A. Internet Appendix to “Population Aging and Bank Risk-Taking”

TABLE A1

Variable Definitions

This table reports variable definitions and sources. Changes (Δ) are from 1997 to 2007, all other variables are as of 1997 (unless indicated otherwise). For details, see Section II.

Variable name	**Description**	**Source**
Bank Level		
EXPOSURE	bank exposure to aging counties (deposit-weighted)	FDIC SOD, NCI SEER
ΔDEPOSITS	change in total deposits	FDIC SDI
ΔLOANS	change in total bank loans	FDIC SDI
ΔMORTGAGES	change in total residential mortgage loans	FDIC SDI
log(ASSETS)	log total assets	FDIC SDI
NON-PERFORMING_LOANS (%)	share of NPL over total loans	FDIC SDI
ROA (%)	return on assets	FDIC SDI
DEPOSITS (%)	total deposits over total liabilities	FDIC SDI
TIER_1_CAPITAL (%)	tier 1 capital ratio	FDIC SDI
NON-INTEREST_INCOME (%)	non-interest income over average assets	FDIC SDI
ΔNPL (mort)	change in net charge-offs on mortgage loans 2007-10	FDIC SDI
ΔNPL	change in net charge-offs on all loans 2007-10	FDIC SDI
ΔLOANS/ASSETS	change in loans over pre-crisis assets 2007-10	FDIC SDI
Bank-County Level		
ΔDEPOSITS	Change in deposits	FDIC SOD
ΔHMDA	Change in mortgage loans	HMDA
ΔLTI (mean)	Change in average loan-to-income ratio	HMDA
ΔLTI (pX)	Change in X-percentile loan-to-income ratio	HMDA
ΔDENIED	Change in share of denied mortgage loans	HMDA
County Level		
ΔOLD	change in population 65+	NCI SEER
log(POPULATION)	log total population	NCI Seer
UNEMPLOYMENT_RATE	unemployment rate	BLS LAUS
PARTICIPATION_RATE	labor force participation rate	BLS LAUS
log(INCOME p.c.)	log income per capita	BEA LAPI
EMPLOYMENT_SHARE_MANUFACTURING	employment share of manufacturing sector (SIC 20)	CBP
EMPLOYMENT_SHARE_RETAIL_TRADE	employment share of retail trade sector (SIC 50)	CBP
EMPLOYMENT_SHARE_SERVICES	employment share services sector (SIC 70)	CBP
ΔDEBT_TO_INCOME	Change in debt-to-income ratio	FRBNY
PRESENCE_OF_EXPOSED_BANKS	loan-weighted average across bank exposure of banks active in county	HMDA, FDIC SOD, NCI SEER
Other Variables		
ELASTICITY	MSA housing supply elasticity	Saiz (2010)

FIGURE A1

County Aging and Bank Exposure – Distribution

These figures show the distributions of the county-level log change in the population of age 65 and above from 1997 to 2007 in panel (a) and bank exposure as defined in Equation 1 in panel (b).

