# Appendix

## A Proofs and supplementary material for Section 2

### A.1 Optimal price setting

From (5) in the main text, lenders' profits are:

$$\Pi = \left(\frac{1}{1-\delta_j}\right) s_j \left(r_j \left(1-\delta_j\right) - \delta_j\right) = s_j \left(r_j - \frac{\delta_j}{1-\delta_j}\right)$$

As in the main text, lenders' first-order condition for optimal price-setting is:

$$s_j - \frac{\partial s_j}{\partial r_j}\left(r_j - \frac{\delta_j}{1-\delta_j}\right) = 0 \tag{22}$$

Now, in any symmetric equilibrium of the Salop circle model, we have $s_j = \frac{1}{N}$. To calculate the demand slope, $\frac{\partial s_j}{\partial r_j}$, consider a pair of banks $j, j'$ next to each other. Let $x$ represent the distance of a consumer to bank $j$, so the distance to the neighboring bank is $\frac{1}{N} - x$. Given $r_j, r'_j$, the set of consumers who choose $j$ satisfies:

$$-r_j - \theta x \leq -r_{j'} - \theta \left(\frac{1}{N} - x\right)$$

The marginal consumer has:

$$x = \frac{1}{2N} + \frac{r_{j'} - r_j}{2\theta}$$

The market share of $j$ takes into account two neighbors $j', j''$, hence:

$$s_j = 2x = \frac{1}{N} + \frac{r_{j'} + r_{j''} - 2r_j}{2\theta}$$

Hence,

$$\frac{\partial s_j}{\partial r_j} = -\frac{1}{\theta} \tag{23}$$

Thus, expression (22) becomes:

$$r_j - \frac{\delta_j}{1-\delta_j} = \frac{\theta}{N} \tag{24}$$

## A.2 Optimal information acquisition

From (7), lenders choose $\delta_j$ to solve:

$$\max_{\delta_j} \max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right) \tag{25}$$

We can differentiate (25) using the envelope theorem. By the chain rule,

$$\frac{d}{d\delta_j} \max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right) =$$
$$\frac{\partial}{\partial \delta_j}\left[\max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right)\right] + \frac{dr_j}{d\delta_j}\frac{\partial}{\partial r_j}\left[\max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right)\right]$$

Now, the first-order condition from appendix A.1 implies that

$$\frac{\partial}{\partial r_j}\left[\max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right)\right] = 0$$

Hence,

$$\frac{d}{d\delta_j} \max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right) =$$
$$\frac{\partial}{\partial \delta_j}\left[\max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right)\right] = -\frac{s_j\left(r_j^*\right)}{\left(1-\delta_j\right)^2} - c_q'\left(\delta_j\right)$$

Hence, the first-order condition is:

$$-\frac{s_j}{\left(1-\delta_j\right)^2} - c_q'\left(\delta_j\right) = 0 \tag{26}$$

Rearranging, we get (8).

### A.2.1 Second-order condition

In order for (26) to be a maximum, a second-order condition must also hold. Differentiating again, we have:

$$\frac{\partial^2}{\partial \delta_j^2} \max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right) = \frac{\partial}{\partial \delta_j}\left[-\frac{s_j}{\left(1-\delta_j\right)^2} - c_q'\left(\delta_j\right)\right]$$

This is:

$$\frac{\partial}{\partial \delta_j}\left[-\frac{s_j}{\left(1-\delta_j\right)^2}-c_q'\left(\delta_j\right)\right]=-\frac{1}{\left(1-\delta_j\right)^2}\frac{\partial s_j}{\partial \delta_j}-\frac{2s_j}{\left(1-\delta_j\right)^3}-c_q''\left(\delta_j\right) \tag{27}$$

This must be negative, at the optimal choice of $\delta_j$ for $j$. Expression (30) of appendix A.2.2 below shows that the derivative of $j$'s optimal market share $s_j$ as $\delta_j$ varies, holding fixed all other agents' interest rates and market shares, is:

$$\frac{ds_j}{d\delta_j}=\frac{\theta}{\left(1-\delta_j\right)^2}$$

Substituting this into (27), we get:

$$\frac{1}{\left(1-\delta_j\right)^2}\frac{\theta}{\left(1-\delta_j\right)^2}-\frac{2s_j}{\left(1-\delta_j\right)^3}-c_q''\left(\delta_j\right)<0$$

This rearranges to:

$$c_q''\left(\delta_j\right)\left(1-\delta_j\right)^4+2s_j\left(1-\delta_j\right)>\theta$$

This is (12).

### A.2.2 Characterizing $\frac{ds_j}{d\delta_j}$

For analytical convenience, define $\zeta_j \equiv \frac{\delta_j}{1-\delta_j}$, so that (6) becomes:

$$r_j-\zeta_j=\frac{\theta}{N} \tag{28}$$

This gives:

$$\frac{dr_j}{d\zeta_j}=1$$

Now,

$$\frac{dr_j}{ds_j}=\frac{1}{\theta} \tag{29}$$

Hence,

$$\frac{ds_j}{d\zeta_j}=\frac{\frac{dr_j}{d\zeta_j}}{\frac{dr_j}{ds_j}}=\theta$$

Now, from the definition of $\zeta_j$, we have:

$$\frac{d\zeta_j}{d\delta_j} = \frac{1}{\left(1-\delta_j\right)^2}$$

Hence,

$$\frac{ds_j}{d\delta_j} = \frac{ds_j}{d\zeta_j}\frac{d\zeta_j}{d\delta_j} = \frac{\theta}{\left(1-\delta_j\right)^2} \tag{30}$$

## A.3 Consumer surplus

In equilibrium, the average consumer's distance from a lender is:

$$\frac{1}{4N}$$

Plugging into expression (1) for consumer welfare, expected welfare of type $G$ consumers is:

$$\mu - r - \frac{\theta}{4N}$$

## A.4 Nonzero Funding Costs, Nonzero Recovery Rates

In the main text, for expositional simplicity we assume that the cost of funds and the recovery rate are both zero. We also assume there are no variable costs of screening. In this section, we relax each of those assumptions and show that the main model predictions hold. Suppose lenders have some positive variable cost $\rho$ for each loan they make. $\rho$ could reflect lenders' funding costs, or a component of screening costs which is variable and scales with the number of consumers. Suppose also that recovery rates are nonzero: lenders can recover $1-\phi$ on average when borrowers default. Lenders' profits are thus:

$$\Pi = \left(\frac{1}{1-\delta_j}\right) s_j \left(r_j\left(1-\delta_j\right) - \delta_j\phi - \rho\right) \tag{31}$$

In words, (31) says that lenders have to pay $\rho$ to borrow a unit of funds to lend to customers. With probability $\delta_j$, the borrower defaults and the lender loses a fraction $\phi$ of the principal, and with probability $\left(1-\delta_j\right)$ the borrower pays $r_j$ to the lender. Profits rearrange to:

$$\Pi = s_j\left(r_j - \frac{\delta_j\phi + \rho}{1-\delta_j}\right)$$

Lender $j$'s optimal markup thus satisfies:

$$r_j - \frac{\delta_j \phi + \rho}{1 - \delta_j} = \frac{\theta}{N} \tag{32}$$

Comparing (32) to the markup equation (6) in the main text, lenders simply set markups above a different marginal cost, $\frac{\delta_j \phi + \rho}{1-\delta_j}$, which reflects lenders' cost of funds and expected recovery rates. All other equilibrium conditions are unchanged.

## A.5 Entry costs

In the baseline model, we have taken the number of firms $N$ as exogeneous. $N$ can be micro-founded using a simple extension to the model with fixed entry costs. Fixed entry costs may differ across markets due to heterogeneous regulatory intensity, labor and rent costs, and other such factors.

Suppose there are a countably infinite number of potential entrants, who are exogeneously ordered. In the first stage, firms sequentially decide whether to pay entry cost $C_e$ to enter the market. If $N$ firms enter, they are uniformly spaced around a Salop circle, as in the main text. Firms then play the screening and price-setting game in the baseline model: firms decide how much to invest in costly screening, and then set prices.

If there are $N$ entrants, firms' profits, net of screening costs, are:

$$\frac{1}{1 - \delta(N)} \left(\frac{\theta}{N}\right) - c_q(\delta(N))$$

where $\delta(N)$ is the solution to (11), the equilibrium amount of screening done if there are $N$ firms. Firms will enter until the marginal entrant's expected profit is negative. Hence, for any entry cost $C_e$, the equilibrium number of firms $N(C_e)$ satisfies:

$$\frac{1}{1 - \delta(N(C_e))} \left(\frac{\theta}{N(C_e)}\right) - c_q(\delta(N(C_e))) > C_e \tag{33}$$

$$\frac{1}{1 - \delta(N(C_e)+1)} \left(\frac{\theta}{N(C_e)+1}\right) - c_q(\delta(N(C_e)+1)) < C_e \tag{34}$$

That is, firms make profits greater than $C_e$ with $N(C_e)$ entrants, but not with $N(C_e)+1$ entrants. Using expressions (33) and (34), we can simulate the equilibrium number of entrants as a function of $C_e$. The results are shown in Appendix Figure A.1. When entry costs are higher, the equilibrium number of entrants decreases.

## A.6 Moral hazard

Here, we consider how our model's conclusions change if there is moral hazard. As in the baseline model, suppose that type-$B$ borrowers always default. However, suppose that type-$G$ borrowers also default with some probability $\phi(r)$, which is an increasing function of the interest rate $r$ that they face. Banks can invest to screen out type-$B$ borrowers, as in the main text. If there are a fraction $\delta$ of type-$B$ borrowers and the interest rate is $r$, the population default rate is thus:

$$\psi(r,\delta) \equiv \delta + (1-\delta)\phi(r) \tag{35}$$

If a lender charges interest rate $r$ and has market share $s_j$, her expected profits are:

$$\left(\frac{1}{1-\delta_j}\right) s_j \left(r_j \left(1-\psi\left(r,\delta_j\right)\right) - \psi\left(r,\delta_j\right)\right)$$

In words, the lender faces a quantity $\frac{s_j}{1-\delta_j}$ of consumers. The default rate among consumers is $\psi\left(r,\delta_j\right)$. Thus, with probability $1-\psi\left(r,\delta_j\right)$, the lender is paid $r_j$, and with probability $\psi\left(r,\delta_j\right)$, the lender loses the principal and the interest payment.

