
Whitestone
Bronx Zoo
Pelham Bay Park
Van Cortlandt Park
Yonkers
Mamaroneck
Port Chester
Rye
Harrison
Mamaroneck Harbor
Rye Playland
Rye Beach
Seaside Park
Seaside Park Race Track
Bayside
Douglaston
Little Neck
Great Neck
Manhasset
Port Washington
Sea Cliff
Glen Cove
Oyster Bay
Bethpage
Farmingdale
Massapequa
Massapequa Park
Seaford
Wantagh
Merrick
Bellmore
Freeport
Baldwin
Rockville Centre
Lynbrook
Valley Stream
Hempstead
Garden City
Mineola
Westbury
Carle Place
Roslyn
Glen Head
Syosset
Jericho
Hicksville
Plainview
Old Bethpage
Levittown
Wantagh
Seaford
Massapequa
Massapequa Park
Amityville
Babylon
Bay Shore
Islip
Ronkonkoma
Holbrook
Patchogue
Mastic Beach
Shirley
Moriches Bay
Great South Bay
Fire Island
Jones Beach
Long Island Sound
Hempstead Harbor
Oyster Bay Harbor
Manhasset Bay
Little Neck Bay
Jamaica Bay
Rockaway Inlet
Sheepshead Bay
Coney Island
Brooklyn
Queens
Nassau County
Suffolk County
Westchester County
Rockland County
Hudson River
East River
Harlem River
Bronx River
Passaic River
Hackensack River
Newark Bay
Kill Van Kull
Arthur Kill
Raritan Bay
Sandy Hook Bay
Lower New York Bay
Upper New York

NYC – LMI 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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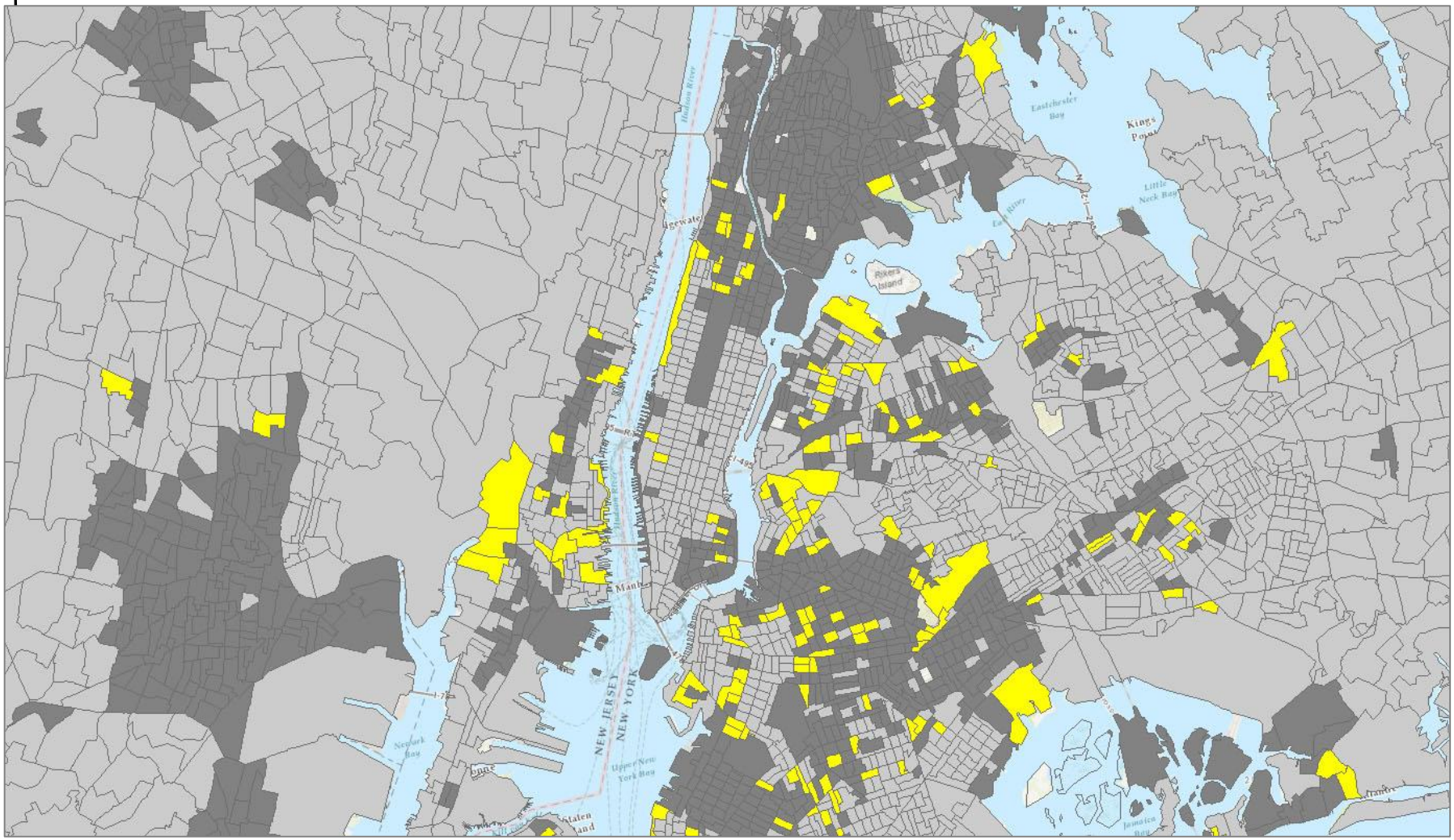

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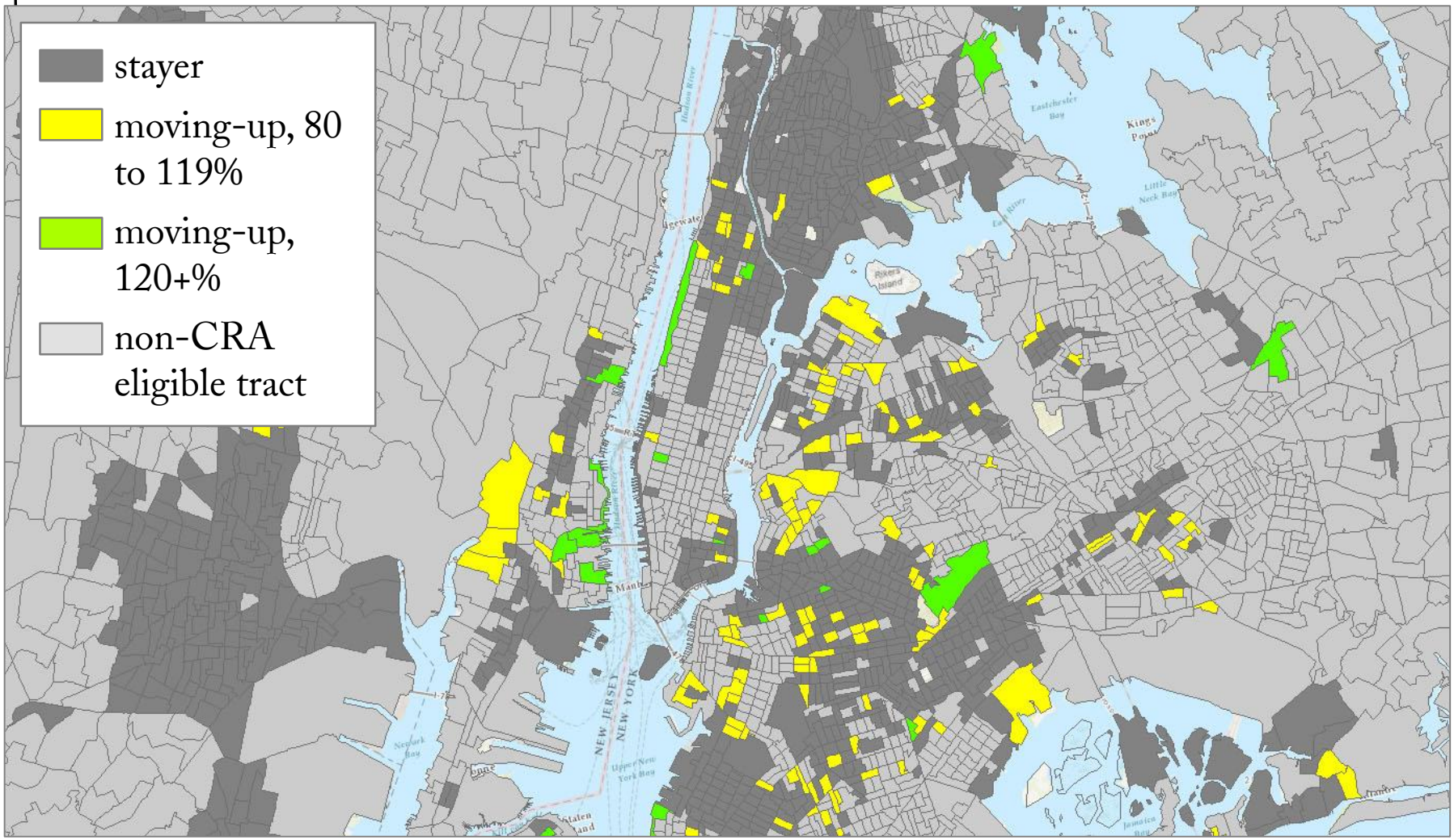