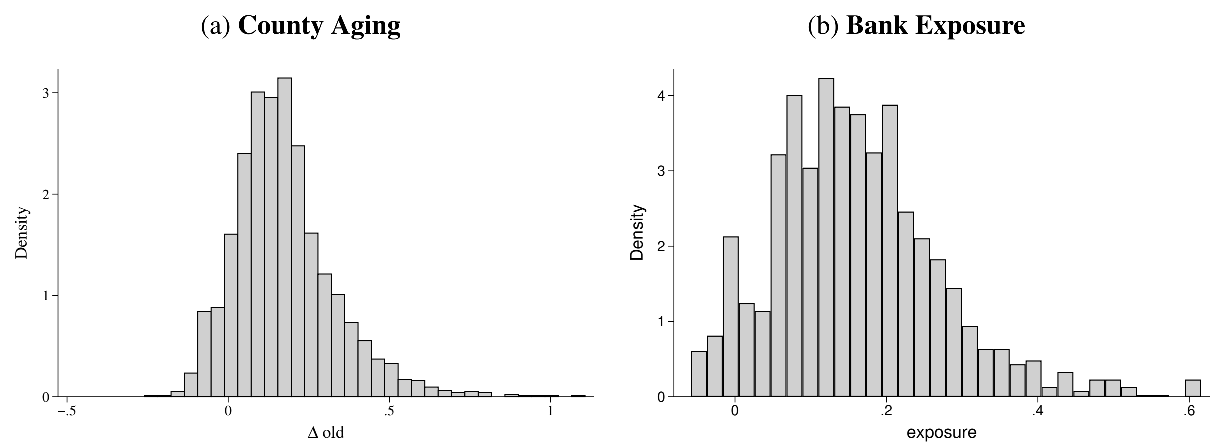
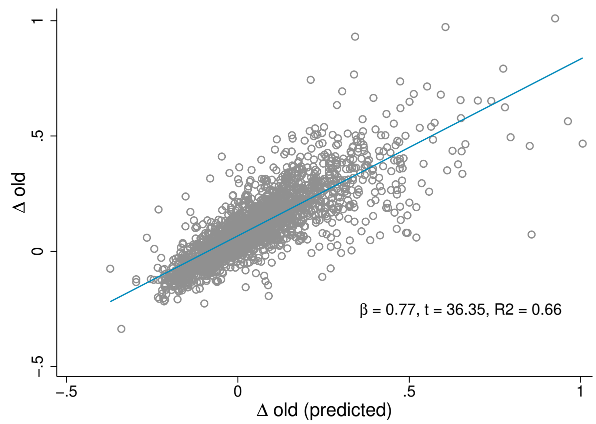


FIGURE A2

Instrumental Variable Strategy

Panel (a) plots counties' actual and predicted change in seniors. ΔOLD denotes the change in county population age 65 and above, and ΔOLD (predicted) denotes the change in county population of age 45 to 65 from 1977 to 1987. Panel (b) plots banks' actual and predicted exposure, where predicted exposure uses ΔOLD_(PREDICTED).

(a) **First stage – aging**



(b) **First stage – exposure**

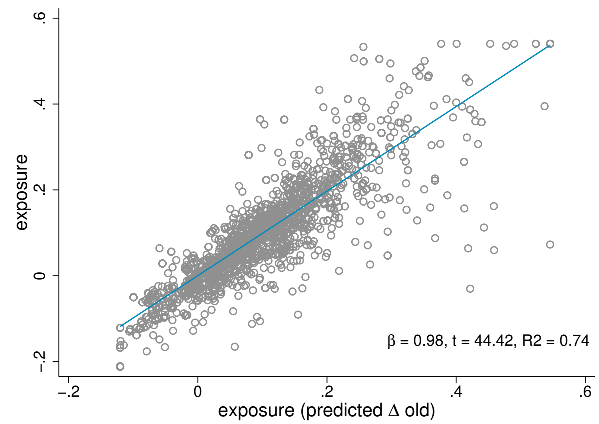


FIGURE A3

Change in County-Level Debt-to-Income Ratios

This figure shows the average change in the county-level debt-to-income ratio from 1997 to 2007. We split the sample into counties that lie in the top, middle, and bottom tercile of local presence of exposed banks. PRESENCE is computed as the average exposure of banks active in a county, weighted by each banks local HMDA loan volume ($\text{PRESENCE}_c = \sum_b \frac{l_{b,c}}{l_c} \times \text{EXPOSURE}_b$, where $l_{b,c}$ and l_c denote bank b's HMDA loans in county c and county c's total HMDA loans (both as of 1997)). Counties with higher values of PRESENCE have a higher share of loans extended by high-exposure banks.