**Price setting.** Conditional on $\delta_j$, the lender chooses $r_j$ to maximize:

$$s_j \left(r_j \left(1-\psi\left(r_j,\delta_j\right)\right) - \psi\left(r_j,\delta_j\right)\right)$$

We can write this as:

$$\underbrace{\left(1-\psi\left(r_j,\delta_j\right)\right) s_j}_{Market\ size} \underbrace{\left(r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right)}_{Markup}$$

Differentiating with respect to $r$, we have:

$$-\frac{d\psi}{dr_j} s_j \left(r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right) + \left(1-\psi\left(r_j,\delta_j\right)\right) s_j' \left(r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right) +$$
$$\left(1-\psi\left(r_j,\delta_j\right)\right) s_j - \left(1-\psi\left(r_j,\delta_j\right)\right) s_j \left(\frac{\partial}{\partial r_j}\left(\frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right)\right) = 0$$

Using (23) from Appendix A.1, we have $s_j' = -\frac{1}{\theta}$. Rearranging,

$$\left(r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right)\left(-\left(1-\psi\left(r_j,\delta_j\right)\right)\frac{1}{\theta} - \frac{d\psi}{dr_j}s_j\right) = \\ -\left[\left(1-\psi\left(r_j,\delta_j\right)\right)s_j - \left(1-\psi\left(r_j,\delta_j\right)\right)s_j\left(\frac{\partial}{\partial r_j}\left(\frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right)\right)\right] \tag{36}$$

Now, we have:

$$\frac{d\psi}{dr_j} = \left(1-\delta_j\right)\frac{d\phi}{dr_j}$$

$$\frac{\partial}{\partial r_j}\left(\frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right) = \frac{1-\delta_j}{(1-\psi)^2}\frac{d\phi}{dr_j}$$

Hence, (36) becomes:

$$\left(r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)}\right)\left(-\left(1-\psi\left(r_j,\delta_j\right)\right)\frac{1}{\theta} - \left(1-\delta_j\right)\frac{d\phi}{dr_j}s_j\right) = \\ -\left[\left(1-\psi\left(r_j,\delta_j\right)\right)s_j - \left(1-\psi\left(r_j,\delta_j\right)\right)s_j\left(\frac{1-\delta_j}{\left(1-\psi\left(r_j,\delta_j\right)\right)^2}\frac{d\phi}{dr_j}\right)\right]$$

Rearranging, we have:

$$r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)} = \\ \left(\left(1-\psi\left(r_j,\delta_j\right)\right)\frac{1}{\theta} + \left(1-\delta_j\right)\frac{d\phi}{dr_j}s_j\right)^{-1}\left[1 - \frac{1-\delta_j}{(1-\psi)^2}\frac{d\phi}{dr_j}\right]\left(1-\psi\left(r_j,\delta_j\right)\right)s_j \tag{37}$$

When there is no moral hazard, $\phi(r) = 0$, so $\frac{d\phi}{dr_j} = 0$, so (37) reduces to (6) in the main text. When there is moral hazard, the RHS of (37) tends to be lower, so lenders' markups above the break-even interest rate are lower. Intuitively, increasing interest rates increases costs, so lenders set lower markups in response.

**Screening incentives.** Recall we defined:

$$\psi(r,\delta) = \delta + (1-\delta)\phi(r)$$

This gives:

$$\frac{\partial \psi}{\partial \delta} = 1 - \phi\left(r\right)$$

Lenders' optimal profits are the solution to:

$$\max_{\delta_j} \max_{r_j} \left(\frac{1}{1-\delta_j}\right) s_j \left(r_j\left(1-\psi\left(r,\delta_j\right)\right) - \psi\left(r,\delta_j\right)\right) - c_q\left(\delta_j\right) \tag{38}$$

Using (35), the objective in (38) becomes:

$$\left(\frac{1}{1-\delta_j}\right) s_j \left(r_j\left(1-\left(\delta_j+\left(1-\delta_j\right)\phi\left(r\right)\right)\right) - \left(\delta_j+\left(1-\delta_j\right)\phi\left(r\right)\right)\right) - c_q\left(\delta_j\right)$$

This rearranges to:

$$= s_j\left(r_j - \frac{\delta_j}{1-\delta_j}\right) + s_j\left(-\phi\left(1+r_j\right)\right) - c_q\left(\delta_j\right) \tag{39}$$

As in Appendix A.2, the envelope theorem applies, so lenders' investment incentives are determined by differentiating (39) with respect to $\delta_j$, holding $s_j$ and $r_j$ fixed. This means that optimal investments are determined by the first-order-condition:

$$\frac{-s_j}{\left(1-\delta_j\right)^2} - c_q'\left(\delta_j\right) = 0$$

which is identical to (8) in the main text. Hence, if there is moral hazard for the type-$G$ consumers, this actually does not change incentives for screening out type-$B$ consumers, in this model.

**Simulations.** To demonstrate the effects of moral hazard on outcomes, we simulate lenders' price-setting decisions. Since screening incentives are unchanged from the main text, we will simply hold default rates $\delta_j$ contant. We will assume that moral hazard has a linear effect on type-$G$ customers' default rates:

$$\phi\left(r\right) = \chi r$$

This gives:

$$\psi\left(r_j,\delta_j\right) = \delta_j + \left(1-\delta_j\right)\chi r$$

Plugging in to (37), we have:

$$r_j - \frac{\psi\left(r_j,\delta_j\right)}{1-\psi\left(r_j,\delta_j\right)} = \left(\left(1-\psi\left(r_j,\delta_j\right)\right)\frac{1}{\theta}+\left(1-\delta_j\right)\chi s_j\right)^{-1}\left[1-\frac{1-\delta_j}{(1-\psi)^2}k\right]\left(1-\psi\left(r_j,\delta_j\right)\right)s_j \quad (40)$$

In any symmetric equilibrium, we have $s_j = \frac{1}{N}$. Using (40), we can simulate markups, for different values of $\chi$. Figure A.2 shows how markups vary with $\chi$. When $\chi$ is larger, so moral hazard is a greater concern, markups are lower for any given value of $N$, because banks internalize the fact that raising interest rates tends to increase default rates.

## A.7 Winner's curse

In this appendix, we relax the assumption that the results of lenders' screening decisions are perfectly correlated. For simplicity, we assume that each customer can only take loans from the two banks on the Salop circle she is nearest to: the transportation costs to other lenders are high enough that there is no interest rate she is willing to borrow at. This simplifies the derivations, since each customer only has two choice of lenders.

Rather than the default rate $\delta_j$, it is convenient to work with measures of type-$B$ consumers. There is a total measure $q$ of type-$B$ consumers. As in the main text, suppose that each lender can invest $\tilde{c}\left(\alpha_j\right)$ to create a test that perfectly identifies a fraction $1-\alpha_j$ of type-$B$ consumers, out of a total measure $q$, and screens them out. In contrast to the main text, we assume that test results are independent across banks. From the perspective of a given bank, consider a customer located between lender $j$ and her neighbor $j'$. There are four types of type-$B$ consumers, who appear with the following probabilities.

1. $\alpha_j\alpha_{j'}$: Pass both tests
2. $\alpha_j\left(1-\alpha_{j'}\right)$: Pass $j$'s test, but not my neighbor's
3. $\left(1-\alpha_j\right)\alpha_{j'}$: Pass my neighbor's test, but not mine
4. $\left(1-\alpha_j\right)\left(1-\alpha_{j'}\right)$: Fail both tests

Categories 3 and 4 of consumers have failed $j$'s test, so $j$ knows that they are type-$B$ consumers and never lends to them. Category 2 of consumers has failed $j'$'s test, so $j'$ does not lend to them: hence, these customers will borrow from $j$ at any price. Category 1 of consumers passes both tests, so they are price sensitive: they will choose the bank that offers higher utility, net of transportation costs.

Let $s_i(r_i)$ represent lender $j$'s market share, among price-elastic consumers. Suppose all lenders are choosing some screening probability $\alpha_{-j}$. The profit of lender $j$ an be written as:

$$\Pi_i = \underbrace{s_i(r_i)r_i}_{Good\ type\ profits} \underbrace{-s_i(r_i)q\alpha_j\alpha_{-j}}_{Group\ 1\ losses} - \underbrace{\frac{2}{N}q\alpha_j\left(1-\alpha_{-j}\right)}_{Group\ 2\ losses} - \tilde{c}\left(\alpha_j\right) \tag{41}$$

In words, for the measure $s_i(r_i)$ of price-elastic type-$G$ consumers, the lender makes $r_i$. For the measure $q\alpha_j\alpha_{-j}$ of type-1 consumers, who have passed $j$'s test as well as the neighbors, $j$ loses the principal. There is a measure $\frac{2}{N}\alpha_j\left(1-\alpha_{-j}\right)$ of type-$B$ consumers who have passed $j$'s test, but not the neighbor's (note the 2 is because $j$ has two neighbors), and $j$ loses the principal on these. Finally, $j$ pays the screening cost $\tilde{c}\left(\alpha_j\right)$.

**Price-setting.** Differentiating (41) with respect to $r_i$, we have:

$$s_i'\left(r_i - q\alpha_j\alpha_{-j}\right) + s_i = 0 \tag{42}$$

Using (23) from Appendix A.1, we have $s_j' = -\frac{1}{\theta}$. Hence, (42) rearranges to:

$$r_i - q\alpha_i\alpha_j = \theta s_i \tag{43}$$

(43) is effectively a markup formula. The marginal cost of increasing lending is equal to the fraction of type-$B$ consumers, among consumers who are marginal with respect to price. Among price-elastic consumers, for every type-$G$, there are $q\alpha_i\alpha_j$ type-$B$'s. Hence, this is the relevant marginal cost for lenders' markups. In symmetric equilibrium, $s_i = \frac{1}{N}$, so markups over marginal costs still decrease as $N$ increases.

**Screening.** To solve for optimal screening decisions, we differentiate (41) with respect to $\alpha_j$. Using the envelope theorem, we can ignore effects of changes in $r_j$. This gives:

$$\frac{d\Pi_i}{d\alpha_i} = -s_i(r_i)q\alpha_{-j} - \frac{2q\left(1-\alpha_j\right)}{N} - \tilde{c}'\left(\alpha_j\right)$$

$$-\tilde{c}'\left(\alpha_j\right) = s_i(r_i)q\alpha_{-j} + \frac{2q\left(1-\alpha_j\right)}{N}$$

In symmetric equilibrium, $s_i(r_i) = \frac{1}{N}$, hence we have:

$$-\tilde{c}'\left(\alpha_j\right) = \frac{\left(2-\alpha_{-j}\right)q}{N} \tag{44}$$

(44) says that, when $\alpha_{-j}$ is lower – when $j$'s neighbors screen more intensely – $j$ also increases

screening intensity. This is because customers who fail $j$'s neighbors' tests will tend to borrow from $j$, which increases $j$'s incentives to invest in screening. However, as in the baseline model, (44) shows that screening incentives are lower when $N$ is larger. Hence, both forces in the baseline model are still present when we assume lenders face a winner's curse.

## A.8 Logit demand model

In this appendix, we consider an alternative model of preferences, the logit model, and show that our results still hold in this setting. As in the main text, there is a unit mass of type-$G$ consumers, and some measure of type-$B$ consumers. The screening technology is identical to the main text: lenders pay a fixed cost $c_q(\delta)$ to lower the population default rate to $\delta$. As in the main text, the willingness-to-pay of consumers for loans is independent of whether they are type $B$ or $G$. Unlike the main text, we assume consumers' preferences over banks are described by a logit model. The utility of consumers' outside option, of not borrowing, is normalized to 0. The utility that consumer $i$ attains if she borrows from lender $j$, at loan rate $r_j$, is:

$$\mu - \alpha r_j + \epsilon_{ij} \tag{45}$$

where $\epsilon_{ij}$ is i.i.d. type-1 extreme value. Hence, consumers have logit demand, with mean utility $\mu$ for borrowing. $\mu$ can be thought of as consumers' mean utility for car loans, relative to the outside option. $\alpha$ determines how sensitive consumers are to interest rates. $\epsilon_{ij}$ is an idiosyncratic preference that consumer $i$ has for lender $j$.[25] Given lenders' interest rates $r_j$, the market share of lender $j$ is:

$$s_j = \frac{\exp\left(\mu - \alpha r_j\right)}{1 + \sum_j \exp\left(\mu - \alpha r_j\right)} \tag{46}$$

Lenders' profits are still, as in the main text:

$$\Pi = \left(\frac{1}{1-\delta_j}\right) s_j \left(r_j\left(1-\delta_j\right) - \delta_j\right) = s_j \left(r_j - \frac{\delta_j}{1-\delta_j}\right)$$

Appendix A.9.1 shows that lenders' optimal prices satisfy:

$$r_j - \frac{\delta_j}{1-\delta_j} = \frac{1}{\alpha\left(1-s_j\right)} \tag{47}$$

[25]Technically, idiosyncratic terms are needed in Bertrand models so that demand is not perfectly elastic, so firms set prices above marginal cost in equilibrium. In our setting, these preference shocks could represent either consumers' actual preferences over lenders, or could represent in reduced-form dealers' relationships with lenders, or consumer search costs.