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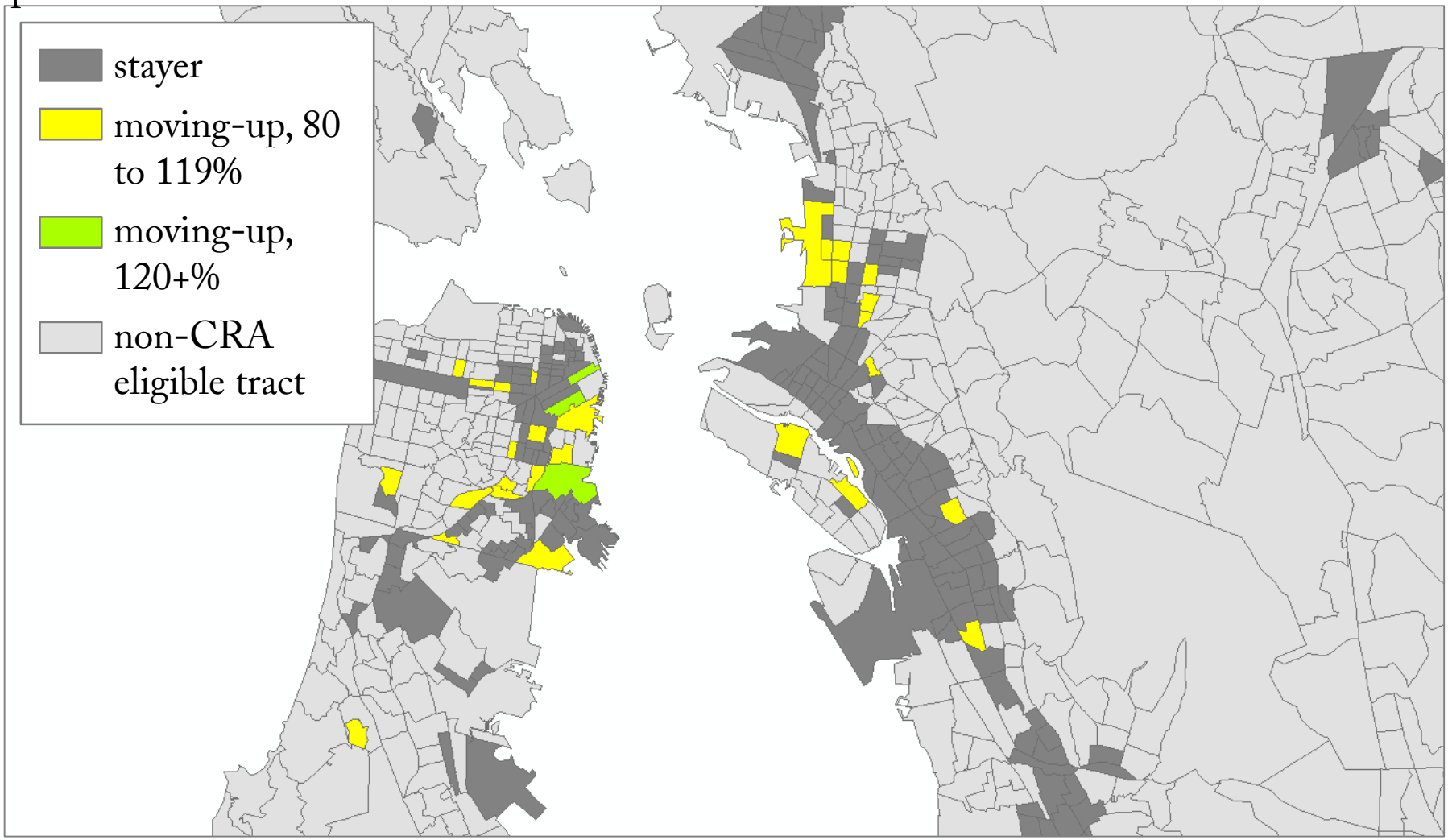

DC – LMI tracts with moving up tracts

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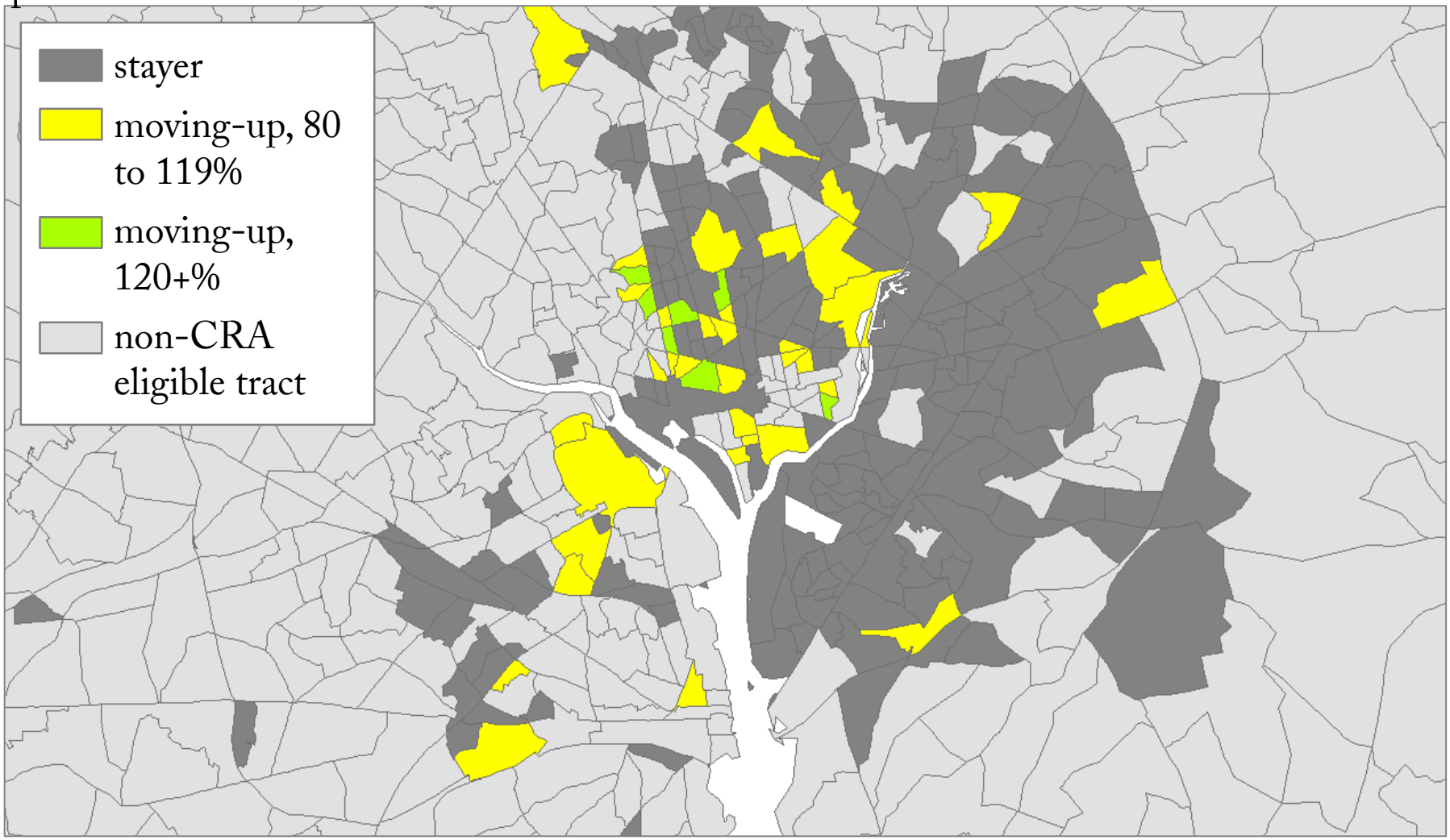