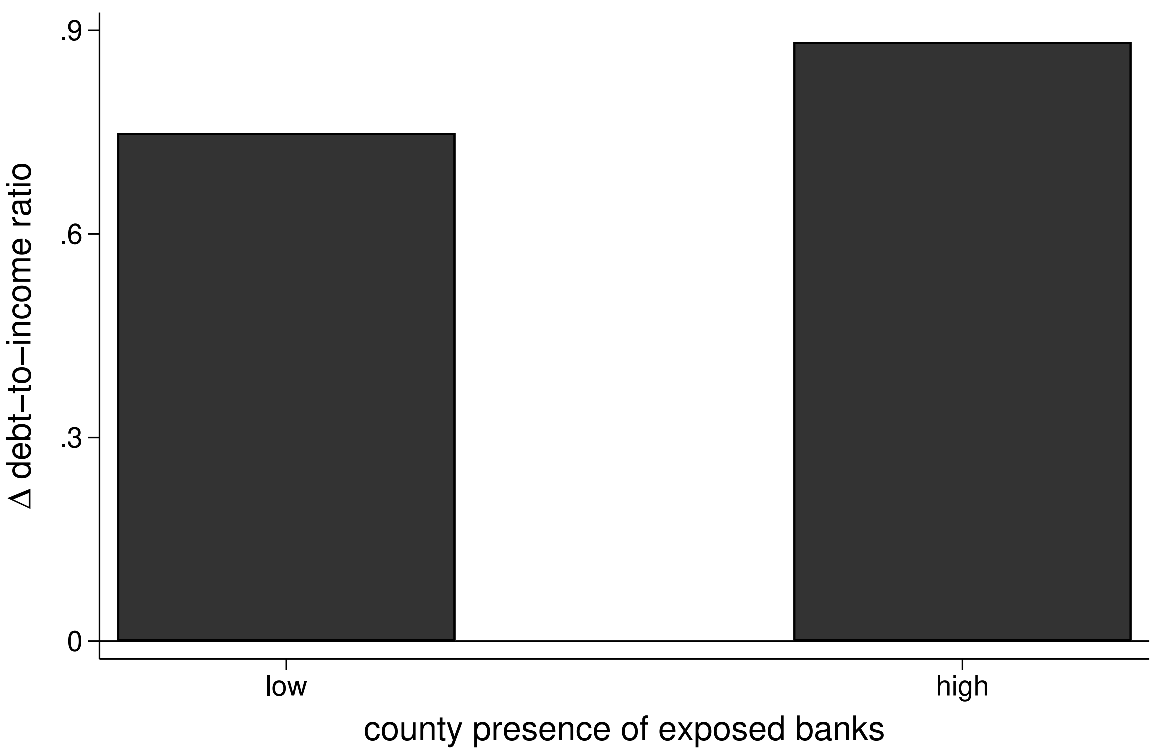


TABLE A2

The Relation Between Age and Deposits

This table shows results for the following regression $\log(\text{DEPOSITS})_i = \text{AGE GROUP}_i + \text{CONTROLS}_i + \tau_t + \varepsilon_i$, where the age group 17-34 is the omitted category. Column (3) adds an extensive set of household-level controls: education level, number of kids, occupation, gender, race, marriage status, home ownership, and a dummy for business ownership. Column (4) further controls for the log of respondents' overall financial wealth. Source: Survey of Consumer Finances 1992, 1998, and 2007. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

VARIABLES	1 log(DEPOSITS)	2 log(DEPOSITS)	3 log(DEPOSITS)	4 log(DEPOSITS)
AGE GROUP 35-64	0.848***	0.842***	0.320***	-0.209***
	(0.022)	(0.022)	(0.024)	(0.017)
AGE GROUP 65+	1.658***	1.656***	1.312***	0.258***
	(0.026)	(0.026)	(0.042)	(0.030)
log(FINANCIAL WEALTH)				0.641***
				(0.003)
No. of obs.	58,078	58,078	58,078	58,078
R^2	0.065	0.066	0.308	0.630
Survey wave FE	-	Yes	Yes	Yes
Controls	-	-	Yes	Yes

TABLE A3

Did Banks Open Branches Between 1994 and 1997?

This table shows results for regressions at the bank-county level. The dependent variables are the change in the number of branches (columns (1) and (4)), a dummy with value one if a bank opened a branch in a county (columns (2) and (5)), and a dummy with value one if a bank entered a county (columns (3) and (6)). ΔOLD denotes the log change in county population age 65 and above. EXPOSURE denotes bank exposure to aging counties (see Equation 1). Standard errors are clustered at the bank and county level. For variable definitions, see Section II. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