The intuition for (47) is that $r_j - \frac{\delta_j}{1-\delta_j}$, the markup of $r_j$ over the break-even interest rate, $\frac{\delta_j}{1-\delta_j}$, is higher when consumers' price sensitivity, $\alpha$, is lower, and when firm $j$'s market share $s_j$ is higher.

Appendix A.9.2 shows that lenders' FOC for optimal information acquisition is unchanged from the main text:

$$\frac{s_j}{\left(1-\delta_j\right)^2} = -c_q'\left(\delta_j\right) \tag{48}$$

However, the second-order condition changes to:

$$c_q''(\delta)(1-\delta)^4 + 2s(1-\delta) > \frac{\alpha}{\frac{1}{s(1-s)} + \frac{1}{(1-s)^2}} \tag{49}$$

A symmetric equilibrium is described by a triple $s, r, \delta$ which solves (46), (47), and (48).[26] Equilibrium consumer surplus, for type $G$ consumers, follows from the standard logit surplus formula, from, for example, Train (2009) :

$$\log\left(1 + \sum_{j=1}^{J} \exp(\mu - \alpha r)\right) + C \tag{50}$$

where $C$ is a constant.

We proceed to solve the model numerically. As in the main text, we parametrize costs as:

$$\tilde{c}(\alpha) = \frac{k}{\alpha}$$

implying that:

$$c_q\left(\delta_j\right) = \frac{kq\left(1-\delta_j\right)}{\delta_j}$$

Figure A.3, analogous to Figure 1, shows equilibrium outcomes, as we vary the number of lenders. The findings are identical to the main text: Concentration increases markups, but decreases default rates. The net effect of concentration on interest rates is positive when $k$ is lower and the population is low-risk, and negative when $k$ is high and the population is high-risk. Quantities always tend to decrease as concentration increases. The main difference of the logit model to the Salop circle model is that consumer surplus tends to increase as markets

[26] We note that these conditions are necessary, but not sufficient, for equilibrium, and that the model does not always have unique equilibria, even when $c_q(\cdot)$ is convex. Intuitively, this is because, in the logit model, costly information acquisition creates increasing returns: if firms acquire more information, default rates $\delta$ are lower, allowing firms to charge lower interest rates, which then increases market shares and increases firms' incentives for information acquisition. Moreover, nontrivial equilibria are not guaranteed to exist: for some choices of $c_q(\cdot)$, there is no $\delta < 1$ which satisfies all three conditions simultaneously.

become more competitive. Intuitively, this is because gains-from-variety are much larger in the logit model than in the Salop circle model, so there is a stronger mechanical effect of increasing $N$ on consumer surplus. However, when $k$ is very large – the blue line – increasing $N$ can still decrease consumer surplus in the logit model.

## A.9 Proofs for Appendix A.8

### A.9.1 Optimal price setting

From (46), market shares are:

$$s_j = \frac{\exp\left(\mu - \alpha r_j\right)}{1 + \sum_j \exp\left(\mu - \alpha r_j\right)}$$

The derivative with respect to the interest rate $r_j$ is:

$$\frac{\partial s_j}{\partial r_j} = -\alpha s_j \left(1 - s_j\right)$$

From (5), lenders choose interest rates to solve:

$$\max_{r_j} \left(s_j\left(r_j\right)\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right)$$

Differentiating with respect to $r_j$, we have:

$$s_j - \frac{\partial s_j}{\partial r_j}\left(r_j - \frac{\delta_j}{1-\delta_j}\right) = 0$$

$$s_j - \alpha s_j \left(1 - s_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) = 0$$

This simplifies to:

$$r_j - \frac{\delta_j}{1-\delta_j} = \frac{1}{\alpha\left(1 - s_j\right)}$$

This is (47).

### A.9.2 Optimal information acquisition

From (7), lenders choose $\delta_j$ to solve:

$$\max_{\delta_j} \max_{r_j} s_j\left(r_j\right)\left(r_j - \frac{\delta_j}{1-\delta_j}\right) - c_q\left(\delta_j\right) \tag{51}$$

As in the baseline model, the envelope theorem gives:

$$\frac{d}{d\delta_j}\left[\max_{r_j} s_j\left(r_j\right)\left(r_j-\frac{\delta_j}{1-\delta_j}\right)\right]=\frac{\partial}{\partial\delta_j}\left[s_j\left(r_j^*\right)\left(r_j^*-\frac{\delta_j}{1-\delta_j}\right)\right]$$

That is, we can hold the interest rate $r_j^*$ constant at the optimal choice when taking the derivative. Thus, we have:

$$\frac{\partial}{\partial\delta_j}\left[s_j\left(r_j^*\right)\left(r_j^*-\frac{\delta_j}{1-\delta_j}\right)\right]=-\frac{s_j\left(r_j^*\right)}{\left(1-\delta_j\right)^2}$$

Note that this is always negative, since $s_j > 0$. That is, higher default rates always decrease the objective. Combining this with the derivative of $c_q\left(\delta_j\right)$, we get the first-order condition:

$$-\frac{s_j}{\left(1-\delta_j\right)^2}-c_q'\left(\delta_j\right)=0 \tag{52}$$

Rearranging, we get (8).

**Second-order condition.** In order for (52) to be a maximum, a second-order condition must also hold. Differentiating again, we have:

$$\frac{\partial^2}{\partial\delta_j^2}\max_{r_j} s_j\left(r_j\right)\left(r_j-\frac{\delta_j}{1-\delta_j}\right)-c_q\left(\delta_j\right)=\frac{\partial}{\partial\delta_j}\left[-\frac{s_j}{\left(1-\delta_j\right)^2}-c_q'\left(\delta_j\right)\right]$$

This is:

$$\frac{\partial}{\partial\delta_j}\left[-\frac{s_j}{\left(1-\delta_j\right)^2}-c_q'\left(\delta_j\right)\right]=-\frac{1}{\left(1-\delta_j\right)^2}\frac{\partial s_j}{\partial\delta_j}-\frac{2s_j}{\left(1-\delta_j\right)^3}-c_q''\left(\delta_j\right) \tag{53}$$

This must be negative, at the optimal choice of $\delta_j$ for $j$. Expression (30) of appendix A.2.2 below shows that the derivative of $j$'s optimal market share $s_j$ as $\delta_j$ varies, holding fixed all other agents' interest rates and market shares, is:

$$\frac{ds_j}{d\delta_j}=\left(\frac{-\alpha}{\left(1+\delta_j\right)^2}\right)\left(\frac{1}{\frac{1}{s_j\left(1-s_j\right)}+\frac{1}{\left(1-s_j\right)^2}}\right)$$

Substituting this into (53), we get:

$$\frac{1}{\left(1-\delta_j\right)^2}\left(\frac{\alpha}{\left(1+\delta_j\right)^2}\right)\left(\frac{1}{\frac{1}{s_j\left(1-s_j\right)}+\frac{1}{\left(1-s_j\right)^2}}\right)-\frac{2s_j}{\left(1-\delta_j\right)^3}-c_q''\left(\delta_j\right)<0$$

This rearranges to:

$$c_q''(\delta_j)(1-\delta_j)^4 + 2s_j(1-\delta_j) > \frac{\alpha}{\frac{1}{s_j(1-s_j)} + \frac{1}{(1-s_j)^2}}$$

This is (49).

**Characterizing $\frac{ds_j}{d\delta_j}$.** First, consider the market share equilibrium conditions, (46) and (47). For analytical convenience, define $\zeta_j \equiv \frac{\delta_j}{1-\delta_j}$, so that (47) becomes:

$$r_j - \zeta_j = \frac{1}{\alpha(1-s_j)} \tag{54}$$

As $\delta_j$ varies, $c_j$ also varies, tracing out (46). From (46), we have:

$$\frac{dr_j}{ds_j} = \frac{-1}{\alpha s_j(1-s_j)} \tag{55}$$

Now, differentiating (28) totally, we have:

$$dr_j - d\zeta_j = d\left(\frac{1}{\alpha(1-s_j)}\right) = \frac{1}{\alpha(1-s_j)^2} ds_j \tag{56}$$

We can solve (56) and (29) for $\frac{d\zeta_j}{ds_j}$, to get:

$$\frac{d\zeta_j}{ds_j} = \frac{-1}{\alpha s_j(1-s_j)} - \frac{1}{\alpha(1-s_j)^2}$$

Inverting,

$$\frac{ds_j}{d\zeta_j} = \frac{-\alpha}{\frac{1}{s_j(1-s_j)} + \frac{1}{(1-s_j)^2}}$$

Now, from the definition of $c_j$, we have:

$$\frac{d\zeta_j}{d\delta_j} = \frac{1}{(1-\delta_j)^2}$$

Hence,

$$\frac{ds_j}{d\delta_j} = \frac{ds_j}{d\zeta_j}\frac{d\zeta_j}{d\delta_j} = \left(\frac{-\alpha}{(1-\delta_j)^2}\right)\left(\frac{1}{\frac{1}{s_j(1-s_j)} + \frac{1}{(1-s_j)^2}}\right) \tag{57}$$

# B Bank Merger Data

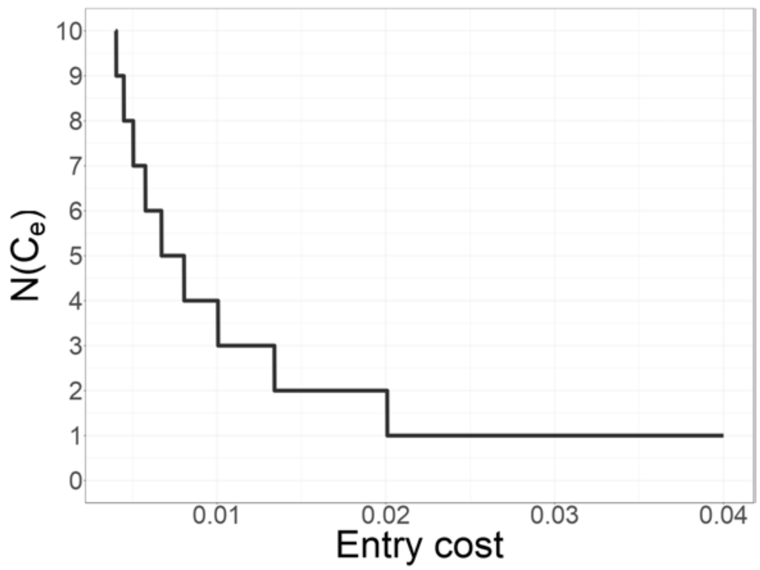
We combine the Bank Mergers data with the quarterly Summary of Deposits data. The bank mergers data is collected from the Transformations file from the National Information Center (NIC) (previously provided by the Federal Reserve Bank of Chicago until 2015), which lists all mergers and acquisitions events of banks and bank holding companies that have occurred since 1976, along with the names of the surviving and non-surviving entities. We exclude government- assisted mergers which resulted in failed banks ceasing to exist.

From the Summary of Deposits data, we initially match commercial banks to their ultimate parent bank holding company using the relationships files from the National Information Center. The latter reports the entire history of a bank's control relationships with others over time, and the effective dates when such relationships hold. We use these links where ownership/control is in any BHC or bank and for which the exact ownership percent is reported. We iterate through the entire chain of relationships for a given entity to infer the ultimate BHC at each point in time, and we adjust the deposit amount recorded in the Summary of Deposits for the ultimate ownership share in the original entity.

When matching the Summary of Deposits data with the bank mergers data, we follow Granja and Paixao (2019): we measure the level of deposits of each acquired bank during the merger year as the level of deposits as of June 30th of the merger year if the merger occurs after June 30th; otherwise, we measure deposits as of June 30th of the previous year.