CLE – LMI tracts with moving up tracts

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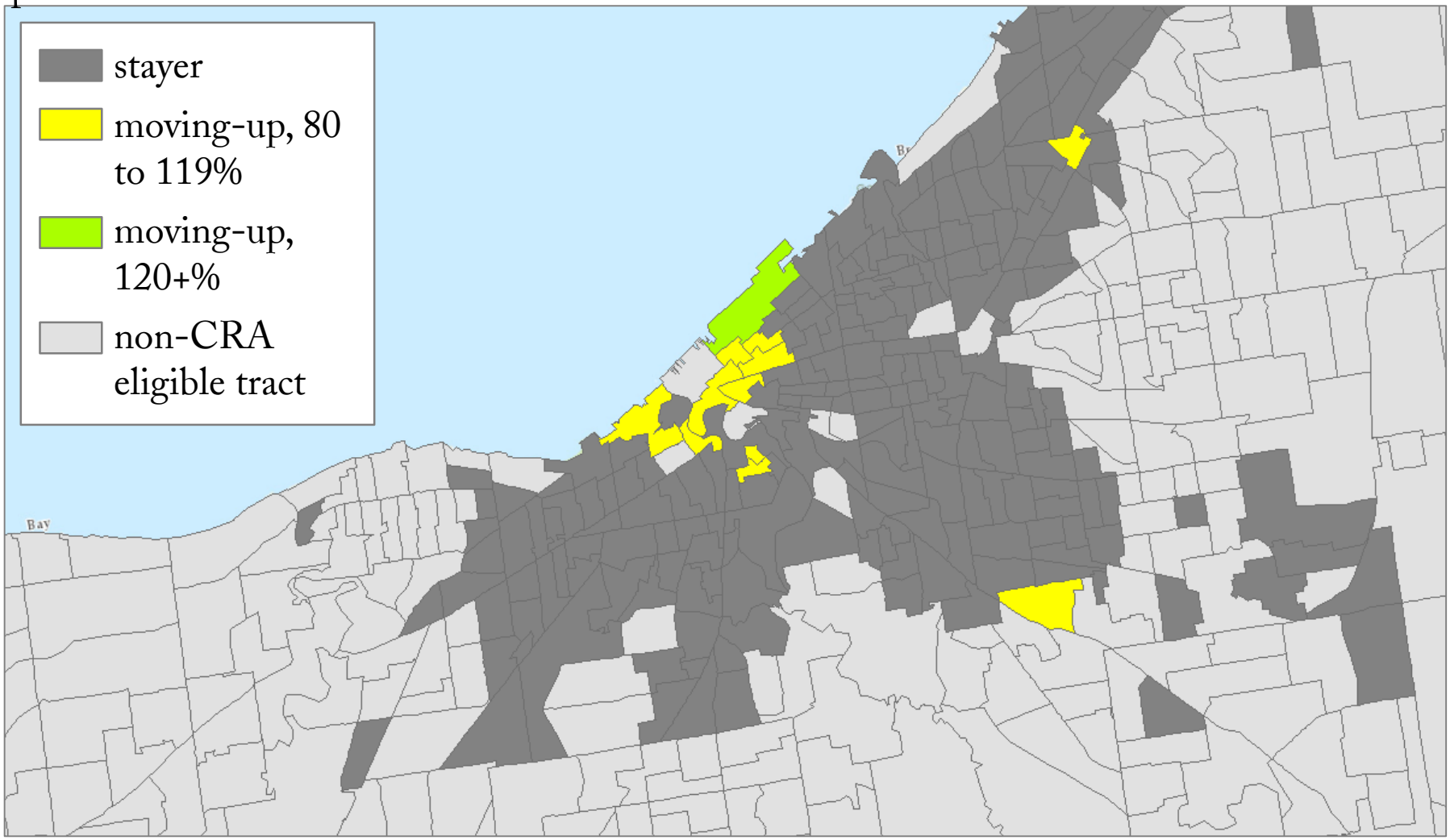

incidence of neighborhood changes

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

		In 2000:		
		LMI	Non-LMI	Total
In 1990:	LMI	12,184	1,921	14,105
	(%)	(86.4%)	(13.6%)	(100.0%)
	Non-LMI	3,271	28,705	31,976
	(%)	(10.2%)	(89.8%)	(100.0%)
	Total	15,455	30,626	46,081

		In 2000:		
		LMI	Non-LMI	Total
In 1990:	LMI	14,175	2,329	16,504
	(%)	(85.9%)	(14.1%)	(100.0%)
	Non-LMI	4,624	31,654	36,278
	(%)	(12.7%)	(87.3%)	(100.0%)
	Total	18,799	33,983	52,782

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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moving up tracts