	1	2	3	4	5	6
VARIABLES	ΔBranches	Open Br	Entry	ΔBranches	Open Br	Entry
Δ OLD	-1.002	0.125*	0.096			
	(0.677)	(0.074)	(0.082)			
EXPOSURE				1.192	0.206	0.287*
				(1.358)	(0.126)	(0.153)
No. of obs.	16,977	16,977	16,977	17,026	17,026	17,026
R^2	0.173	0.390	0.387	0.115	0.199	0.158
County Controls	Yes	Yes	Yes	-	-	-
Bank FE	Yes	Yes	Yes	-	-	-
Bank Controls	-	-	-	Yes	Yes	Yes
County FE	-	-	-	Yes	Yes	Yes

TABLE A4

Growth and Exposure – Other Demographic Groups

This table shows results at the bank-county level for regression equation (6) with the change in deposits as dependent variable in columns (1)–(3); and for regression equation (3) with the change in HMDA loans as dependent variable in columns (4)–(6). OLD denotes the population 65 and above. Each column in columns (1)–(3) controls for population growth in a different cohort (POP, YOUNG, PRIME_WORKING_AGE, corresponding to the total population, population age 29 and younger, and population age 25-44, respectively). Each column in columns (4)–(6) controls for bank exposure to each of these groups. The different exposure measures are constructed as defined in Equation 1. For variable definitions, see Section II. *** p <0.01, ** p <0.05, * p <0.1.

	1	2	3	4	5	6
VARIABLES	ΔDEPOSITS	ΔDEPOSITS	ΔDEPOSITS	ΔHMDA	ΔHMDA	ΔHMDA
ΔOLD	0.762***	0.857***	0.670***			
	(0.108)	(0.116)	(0.139)			
EXPOSURE				1.694***	1.681***	1.778***
				(0.111)	(0.113)	(0.112)
No. of obs.	13,086	13,086	13,086	47,004	47,004	47,004
R^2	0.350	0.350	0.351	0.209	0.209	0.209
County Controls	Yes	Yes	Yes	-	-	-
Bank Controls	-	-	-	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	-	-	-
County FE	-	-	-	Yes	Yes	Yes
Δ pop	Yes	Yes	Yes	Yes	Yes	Yes
Δ young	-	Yes	Yes	-	Yes	Yes
Δ prime age	-	-	Yes	-	-	Yes

TABLE A5

Bank Size×County Fixed Effects, Permanent Branch Sample, and Denied Loans

This table shows results for regressions at the bank-county level. The dependent variable is the change in bank-county HMDA loans in columns (1)–(2); the change in the LTI ratio in columns (3)–(6); and the change in the share of denied loans in columns (7)–(8). EXPOSURE denotes bank exposure to aging counties (as defined in Equation 1). In columns (3)–(4), NO_BRANCH is a dummy with a value of one for bank-county pairs in which a bank does not operate branches in 1997, and zero otherwise. In columns (5)–(6), NO_BRANCH is a dummy with a value of one for bank-county pairs in which a bank had no branches in 1997 *and* did not open any branches during the sample period, and zero otherwise. For fixed effects and controls, see table footer. Standard errors are clustered at the bank and county level. For variable definitions, see Section II. *** p <0.01, ** p <0.05, * p <0.1.

	1	2	3	4	5	6	7	8
					97 and 07	97 and 07		
VARIABLES	ΔHMDA	ΔHMDA	ΔLTI	ΔLTI	ΔLTI	ΔLTI	ΔDENIED	ΔDENIED
EXPOSURE	1.121***		0.849***		0.132		-0.232***	
	(0.077)		(0.096)		(0.115)		(0.025)	
NO_BRANCH		0.634***		-0.211***	-0.138***	-0.162***		0.027***
		(0.026)		(0.023)	(0.019)	(0.019)		(0.005)
EXPOSURE × NO_BRANCH		0.512**		0.670***	0.756***	0.657***		-0.073*
		(0.202)		(0.191)	(0.153)	(0.160)		(0.044)
No. of obs.	49,781	49,633	19,140	18,644	20,500	20,108	19,140	18,644
Bank Controls	Yes	-	Yes	-	Yes	-	Yes	-
Bank size*County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	-	Yes	-	Yes	-	Yes	-	Yes

Amiti-Weinstein Decomposition

To provide evidence on the negative influence of aging on local mortgage loan demand, we use the method developed by Amiti and Weinstein (2018). To understand the intuition behind this method, consider the following fixed effects model

$$\Delta L_{cbt} = \alpha_{ct} + \beta_{bt} + \varepsilon_{cbt}, \tag{8}$$

where the growth in loans of borrower c (a county in our case) obtained from a lender b at time t is regressed on borrower-time (α_{ct}) and lender-time (β_{bt}) fixed effects. α_{ct} captures the component in loan variation explained by borrower-level variation and β_{bt} captures the component explained by lender-level variation. Amiti and Weinstein (2018) illustrate that the empirical counterparts of α_{ct} and β_{bt} provide estimates for loan demand and loan supply channels, respectively, if appropriately weighted.