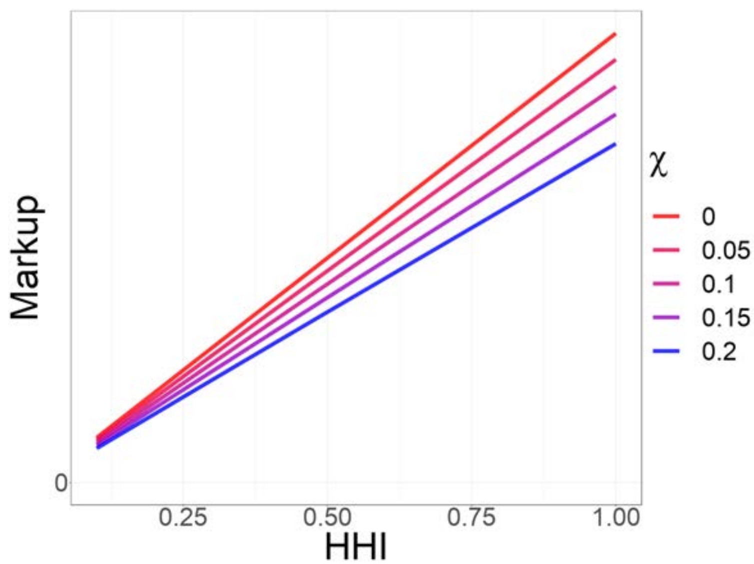
Between 2009 and 2019 there are a total of 1442 mergers, covering 1812 distinct counties. Table A.4 shows the number of mergers in each year, as well as the distribution of the number of mergers across counties for each year. Table A.5 shows the largest 50 mergers in the sample, by number of counties affected, listed by chronological order.

**Figure A.1: Equilibrium Entry**



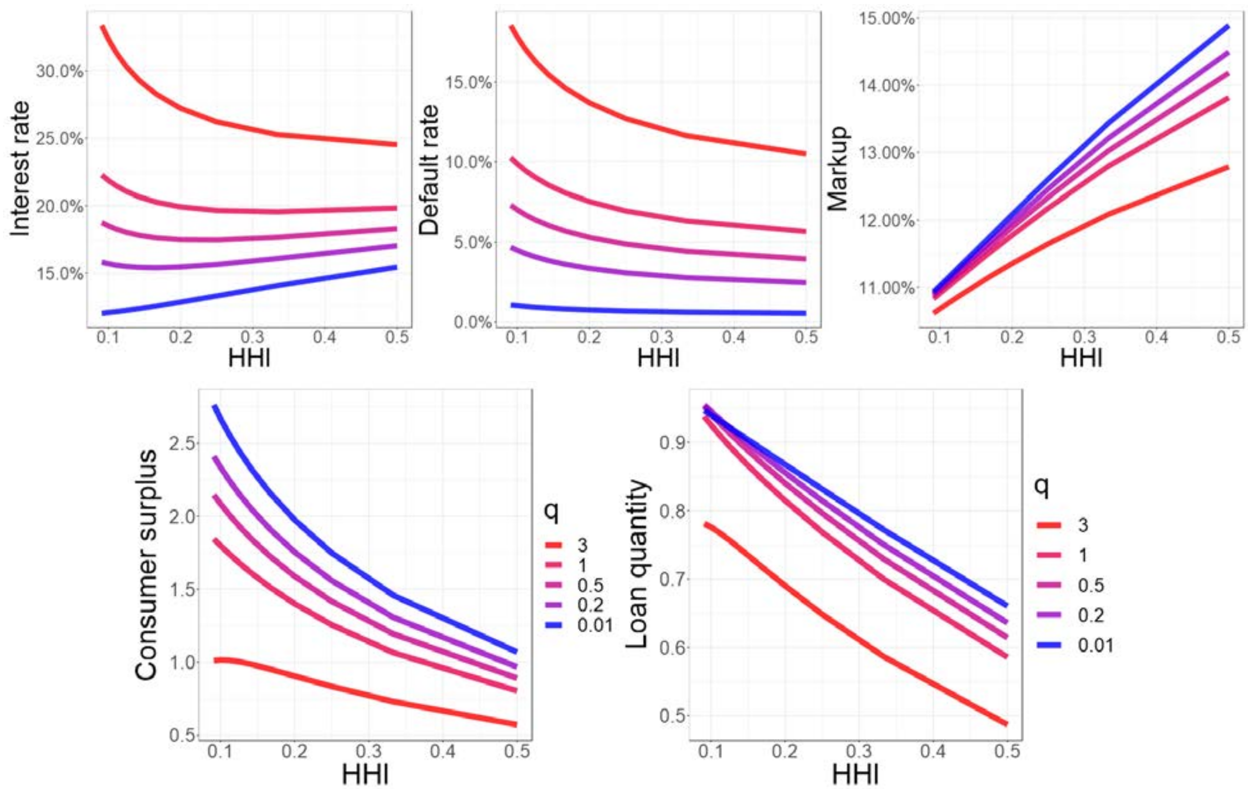

The above figure shows the equilibrium number of entrants as a function of the fixed entry cost $C_e$, in the entry model of Appendix A.5. The x-axis shows the fixed entry cost $C_e$. The y-axis shows the equilibrium number of entrants, $N(C_e)$, which we calculate by solving (33) and (34). We use the cost function (14), and we set $\theta = 0.04, \mu = 0.5, k = 10^{-5}$.

**Figure A.2: Markups under moral hazard**



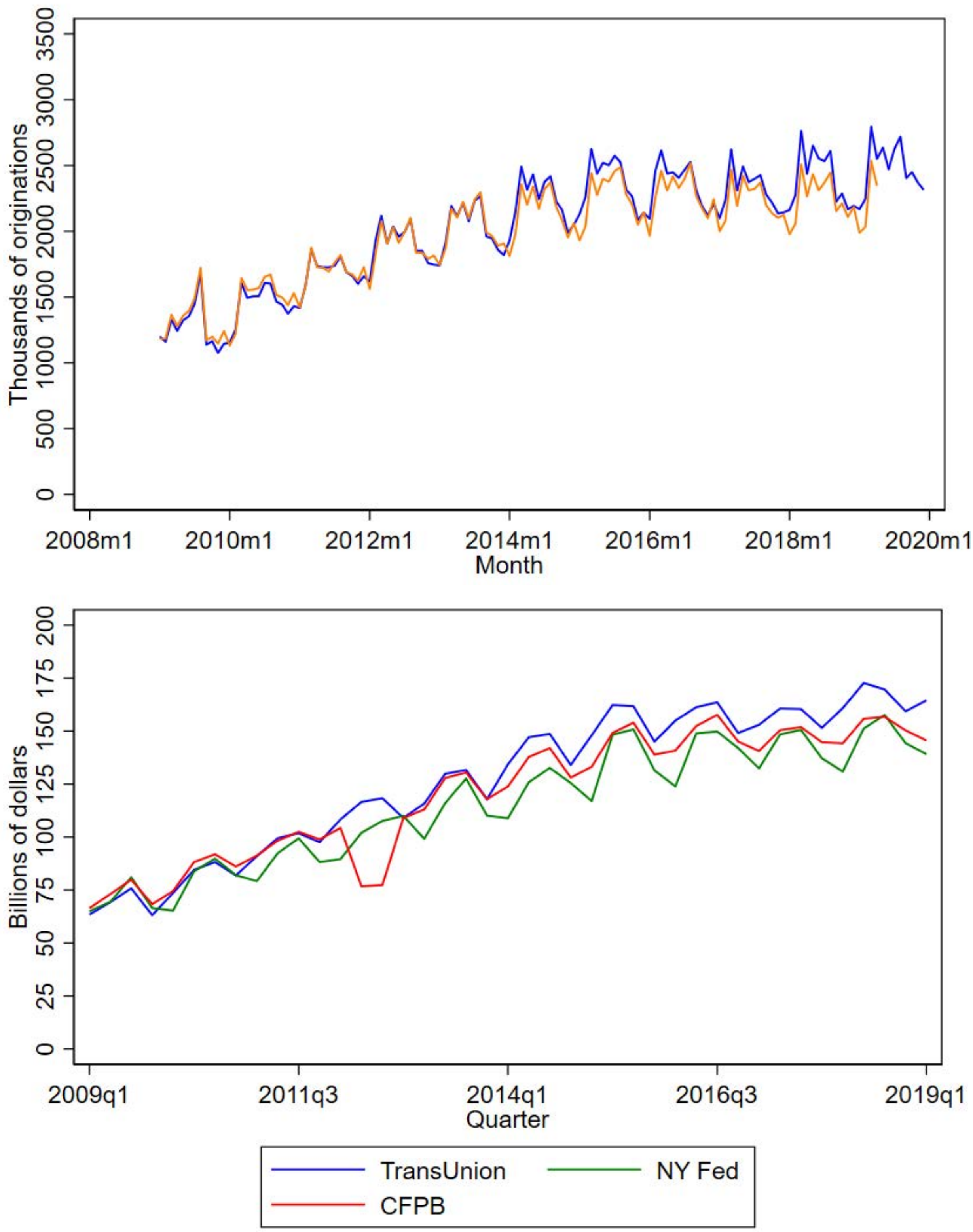

The above figure shows equilibrium markups when there is moral hazard, for different values of $\chi$. The $x$-axis shows the HHI, as we vary the number of lenders $N$. The $y$-axis shows the equilibrium markup, $r_j - \frac{\psi(r_j,\delta_j)}{1-\psi(r_j,\delta_j)}$, calculated as the RHS of (40). We set $\delta = 0.1, \theta = 0.04$.

**Figure A.3: Logit Model Simulations**



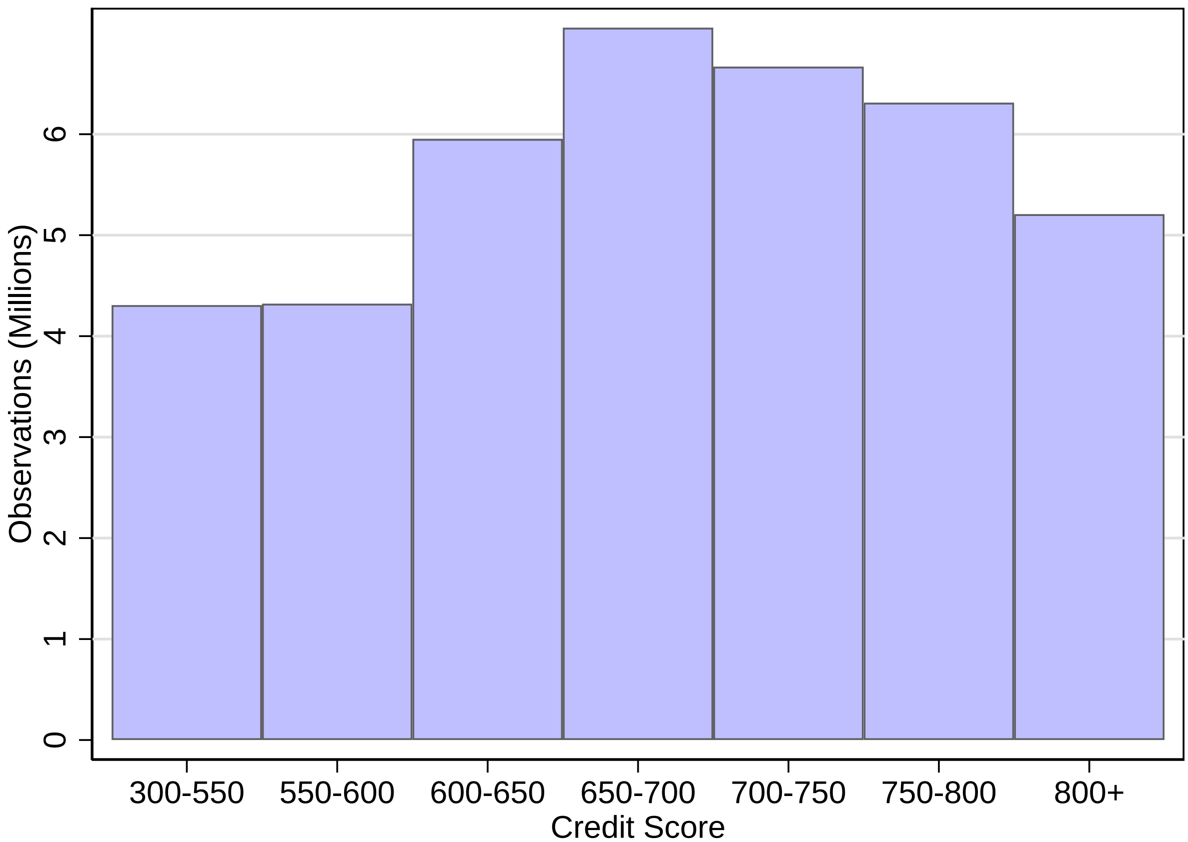

The above figure shows model outcomes, for different values of $HHI$ and $q$, in the logit model described in Appendix A.8. The top left panel shows equilibrium interest rates, $r$. The top middle panel shows default rates, $\delta$. The top right panel shows markups over the break-even interest rate, $r - \frac{\delta}{1-\delta}$. The bottom left panel shows consumer surplus, (50). The bottom right panel shows total loan quantity. All simulations use $\alpha = 10, \mu = 1.5, k = 0.001$.