moving down tracts

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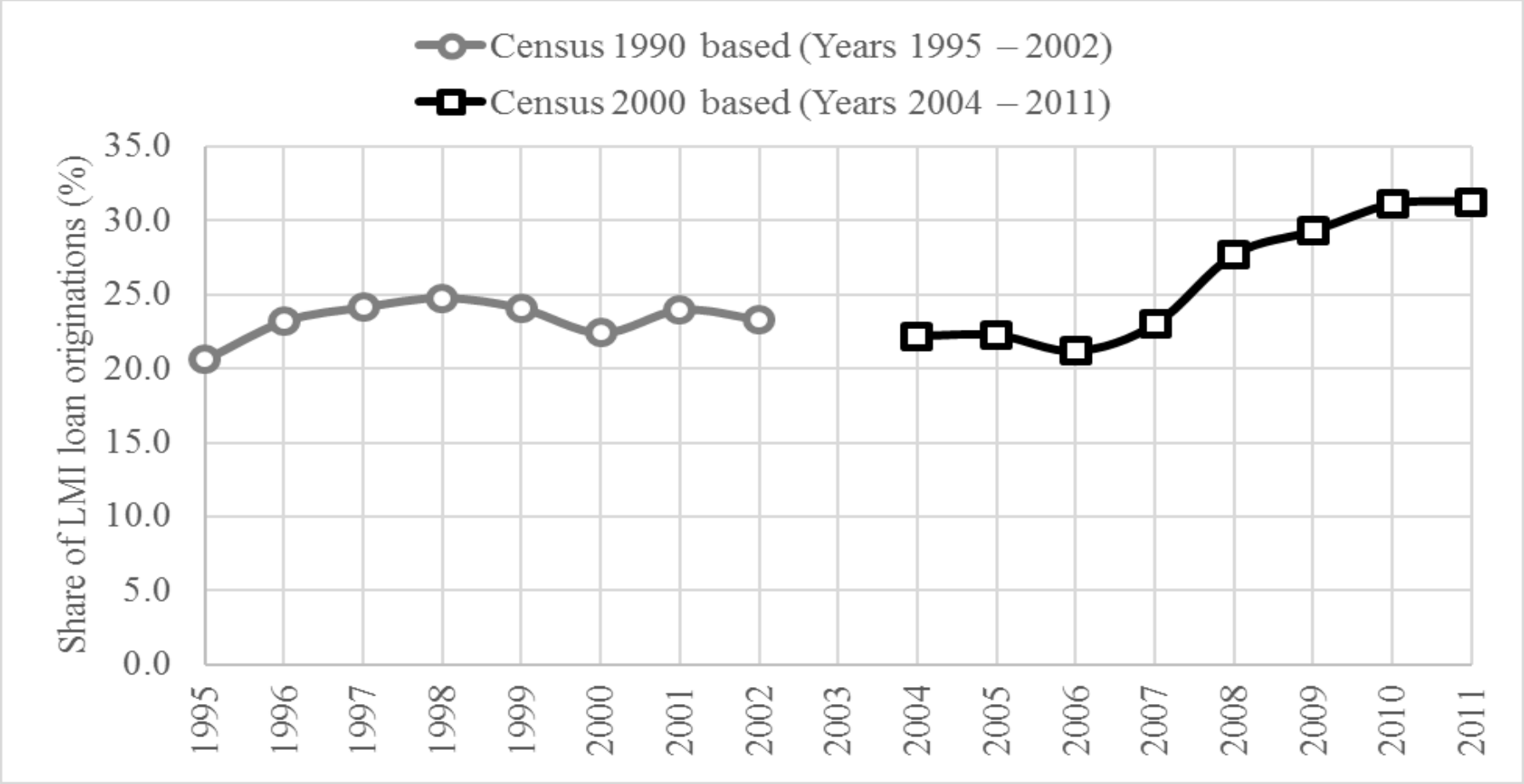
shift in lending towards moving up tracts

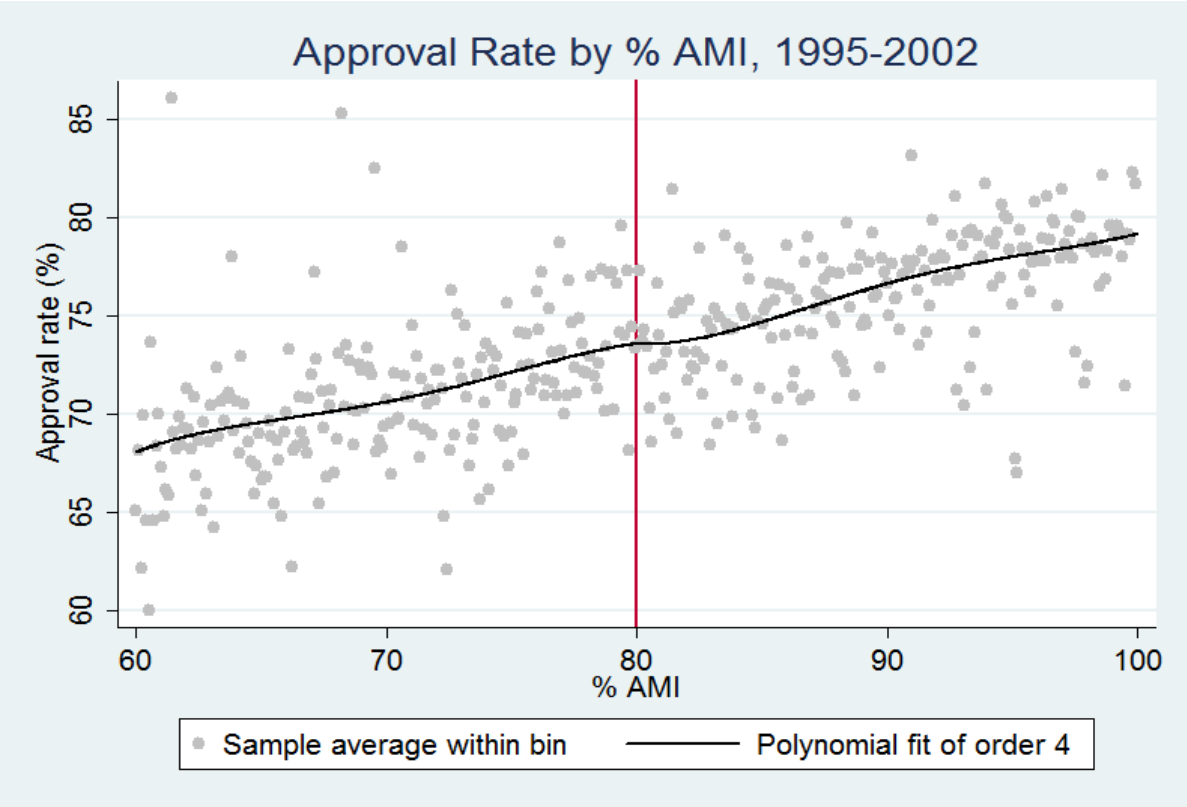
Share of LMI lending to moving up tracts



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



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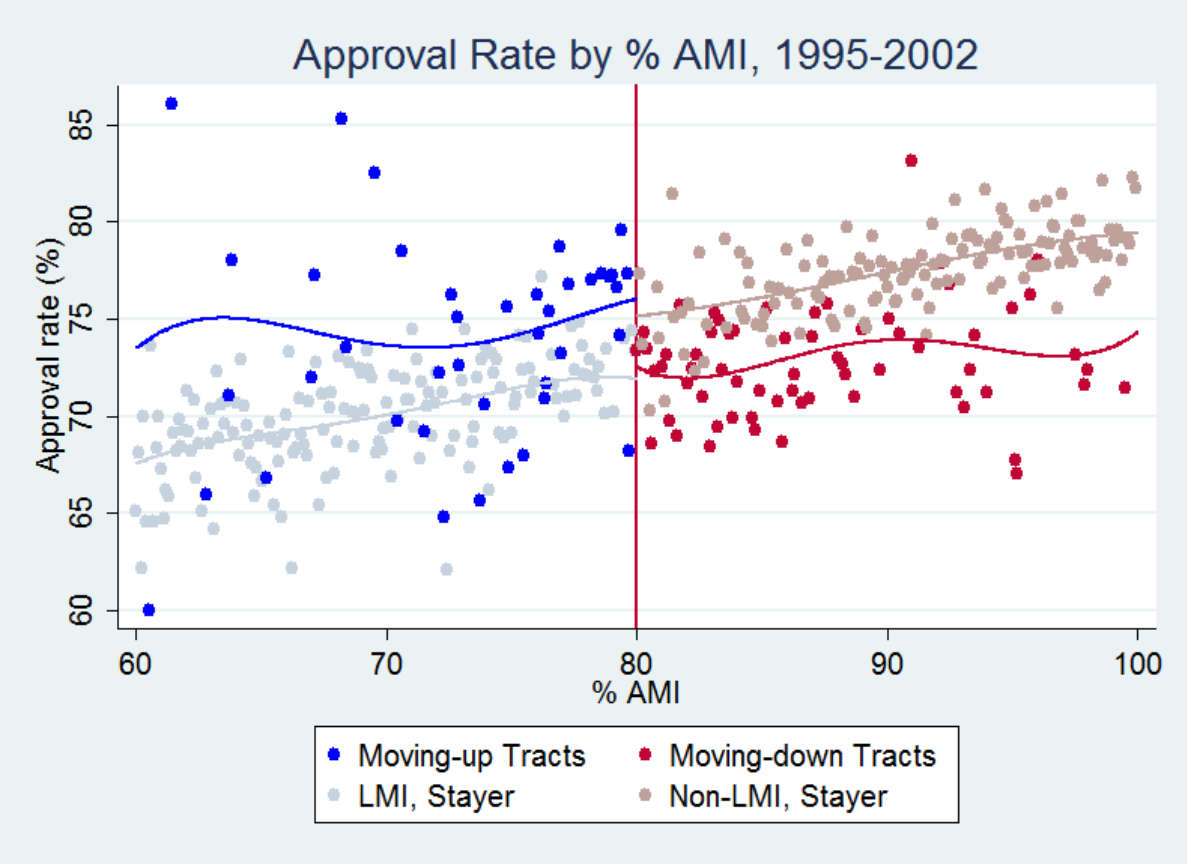
Note: Dots represent the sample averages within intervals of 0.1 in median family income of a census tract as a share of area median income (AMI). The solid line is from a fourth-order polynomial in AMI share fitted separately for observations above and below the 80 percent threshold. The dotted line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