Amiti and Weinstein (2018) develop their method by modifying the model in 8 in two ways. The first modification ensures that the estimated borrower and lender shocks aggregate up to exactly match total loan growth in the economy. They show that this adding up constraint is satisfied when one uses lagged loan amounts as weights. The second modification establishes that the method incorporates both the formation and termination of lending relationships. This modification is done by changing the normalization by dropping the first borrower and lender from the estimation.

Formally, these modifications enable Amiti and Weinstein (2018) to obtain lender- and borrower-level shocks by solving the following system of B + C equations up to a numeraire:

$$D^{B}_{bt} = \frac{\sum_f L_{cbt} - \sum_f L_{cb,t-1}}{\sum_c L_{cb,t-1}} = \hat{c}_t + \hat{\hat{\beta}}_{bt} + \sum_c \varphi_{cb,t-1} \hat{\hat{\alpha}}_{ct} \tag{9}$$

(10) $$D^{C}_{ct} = \frac{\sum_b L_{cbt} - \sum_b L_{cb,t-1}}{\sum_b L_{cb,t-1}} = \hat{c}_t + \hat{\hat{\alpha}}_{ct} + \sum_b \vartheta_{cb,t-1}\hat{\hat{\beta}}_{bt}$$

where D represents the growth of bank's total lending, or firm's total borrowing, and $\hat{c}_t$ is a time fixed effect. $\varphi_{cb,t-1} \equiv \frac{L_{cb,t-1}}{\sum_c L_{cb,t-1}}$ and $\vartheta_{cb,t-1} \equiv \frac{L_{cb,t-1}}{\sum_b L_{cb,t-1}}$ show the weight of each loan for the banks and counties, respectively. $\hat{\hat{\beta}}_{bt}$ and $\hat{\hat{\alpha}}_{ct}$ are modified forms of $\hat{\beta}_{bt}$ and $\hat{\alpha}_{ct}$ in 8, where $\hat{\hat{\beta}}_{bt} \equiv \beta_{bt} - \beta_{1t}$ and $\hat{\alpha}_{ct} \equiv \alpha_{ct} - \alpha_{1t}$. Note that β_{1t} and α_{1t} are the fixed effects of the first lender and borrower, which are dropped from the estimation for normalization purposes. In these equations, $\ddot{\beta}_{bt}$ captures the lender supply shocks and $\ddot{\alpha}_{ct}$ the borrower demand shocks. In words, this method explains a lender's aggregate loan growth by lender-specific loan supply factors and a weighted average of changes in loan demand of its borrowers. Similarly, a borrower's aggregate loan growth is driven by its loan demand and a weighted average of loan supply factors of all its lenders.

After obtaining α_{ct} and β_{bt}, we can decompose the aggregate loan growth D_t into three components.

(11) $$D_t = (\bar{A}_t + \bar{B}_t) + \mathbf{W^{B}_{t-1} F_{t-1} \dot{A}_t} + \mathbf{W^{B}_{t-1} \dot{B}_t}$$

The first component, $(\bar{A}_t + \bar{B}_t)$, shows the common shocks on aggregate lending and measures what happens to the lending of the median borrower-lender pair. The second components are vectors, $\mathbf{\dot{A}_t}$ and $\mathbf{\dot{B}_t}$, that stack borrower- and lender-level shocks, α_{ct} and β_{bt}. These vectors show the granular shocks a là Gabaix (2011) and are expressed as deviations from $\bar{A}_t$ and $\bar{B}_t$. These vectors measure the importance of granular shocks on aggregate lending. $\mathbf{F_{t-1}}$ is a weighting matrix and $\mathbf{W^{B}_{t-1}}$ is the share of lender l's loan volume out of total lending by all lenders in year t.