**Figure A.4: Auto Loans in TU and Comparable Datasets**



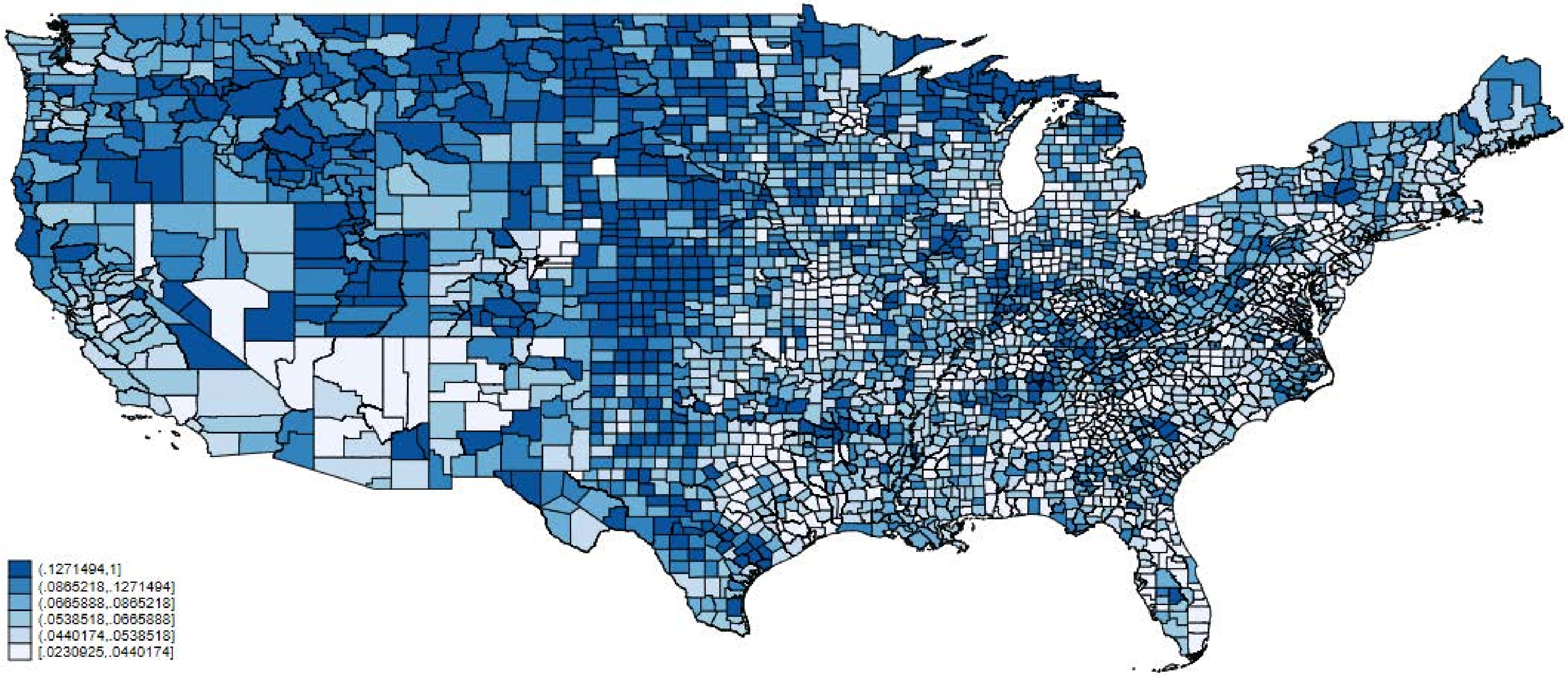

The above figure shows monthly auto loan originations. The top panel shows the number of loans, while the bottom panel shows the volume. The blue line shows the TU data series, while the red line shows a similar CFPB data series. Source: TransUnion, CFPB, and NY Fed.

**Figure A.5: Distribution of Credit Scores**




The above figure shows the total number of observations within each credit rating bin. Credit scores are given by VantageScore ratings. Source: TransUnion

**Figure A.6: Geographic Distribution of Market Competition**

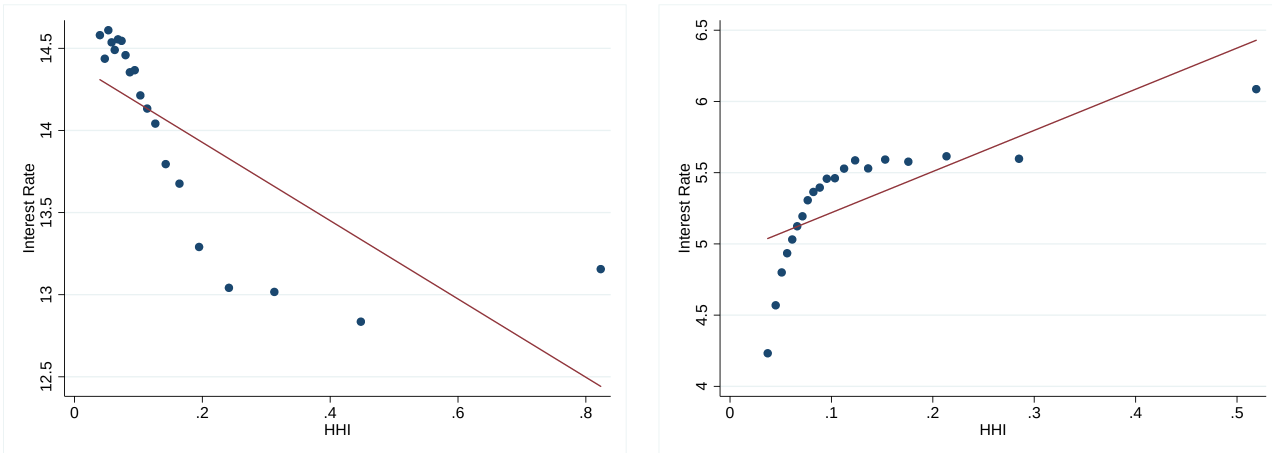



The above figure shows the average auto loan market HHI in each mainland US county in 2009. Darker shades show more concentrated auto lending markets. Source: TransUnion

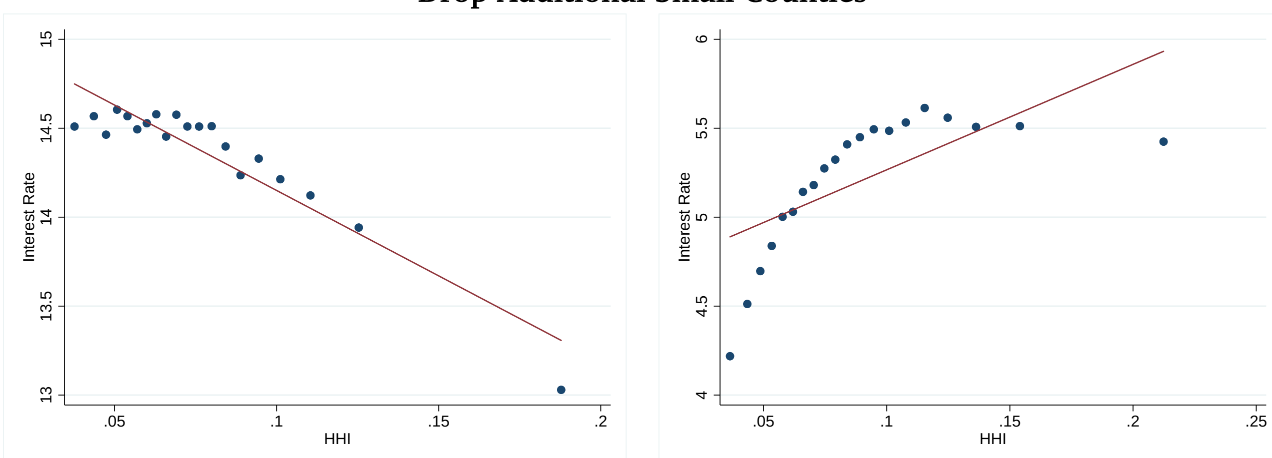
**Figure A.7: Interest Rates and Competition: Alternative Measurement**