shift in lending towards moving up tracts

Share of LMI lending to moving up tracts



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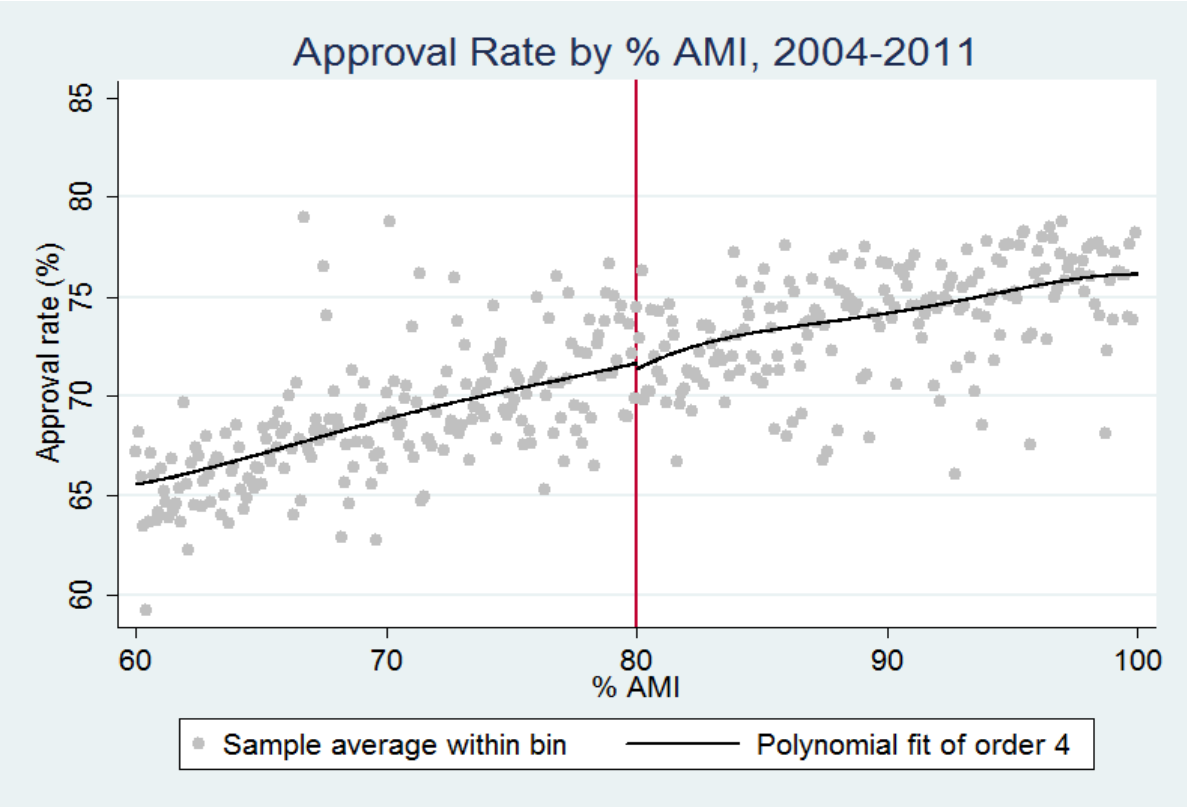

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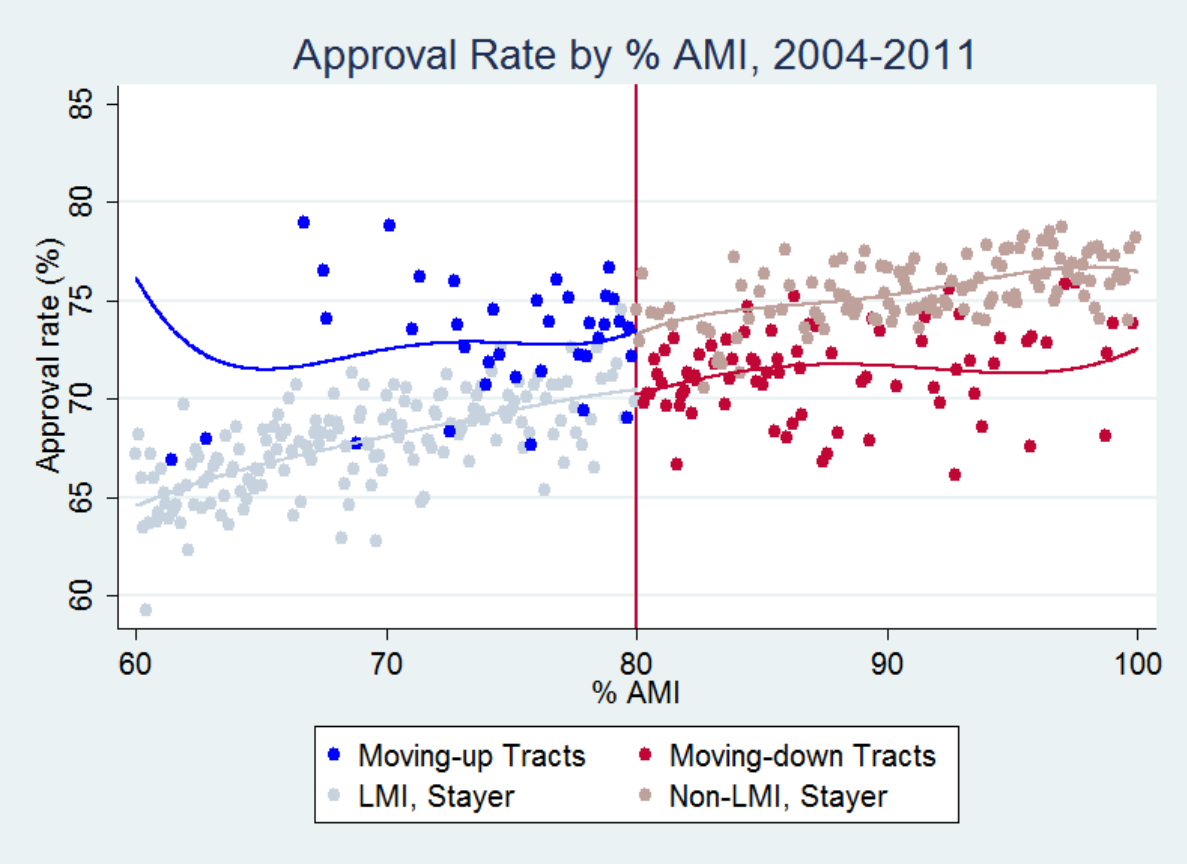

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two possible channels explaining the pattern