**Credit Score Below 600** | **Credit Score Above 600**

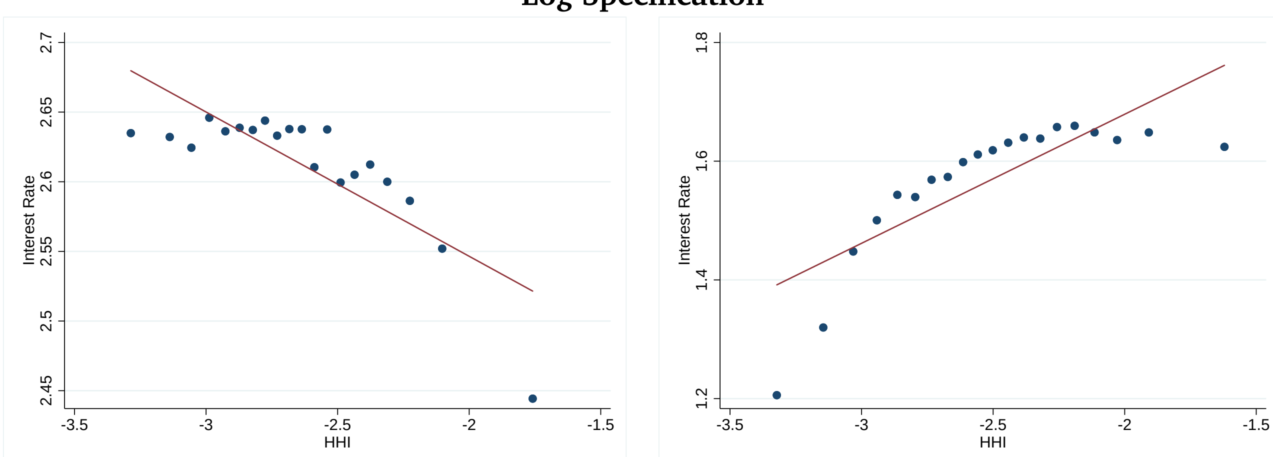
**No Small Counties Dropped**




**Drop Additional Small Counties**




**Log Specification**

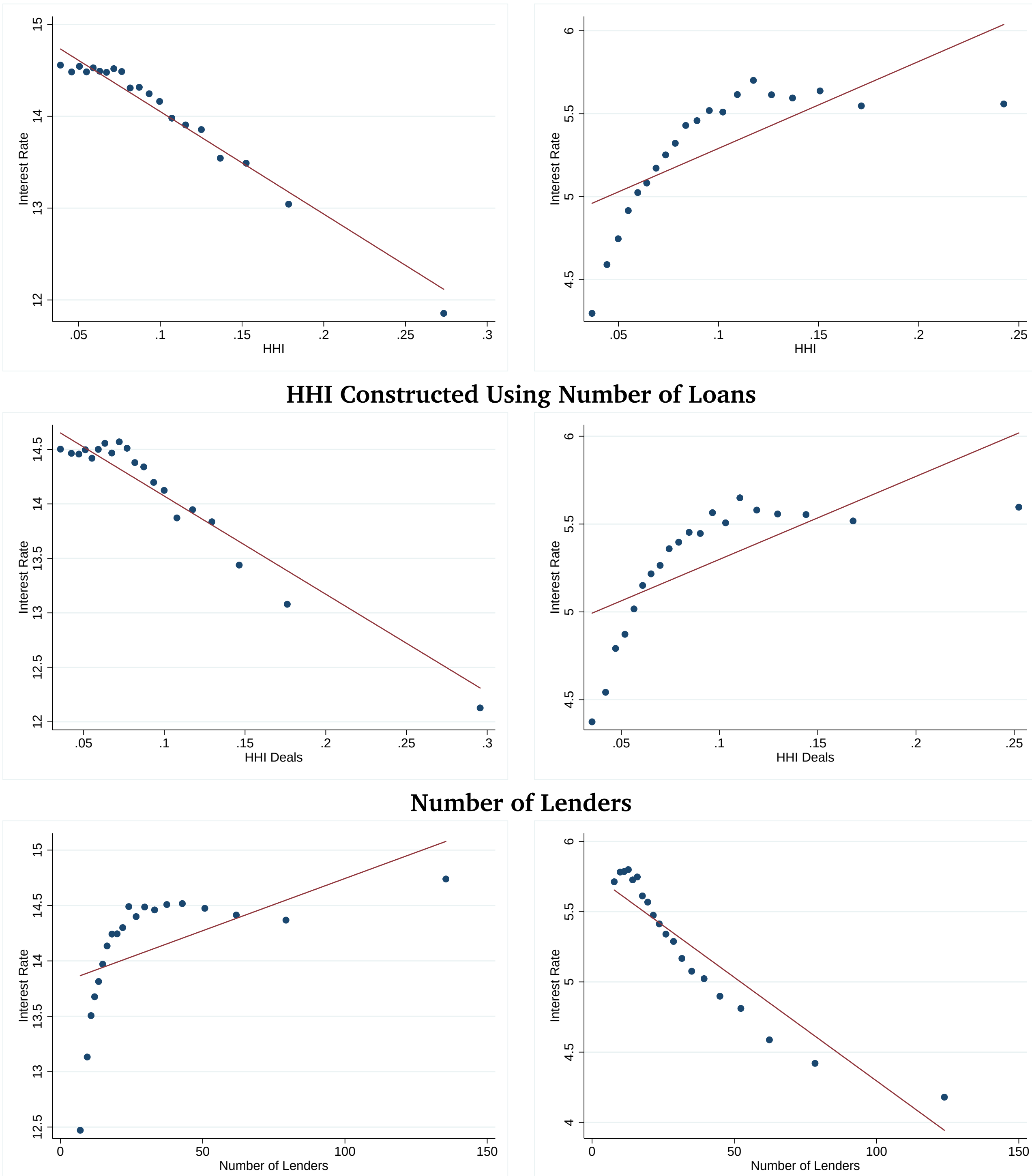



The above figure shows median interest rates in a county for given credit score ranges, broken down by ventile of HHI using alternative samples or measurement. The measurement or sample is noted above each panel. HHI is defined using the volume of auto loans, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is a lender's share of auto lending in a county within a credit score range. Credit score ranges are denoted above each panel. Credit scores are given by VantageScore ratings. Source: TransUnion.

**Figure A.8: Interest Rates and Competition: Alternative Measurement**

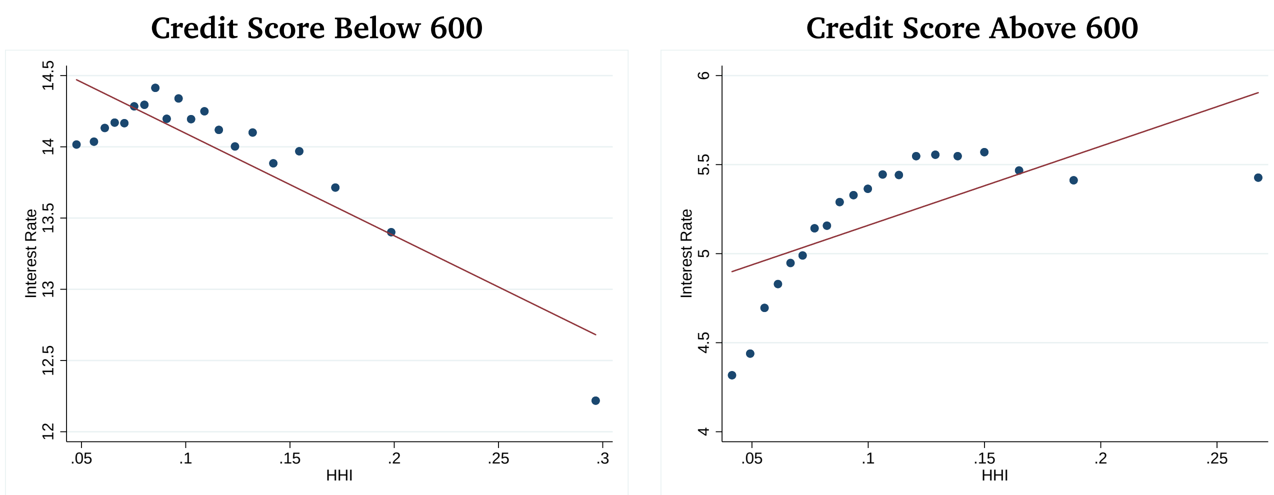
**Credit Score Below 600** **Credit Score Above 600**

**Winsorized**



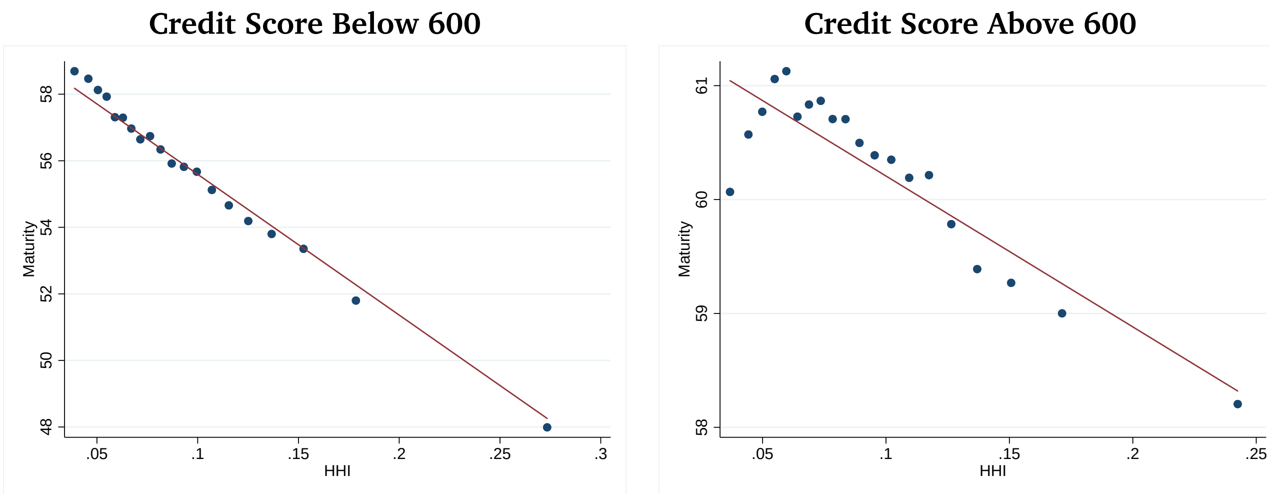

The above figure shows median interest rates in a county for given credit score ranges, broken down by ventile of HHI using alternative measurement. The measurement change is noted above each panel. For the top panel, HHI is defined using the volume of auto loans, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is a lender's share of auto lending in a county within a credit score range. For the middle panel, HHI is constructed using lenders' market shares by number of loans, rather than total loan amounts. Credit score ranges are denoted above each panel. Credit scores are given by VantageScore ratings. Source: TransUnion.

**Figure A.9: Interest Rates and Competition Excluding New Entrants**



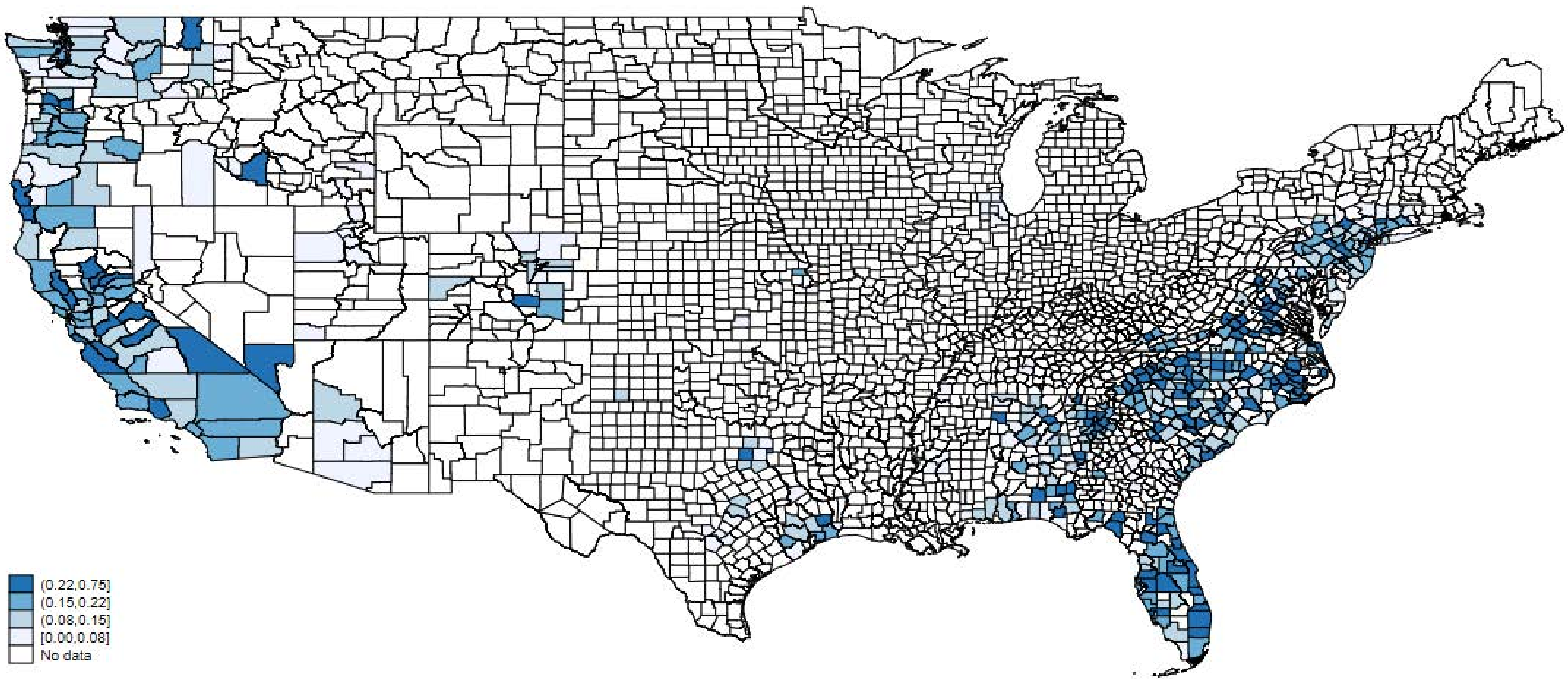

The above figure shows median interest rates in a county for given credit score ranges, broken down by ventile of HHI. The sample is restricted to lenders that operated since 2009, and thus excludes new entrants. HHI is defined using the volume of auto loans, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is a lender's share of auto lending in a county within a credit score range. Credit score ranges are denoted above each panel. Credit scores are given by VantageScore ratings. Source: TransUnion.

**Figure A.10: Maturity and Competition**



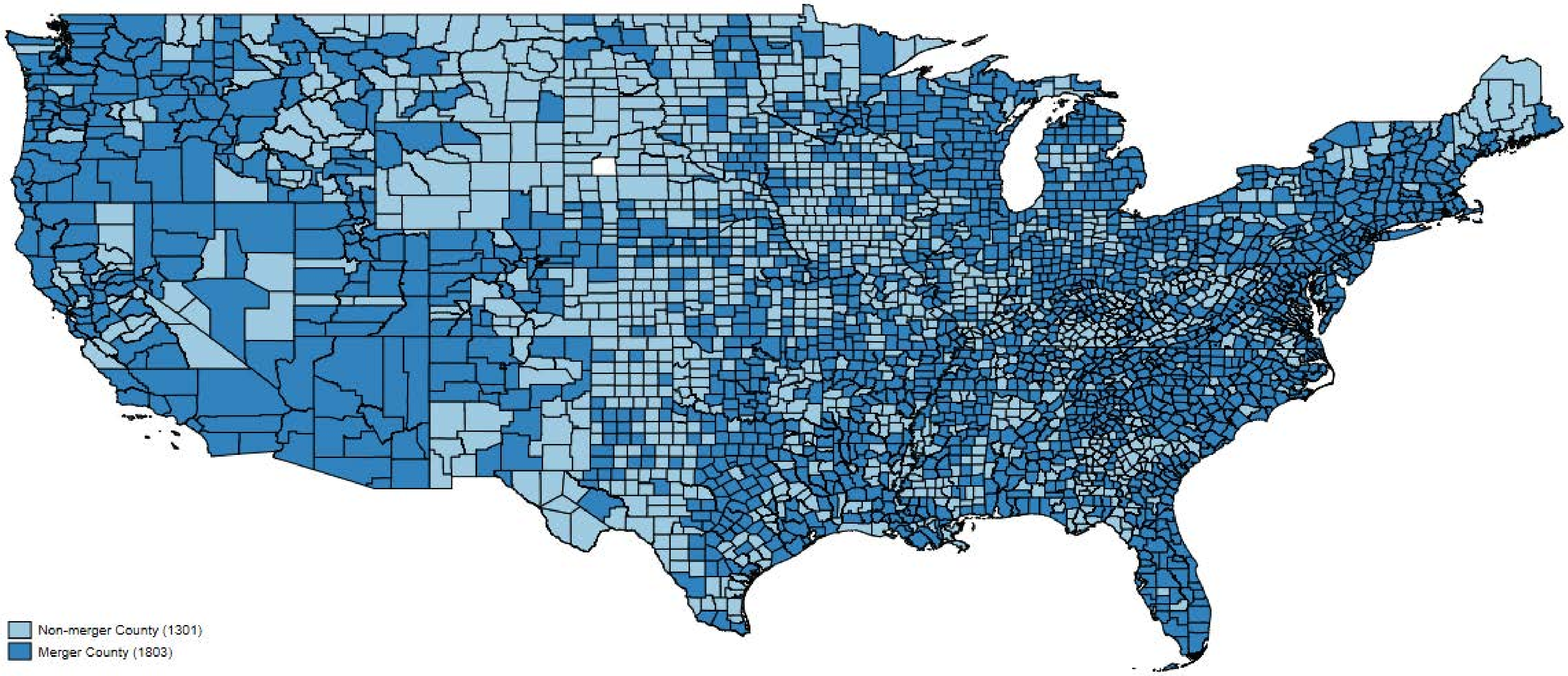

The above figure shows mean loan maturity in a county for given credit score ranges, broken down by ventile of HHI. HHI is defined using the volume of auto loans, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is a lender's share of auto lending in a county within a credit score range. Credit score ranges are denoted above each panel. Credit scores are given by VantageScore ratings. Source: TransUnion.

## Figure A.11: Geographic Distribution of Failed Bank Deposit Shares



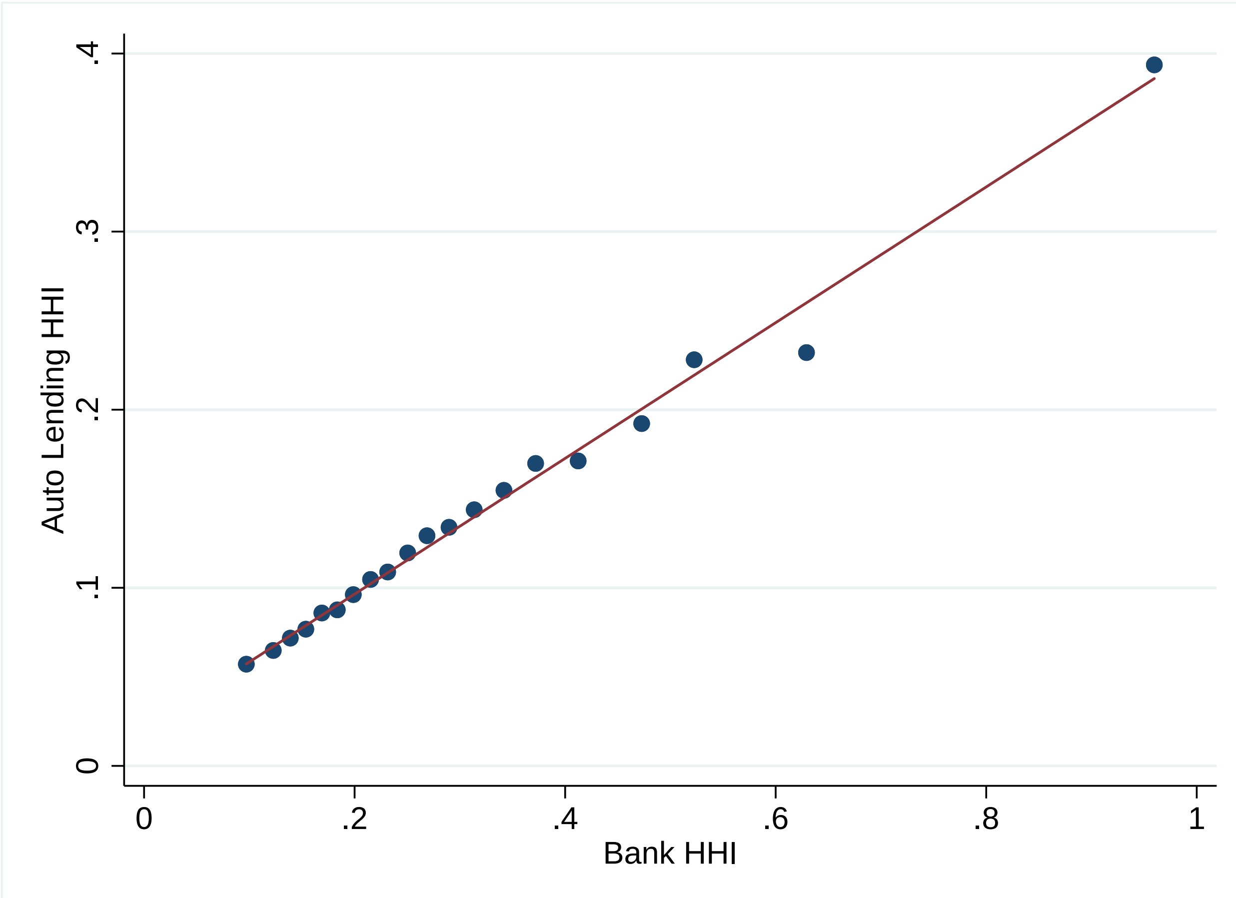

The above figure shows the deposit share in 2008 of the three largest banks that failed during the 2008 crisis, Wachovia, Washington Mutual and Countrywide. Source: Federal Reserve Call Reports

**Figure A.12: Geographic Distribution of Mergers**



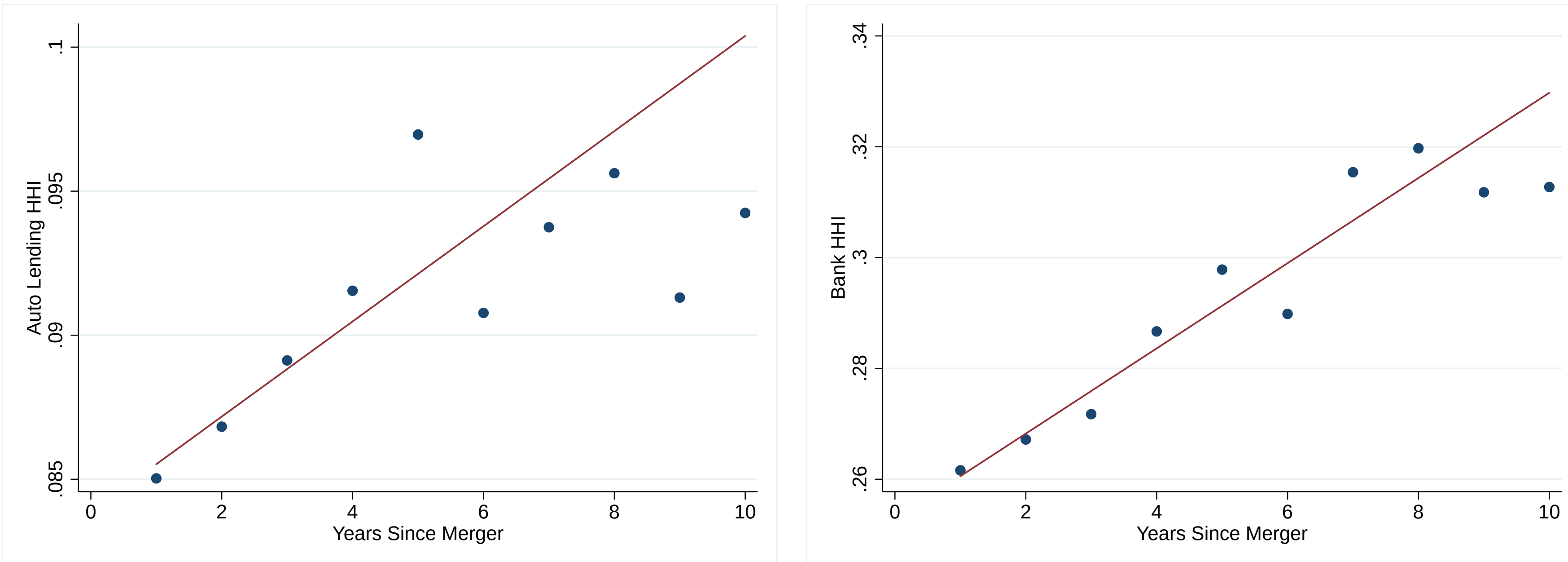

The above figure shows counties affected by bank mergers. Source: NIC and Federal Reserve Call Reports