(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

$$y_{ijklm} = \boldsymbol{\psi X_{ijklm}} + \boldsymbol{\omega N_{kl}} + BankFE_j + CountyFE_l + YearFE_m + \varepsilon_{ijklm}$$

Base model

y_{ijklm}: 1 = approved; 0 = denied

$\boldsymbol{X_{ijklm}}$: a vector of applicant attributes

$\boldsymbol{N_{kl}}$: the most recent decennial census data on neighborhood characteristics

$BankFE_j$, $CountyFE_l$, $YearFE_m$: institution-, year-, or location-specific heterogeneity

method and data – empirical model

Loan decision-making model

$$y_{ijklm} = \boldsymbol{\psi X_{ijklm}} + \boldsymbol{\omega N_{kl}} + BankFE_j + CountyFE_l + YearFE_m + \boldsymbol{\alpha M_{kl}} + \boldsymbol{\beta}\left(\boldsymbol{M_{kl}} \times Assess_{jklm}\right) + \boldsymbol{\gamma S_{jkl}} + \varepsilon_{ijklm}$$

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y_{ijklm}: 1 = approved; 0 = denied

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(1) Learning and adaptation hypothesis

$\boldsymbol{M_{kl}}$ (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

$$y_{ijklm} = \boldsymbol{\psi X_{ijklm}} + \boldsymbol{\omega N_{kl}} + BankFE_j + CountyFE_l + YearFE_m + \boldsymbol{\alpha M_{kl}} + \boldsymbol{\beta}\left(\boldsymbol{M_{kl}} \times Assess_{jklm}\right) + \boldsymbol{\gamma S_{jkl}} + \varepsilon_{ijklm}$$

(1) Learning and adaptation hypothesis

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

$\left(\boldsymbol{M_{kl}} \times Assess_{jklm}\right)$ – 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

$\boldsymbol{S_{jkl}}$ – 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) $70\% \leqq x < 90\%$, (2) $75\% \leqq x < 85\%$, and (3) $77\% \leqq x < 83\%$

summarized results

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

	All Tracts		[70%, 90%)		[75%, 85%)		[77%, 83%)	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Learning and Adaptation								
Moving down	–0.003	*	–0.007	**	–0.009	**	–0.009	*
	(0.001)		(0.002)		(0.003)		(0.004)	
Moving up (80 to 119 %)	0.012	***	0.011	***	0.013	***	0.009	*
	(0.002)		(0.002)		(0.003)		(0.004)	
Moving up (120+ %)	0.051	***	0.007		0.003		0.005	
	(0.005)		(0.008)		(0.010)		(0.011)	
Stayer, non-LMI	0.033	***	0.004	*	0.006	*	0.004	
	(0.001)		(0.002)		(0.003)		(0.004)	
Assessment area × Moving up type								
Stayer, LMI	0.033	***	0.018	***	0.019	***	0.022	***
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving down	0.038	***	0.023	***	0.025	***	0.030	***
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving up (80 to 119 %)	0.036	***	0.016	***	0.017	***	0.023	***
	(0.002)		(0.002)		(0.003)		(0.003)	
Moving up (120+ %)	0.022	***	0.025	**	0.029	**	0.038	**
	(0.005)		(0.009)		(0.011)		(0.011)	
Stayer, non-LMI	0.022	***	0.021	***	0.021	***	0.023	***
	(0.000)		(0.001)		(0.002)		(0.003)	
Self-reinforcement								
At industry-level (%)	0.885	***	2.998	***	2.493	***	2.090	***
	(0.024)		(0.192)		(0.282)		(0.372)	
At lender-level (%)	0.001	***	0.000	***	0.000		0.001	**
	(0.000)		(0.000)		(0.000)		(0.000)	
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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	(0.002)		(0.002)		(0.003)		(0.004)	
Moving up (120+ %)	0.051	***	0.007		0.003		0.005	
	(0.005)		(0.008)		(0.010)		(0.011)	
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Moving up (120+ %)	0.022	***	0.025	**	0.029	**	0.038	**
	(0.005)		(0.009)		(0.011)		(0.011)	
Stayer, non-LMI	0.022	***	0.021	***	0.021	***	0.023	***
	(0.000)		(0.001)		(0.002)		(0.003)	
Self-reinforcement								
At industry-level (%)	0.885	***	2.998	***	2.493	***	2.090	***
	(0.024)		(0.192)		(0.282)		(0.372)	
At lender-level (%)	0.001	***	0.000	***	0.000		0.001	**
	(0.000)		(0.000)		(0.000)		(0.000)	
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)

	All Tracts		[70%, 90%)		[75%, 85%)		[77%, 83%)	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Learning and Adaptation								
Moving down	–0.003	*	–0.007	**	–0.009	**	–0.009	*
	(0.001)		(0.002)		(0.003)		(0.004)	
Moving up (80 to 119 %)	0.012	***	0.011	***	0.013	***	0.009	*
	(0.002)		(0.002)		(0.003)		(0.004)	
Moving up (120+ %)	0.051	***	0.007		0.003		0.005	
	(0.005)		(0.008)		(0.010)		(0.011)	
Stayer, non-LMI	0.033	***	0.004	*	0.006	*	0.004	
	(0.001)		(0.002)		(0.003)		(0.004)	
Assessment area × Moving up type								
Stayer, LMI	0.033	***	0.018	***	0.019	***	0.022	***
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving down	0.038	***	0.023	***	0.025	***	0.030	***
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving up (80 to 119 %)	0.036	***	0.016	***	0.017	***	0.023	***
	(0.002)		(0.002)		(0.003)		(0.003)	
Moving up (120+ %)	0.022	***	0.025	**	0.029	**	0.038	**
	(0.005)		(0.009)		(0.011)		(0.011)	
Stayer, non-LMI	0.022	***	0.021	***	0.021	***	0.023	***
	(0.000)		(0.001)		(0.002)		(0.003)	
Self-reinforcement								
At industry-level (%)	0.885	***	2.998	***	2.493	***	2.090	***
	(0.024)		(0.192)		(0.282)		(0.372)	
At lender-level (%)	0.001	***	0.000	***	0.000		0.001	**
	(0.000)		(0.000)		(0.000)		(0.000)	
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, 2004–2011 (dependent variable: whether a loan application is approved)

	All Tracts		[70%, 90%)		[75%, 85%)		[77%, 83%)	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Learning and Adaptation								
Moving down	0.004	***	–0.000		0.003		0.001	
	(0.001)		(0.001)		(0.002)		(0.003)	
Moving up (80 to 119 %)	0.014	***	0.007	***	0.007	***	0.011	***
	(0.001)		(0.001)		(0.002)		(0.003)	
Moving up (120+ %)	0.038	***	0.012	**	0.017	**	0.012	
	(0.003)		(0.004)		(0.005)		(0.007)	
Stayer, non-LMI	0.017	***	0.007	***	0.012	***	0.010	**
	(0.001)		(0.001)		(0.002)		(0.003)	
Assessment area × Moving up type								
Stayer, LMI	–0.004	***	–0.000		–0.002		–0.001	
	(0.001)		(0.001)		(0.002)		(0.002)	
Moving down	–0.003	***	0.003		0.002		0.004	
	(0.001)		(0.001)		(0.002)		(0.002)	
Moving up (80 to 119 %)	0.004	**	0.007	***	0.007	**	0.007	*
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving up (120+ %)	0.020	***	0.024	***	0.017	**	0.021	**
	(0.003)		(0.005)		(0.006)		(0.008)	
Stayer, non-LMI	0.007	***	0.008	***	0.009	***	0.012	***
	(0.000)		(0.001)		(0.002)		(0.002)	
Self-reinforcement								
At industry-level (%)	1.292	***	4.830	***	3.676	***	3.963	***
	(0.034)		(0.210)		(0.293)		(0.495)	
At lender-level (%)	0.000	***	0.000		0.000		0.001	
	(0.000)		(0.000)		(0.000)		(0.000)	
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	0.1716		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)

	All Tracts		[70%, 90%)		[75%, 85%)		[77%, 83%)	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Learning and Adaptation								
Moving down	0.004	***	–0.000		0.003		0.001	
	(0.001)		(0.001)		(0.002)		(0.003)	
Moving up (80 to 119 %)	0.014	***	0.007	***	0.007	***	0.011	***
	(0.001)		(0.001)		(0.002)		(0.003)	
Moving up (120+ %)	0.038	***	0.012	**	0.017	**	0.012	
	(0.003)		(0.004)		(0.005)		(0.007)	
Stayer, non-LMI	0.017	***	0.007	***	0.012	***	0.010	**
	(0.001)		(0.001)		(0.002)		(0.003)	
Assessment area × Moving up type								
Stayer, LMI	–0.004	***	–0.000		–0.002		–0.001	
	(0.001)		(0.001)		(0.002)		(0.002)	
Moving down	–0.003	***	0.003		0.002		0.004	
	(0.001)		(0.001)		(0.002)		(0.002)	
Moving up (80 to 119 %)	0.004	**	0.007	***	0.007	**	0.007	*
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving up (120+ %)	0.020	***	0.024	***	0.017	**	0.021	**
	(0.003)		(0.005)		(0.006)		(0.008)	
Stayer, non-LMI	0.007	***	0.008	***	0.009	***	0.012	***
	(0.000)		(0.001)		(0.002)		(0.002)	
Self-reinforcement								
At industry-level (%)	1.292	***	4.830	***	3.676	***	3.963	***
	(0.034)		(0.210)		(0.293)		(0.495)	
At lender-level (%)	0.000	***	0.000		0.000		0.001	
	(0.000)		(0.000)		(0.000)		(0.000)	
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	0.1716		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)

	All Tracts		[70%, 90%)		[75%, 85%)		[77%, 83%)	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Learning and Adaptation								
Moving down	0.004	***	–0.000		0.003		0.001	
	(0.001)		(0.001)		(0.002)		(0.003)	
Moving up (80 to 119 %)	0.014	***	0.007	***	0.007	***	0.011	***
	(0.001)		(0.001)		(0.002)		(0.003)	
Moving up (120+ %)	0.038	***	0.012	**	0.017	**	0.012	
	(0.003)		(0.004)		(0.005)		(0.007)	
Stayer, non-LMI	0.017	***	0.007	***	0.012	***	0.010	**
	(0.001)		(0.001)		(0.002)		(0.003)	
Assessment area × Moving up type								
Stayer, LMI	–0.004	***	–0.000		–0.002		–0.001	
	(0.001)		(0.001)		(0.002)		(0.002)	
Moving down	–0.003	***	0.003		0.002		0.004	
	(0.001)		(0.001)		(0.002)		(0.002)	
Moving up (80 to 119 %)	0.004	**	0.007	***	0.007	**	0.007	*
	(0.001)		(0.002)		(0.002)		(0.003)	
Moving up (120+ %)	0.020	***	0.024	***	0.017	**	0.021	**
	(0.003)		(0.005)		(0.006)		(0.008)	
Stayer, non-LMI	0.007	***	0.008	***	0.009	***	0.012	***
	(0.000)		(0.001)		(0.002)		(0.002)	
Self-reinforcement								
At industry-level (%)	1.292	***	4.830	***	3.676	***	3.963	***
	(0.034)		(0.210)		(0.293)		(0.495)	
At lender-level (%)	0.000	***	0.000		0.000		0.001	
	(0.000)		(0.000)		(0.000)		(0.000)	
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	0.1716		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

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

	1995		1996		1997		1998		1999		2000		2001		2002	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
All tracts																
At industry-level (%)	0.780	***	0.793	***	0.787	***	0.805	***	0.960	***	0.689	***	0.982	***	0.910	***
	(0.088)		(0.079)		(0.076)		(0.068)		(0.065)		(0.061)		(0.060)		(0.056)	
At lender-level (%)	0.001	***	0.000	***	0.001	***	0.000	***	0.001	***	0.001	***	0.001	***	0.000	***
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.0915		0.1084		0.1193		0.1380		0.1246		0.1454		0.1530		0.1143	
No. of observations	1,740,302		2,048,046		2,075,242		2,352,100		2,638,261		2,869,543		2,752,964		3,088,072	
[70%, 90%)																
At industry-level (%)	2.410	**	2.589	***	3.718	***	4.718	***	2.351	***	1.611	**	2.768	***	2.530	***
	(0.696)		(0.634)		(0.620)		(0.574)		(0.538)		(0.496)		(0.486)		(0.439)	
At lender-level (%)	0.000		0.000		0.000		0.000		0.001	**	0.000		0.001		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.0980		0.1179		0.1379		0.1562		0.1368		0.1492		0.1612		0.1288	
No. of observations	263,631		307,702		309,376		339,499		390,567		452,851		425,436		476,832	
[75%, 85%)																
At industry-level (%)	2.094	*	1.882	*	2.781	**	5.327	***	1.364		0.967		1.554	*	2.441	***
	(1.027)		(0.939)		(0.916)		(0.867)		(0.807)		(0.727)		(0.719)		(0.644)	
At lender-level (%)	–0.000		0.001		–0.000		–0.000		0.001		0.000		0.001	*	0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.0985		0.1178		0.1427		0.1590		0.1375		0.1500		0.1615		0.1281	
No. of observations	132,984		154,255		155,538		170,124		196,133		229,021		215,130		240,186	
[77%, 83%)																
At industry-level (%)	2.645	*	1.561		1.913		5.118	***	1.044		0.378		0.542		1.928	*
	(1.344)		(1.225)		(1.199)		(1.156)		(1.083)		(0.966)		(0.968)		(0.850)	
At lender-level (%)	0.000		0.002	**	0.000		0.000		0.001		–0.000		0.003	**	0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Adjusted R-squared	0.1000		0.1194		0.1417		0.1621		0.1407		0.1487		0.1612		0.1282	
No. of observations	77,303		89,419		90,437		98,726		114,144		133,192		125,728		139,555	

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)

	1995		1996		1997		1998		1999		2000		2001		2002	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
All tracts																
At industry-level (%)	0.780	***	0.793	***	0.787	***	0.805	***	0.960	***	0.689	***	0.982	***	0.910	***
	(0.088)		(0.079)		(0.076)		(0.068)		(0.065)		(0.061)		(0.060)		(0.056)	
At lender-level (%)	0.001	***	0.000	***	0.001	***	0.000	***	0.001	***	0.001	***	0.001	***	0.000	***
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.0915		0.1084		0.1193		0.1380		0.1246		0.1454		0.1530		0.1143	
No. of observations	1,740,302		2,048,046		2,075,242		2,352,100		2,638,261		2,869,543		2,752,964		3,088,072	
[70%, 90%)																
At industry-level (%)	2.410	**	2.589	***	3.718	***	4.718	***	2.351	***	1.611	**	2.768	***	2.530	***
	(0.696)		(0.634)		(0.620)		(0.574)		(0.538)		(0.496)		(0.486)		(0.439)	
At lender-level (%)	0.000		0.000		0.000		0.000		0.001	**	0.000		0.001		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.0980		0.1179		0.1379		0.1562		0.1368		0.1492		0.1612		0.1288	
No. of observations	263,631		307,702		309,376		339,499		390,567		452,851		425,436		476,832	
[75%, 85%)																
At industry-level (%)	2.094	*	1.882	*	2.781	**	5.327	***	1.364		0.967		1.554	*	2.441	***
	(1.027)		(0.939)		(0.916)		(0.867)		(0.807)		(0.727)		(0.719)		(0.644)	
At lender-level (%)	–0.000		0.001		–0.000		–0.000		0.001		0.000		0.001	*	0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.0985		0.1178		0.1427		0.1590		0.1375		0.1500		0.1615		0.1281	
No. of observations	132,984		154,255		155,538		170,124		196,133		229,021		215,130		240,186	
[77%, 83%)																
At industry-level (%)	2.645	*	1.561		1.913		5.118	***	1.044		0.378		0.542		1.928	*
	(1.344)		(1.225)		(1.199)		(1.156)		(1.083)		(0.966)		(0.968)		(0.850)	
At lender-level (%)	0.000		0.002	**	0.000		0.000		0.001		–0.000		0.003	**	0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Adjusted R-squared	0.1000		0.1194		0.1417		0.1621		0.1407		0.1487		0.1612		0.1282	
No. of observations	77,303		89,419		90,437		98,726		114,144		133,192		125,728		139,555	

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)

	2004		2005		2006		2007		2008		2009		2010		2011	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
All tracts																
At industry-level (%)	1.144	***	1.236	***	1.494	***	1.038	***	1.102	***	1.343	***	1.762	***	1.629	***
	(0.074)		(0.072)		(0.074)		(0.083)		(0.129)		(0.167)		(0.176)		(0.181)	
At lender-level (%)	0.000	**	0.001	***	0.001	***	0.001	**	0.000		0.001	**	0.001	**	0.001	*
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.1300		0.2103		0.2512		0.2505		0.1555		0.1065		0.0810		0.0800	
No. of observations	3,546,212		3,988,874		3,933,085		3,325,292		1,549,611		932,656		832,150		786,325	
[70%, 90%)																
At industry-level (%)	4.792	***	4.358	***	4.674	***	4.269	***	6.976	***	5.066	***	4.332	**	6.609	***
	(0.475)		(0.423)		(0.416)		(0.486)		(0.845)		(1.223)		(1.323)		(1.413)	
At lender-level (%)	0.000		0.001		0.001		0.000		–0.001		0.001		0.002	**	0.001	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.001)		(0.001)		(0.001)		(0.001)	
Adjusted R-squared	0.1392		0.2426		0.2895		0.2721		0.1673		0.1254		0.0977		0.0947	
No. of observations	578,262		696,920		713,994		574,119		229,921		123,724		104,349		95,423	
[75%, 85%)																
At industry-level (%)	2.814	***	3.151	***	3.674	***	3.943	***	5.676	***	5.611	**	2.798		6.659	**
	(0.693)		(0.597)		(0.564)		(0.661)		(1.186)		(1.770)		(1.978)		(2.142)	
At lender-level (%)	–0.000		0.002	**	0.000		0.001		–0.000		–0.000		0.003	**	0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Adjusted R-squared	0.1397		0.2435		0.2903		0.2744		0.1903		0.1291		0.0970		0.0894	
No. of observations	286,627		348,243		357,831		286,611		114,465		61,219		51,491		47,282	
[77%, 83%)																
At industry-level (%)	4.560	***	3.211	**	4.633	***	2.735	*	2.831		6.075		2.855		8.059	*
	(1.129)		(1.035)		(0.938)		(1.138)		(2.061)		(3.140)		(3.480)		(3.620)	
At lender-level (%)	0.001		0.002		–0.000		0.001		–0.001		0.001		0.004		0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.002)		(0.002)		(0.002)	
Adjusted R-squared	0.1406		0.2455		0.2928		0.2759		0.1696		0.1282		0.0912		0.0892	
No. of observations	164,571		199,440		205,661		163,916		65,094		34,459		29,350		26,960	

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)

	2004		2005		2006		2007		2008		2009		2010		2011	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
All tracts																
At industry-level (%)	1.144	***	1.236	***	1.494	***	1.038	***	1.102	***	1.343	***	1.762	***	1.629	***
	(0.074)		(0.072)		(0.074)		(0.083)		(0.129)		(0.167)		(0.176)		(0.181)	
At lender-level (%)	0.000	**	0.001	***	0.001	***	0.001	**	0.000		0.001	**	0.001	**	0.001	*
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Adjusted R-squared	0.1300		0.2103		0.2512		0.2505		0.1555		0.1065		0.0810		0.0800	
No. of observations	3,546,212		3,988,874		3,933,085		3,325,292		1,549,611		932,656		832,150		786,325	
[70%, 90%)																
At industry-level (%)	4.792	***	4.358	***	4.674	***	4.269	***	6.976	***	5.066	***	4.332	**	6.609	***
	(0.475)		(0.423)		(0.416)		(0.486)		(0.845)		(1.223)		(1.323)		(1.413)	
At lender-level (%)	0.000		0.001		0.001		0.000		–0.001		0.001		0.002	**	0.001	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.001)		(0.001)		(0.001)		(0.001)	
Adjusted R-squared	0.1392		0.2426		0.2895		0.2721		0.1673		0.1254		0.0977		0.0947	
No. of observations	578,262		696,920		713,994		574,119		229,921		123,724		104,349		95,423	
[75%, 85%)																
At industry-level (%)	2.814	***	3.151	***	3.674	***	3.943	***	5.676	***	5.611	**	2.798		6.659	**
	(0.693)		(0.597)		(0.564)		(0.661)		(1.186)		(1.770)		(1.978)		(2.142)	
At lender-level (%)	–0.000		0.002	**	0.000		0.001		–0.000		–0.000		0.003	**	0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Adjusted R-squared	0.1397		0.2435		0.2903		0.2744		0.1903		0.1291		0.0970		0.0894	
No. of observations	286,627		348,243		357,831		286,611		114,465		61,219		51,491		47,282	
[77%, 83%)																
At industry-level (%)	4.560	***	3.211	**	4.633	***	2.735	*	2.831		6.075		2.855		8.059	*
	(1.129)		(1.035)		(0.938)		(1.138)		(2.061)		(3.140)		(3.480)		(3.620)	
At lender-level (%)	0.001		0.002		–0.000		0.001		–0.001		0.001		0.004		0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.002)		(0.002)		(0.002)	
Adjusted R-squared	0.1406		0.2455		0.2928		0.2759		0.1696		0.1282		0.0912		0.0892	
No. of observations	164,571		199,440		205,661		163,916		65,094		34,459		29,350		26,960	

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?

appendix

The conventional model might have been of a form:

$$b_1 \times Assess + b_2 \times mdown + b_3 \times mup80 + b_4 \times mup120 + b_5 \times nonLMI + b_6 \times (Assess \times mdown) + b_7 \times (Assess \times mup80) + b_8 \times (Assess \times mup120) + b_9 \times (Assess \times nonLMI)$$

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.

	(1) Assessment area	(2) Non-assessment area	Diff.: (1) – (2)
Stayer, LMI	b_1	0	b_1
Moving-down	$b_1 + b_2 + b_6$	b_2	$b_1 + b_6$
Moving-up, 80–119%	$b_1 + b_3 + b_7$	b_3	$b_1 + b_7$
Moving-up, 120+%	$b_1 + b_4 + b_8$	b_4	$b_1 + b_8$
Stayer, non-LMI	$b_1 + b_5 + b_9$	b_5	$b_1 + b_9$

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

$$c_1 \times mdown + c_2 \times mup80 + c_3 \times mup120 + c_4 \times nonLMI + c_5 \times (Assess \times LMI) + c_6 \times (Assess \times mdown) + c_7 \times (Assess \times mup80) + c_8 \times (Assess \times mup120) + c_9 \times (Assess \times nonLMI)$$

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

	(1) Assessment area	(2) Non-assessment area	Diff.: (1) – (2)
Stayer, LMI	c_5	0	c_5
Moving-down	$c_1 + c_6$	c_1	c_6
Moving-up, 80–119%	$c_2 + c_7$	c_2	c_7
Moving-up, 120+%	$c_3 + c_8$	c_3	c_8
Stayer, non-LMI	$c_4 + c_9$	c_4	c_9