**Figure A.13: Auto Lending and Bank HHI**



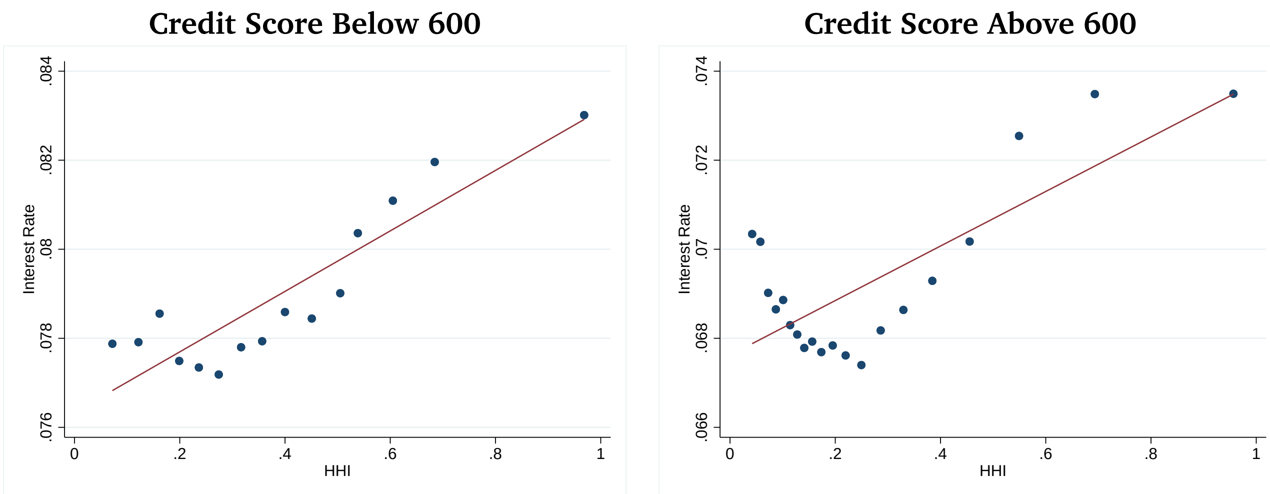

The above figure shows auto lending HHI, broken down by ventile of bank deposit market HHI. HHI is defined using the volume of auto loans or deposits, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is the share of auto lending or deposits in a county within a credit score range. Source: TransUnion and Federal Reserve Call Reports

**Figure A.14: HHI Following Acquisition**




The above figure shows average HHI, by the numbers of years since a bank merger occurred. HHI is defined using the volume of auto loans or deposits, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is the share of auto lending or deposits in a county within a credit score range. Source: TransUnion and Federal Reserve Call Reports

**Figure A.15: Interest Rates and Competition in the Mortgage Market**




The above figure shows median interest rates in a county for given credit score ranges, broken down by ventile of HHI. HHI is defined using the volume of mortgage loans, that is $HHI = \sum_i^N s_i^2$, where $s_i$ is a lender's share of auto lending in a county within a credit score range. Credit score ranges are denoted above each panel. Credit scores are given by VantageScore ratings. Source: TransUnion.

**Table A.1: Variable Definitions**

This table describes the main analysis variables used. All variables are constructed using a dataset provided to the University of Chicago Booth School of Business by TransUnion. Observations are at the county-year level.

| **Name** | **Description** |
|---|---|
| ***Loan information*** | |
| Principal | The original balance on the loan. |
| Monthly Payment | The payment due on a loan each month. |
| Maturity | The total number of months that the borrower is scheduled to be making payments on the loan. |
| Interest Rate | The annual percentage rate on the loan. Calculated by authors using data on principal, payments, and maturity available in the TransUnion data. |
| 90-day Delinquency | Indicates whether the payment on a loan has ever been delinquent by 90 days. |
| Credit Score | VantageScore 3.0 taken from January of each year for each borrower. |
| ***Market information*** | |
| HHI (Deals) | The HHI calculated for a given county-year, based on the number of auto loan originations. |
| HHI (Volume) | The HHI calculated for a given county-year, based on the volume of the auto loan originations. |
| Number of lenders | The number of lenders that are active in a given county-year. |
| Share of lenders only in auto market | The percentage of lenders in each county-year that are only active in the auto loan market, and no others. |

## Table A.2: Concentration and Interest Rates by Lender

The table shows the relationship between the number of loans rates and HHI, split by credit score at the county, lender by year level. The first four columns vary the inclusion of lender fixed effects. The second four columns split the sample by whether a lender offers only auto loans, or other types of consumer credit. The inclusion of fixed effects is denoted beneath each column. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}\ p < .05$, $^{***}\ p < .01$.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Ln(Interest Rate) | | | | | | | |
| | Full Sample | | | | Auto Lenders | | All Lenders | |
| | Credit Score 300-600 | | Credit Score 600-850 | | Credit Score 300-600 | Credit Score 600-850 | Credit Score 300-600 | Credit Score 600-850 |
| Ln(HHI) | -0.0737$^{***}$ | -0.0727$^{***}$ | 0.110$^{**}$ | 0.105$^{**}$ | -0.0689$^{***}$ | 0.173$^{**}$ | -0.0785$^{***}$ | 0.0282 |
| | (0.0103) | (0.00996) | (0.0517) | (0.0502) | (0.0114) | (0.0764) | (0.00921) | (0.0245) |
| County X Credit Score Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Lender Fixed Effects | No | Yes | No | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,866,741 | 1,865,935 | 5,213,296 | 5,212,710 | 1,107,222 | 2,401,999 | 758,663 | 2,810,678 |
| $R^2$ | 0.678 | 0.689 | 0.802 | 0.805 | 0.728 | 0.813 | 0.622 | 0.760 |

## Table A.3: Concentration and Interest Rates by Lender Size

This table shows the relationship between interest rates and HHI, interacted with the total volume of outstanding loans (in billions of dollars) and the number of counties in which a lender is active. The first pair of columns interacts with volume, while the second pair interacts with the number of counties. The first columns in each pair shows estimates for borrowers with VantageScore scores below 600, while the second column in each pair shows estimates for borrowers with VantageScore scores above 600. The inclusion of fixed effects is denoted beneath each column. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}\ p < .05$, $^{***}\ p < .01$.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Credit Score | | | |
| | 300-600 | 600-850 | 300-600 | 600-850 |
| HHI | -0.0806*** | 0.0998** | -0.0909*** | 0.0881* |
| | (0.0106) | (0.0485) | (0.0108) | (0.0456) |
| Volume | 0.000244*** | 0.000367** | | |
| | (0.0000254) | (0.000146) | | |
| HHI X Volume | 0.0000800*** | 0.000113** | | |
| | (0.00000833) | (0.0000453) | | |
| # Counties | | | 0.0000327*** | 0.0000369*** |
| | | | (0.00000368) | (0.0000117) |
| HHI X # Counties | | | 0.0000105*** | 0.0000132*** |
| | | | (0.00000121) | (0.00000415) |
| County X Credit Score Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| Observations | 1,866,741 | 5,213,296 | 1,866,741 | 5,213,296 |
| $R^2$ | 0.678 | 0.802 | 0.678 | 0.802 |

**Table A.4: Number of Merger Events by Year**

This table shows the annual number of bank mergers and acquisitions. Source: NIC

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 55 | 52 | 66 | 109 | 134 | 162 | 189 | 173 | 153 | 184 | 165 |

## Table A.5: Top 50 List of Bank Mergers

This table lists the top 50 bank mergers ranked by number of counties covered by the acquired bank during the merger year. Source: NIC, Federal Reserve Call Reports.

| Event Date | Acquired Bank Name | # Counties |
|---|---|---|
| 2009-5 | PROVIDENT BANKSHARES CORPORATION | 23 |
| 2010-10 | SOUTH FINANCIAL GROUP, THE | 58 |
| 2010-12 | J. R. MONTGOMERY BANCORPORATION | 42 |
| 2011-7 | MARSHALL & ILSLEY CORPORATION | 87 |
| 2012-7 | AMERICAN STATE FINANCIAL CORPORATION | 18 |
| 2013-2 | BANCTRUST FINANCIAL GROUP, INC. | 18 |
| 2013-4 | CITIZENS REPUBLIC BANCORP, INC. | 73 |
| 2013-4 | WEST COAST BANCORP | 13 |
| 2013-9 | FIRST M & F CORPORATION | 17 |
| 2013-10 | LIBERTY BANCSHARES, INC | 15 |
| 2014-1 | STELLARONE CORPORATION | 34 |
| 2014-4 | STERLING FINANCIAL CORPORATION | 62 |
| 2014-7 | PIEDMONT COMMUNITY BANK HOLDINGS, INC. | 21 |
| 2014-10 | FIRST CITIZENS BANCORPORATION, INC. | 50 |
| 2015-2 | COMMUNITY FIRST BANCSHARES, INC. | 15 |
| 2015-5 | CENTRAL BANCSHARES, INC. | 13 |
| 2015-7 | Heritage Bank of the South | 22 |
| 2015-8 | SUSQUEHANNA BANCSHARES, INC. | 40 |
| 2015-11 | Hudson City Savings Bank | 23 |
| 2015-11 | CITY NATIONAL CORPORATION | 18 |
| 2016-4 | NATIONAL PENN BANCSHARES, INC. | 18 |
| 2016-5 | AnchorBank, fsb | 18 |
| 2016-7 | COMMUNITY & SOUTHERN HOLDINGS, INC. | 28 |
| 2016-8 | FIRSTMERIT CORPORATION | 97 |
| 2016-8 | FIRST NIAGARA FINANCIAL GROUP, INC. | 59 |
| 2016-9 | TALMER BANCORP INC. | 25 |
| 2016-10 | FNB UNITED CORP. | 17 |
| 2017-3 | YADKIN VALLEY FINANCIAL CORPORATION | 36 |
| 2017-4 | CARLILE BANCSHARES, INC. | 17 |
| 2017-5 | CASCADE BANCORP | 21 |
| 2017-5 | MERCHANTS BANCSHARES, INC. | 13 |
| 2017-6 | BANK OF THE OZARKS INC | 101 |
| 2017-11 | BANCORPSOUTH, INC. | 97 |
| 2017-11 | FIRST SOUTH BANCORP, INC. | 18 |
| 2017-12 | NORTH AMERICAN FINANCIAL HOLDINGS, INC. | 61 |
| 2017-12 | PARK STERLING CORPORATION | 27 |
| 2018-1 | HCBF HOLDING COMPANY, INC. | 15 |
| 2018-1 | CENTRAL COMMUNITY CORPORATION | 13 |
| 2018-2 | Bank Mutual | 29 |
| 2018-4 | MAINSOURCE FINANCIAL GROUP, INC. | 42 |
| 2018-9 | ZIONS BANCORPORATION | 113 |
| 2019-1 | FCB FINANCIAL HOLDINGS, INC. | 17 |
| 2019-1 | STATE BANK FINANCIAL CORPORATION | 15 |
| 2019-4 | AMERICUS FINANCIAL SERVICES, INC. | 17 |
| 2019-7 | FIDELITY SOUTHERN CORPORATION | 23 |
| 2019-8 | TCF FINANCIAL CORPORATION | 38 |
| 2019-9 | MIDSOUTH BANCORP, INC. | 23 |
| 2019-9 | LIBERTY SHARES, INC. | 14 |
| 2019-11 | LANDRUM COMPANY | 14 |
| 2019-12 | SUNTRUST BANKS, INC. | 224 |

## Table A.6: Concentration, Failures and Interest Rates

The first two columns show the relationship between ln(HHI) and the share of deposits in the three banks that failed during the financial crisis. The second two columns show the relationship between the log of interest rates and the share of deposits in the three banks that failed during the financial crisis. The last two columns show the relationship between ln(HHI) and the log of interest rates, instrumenting using the share of deposits in the three banks that failed during the financial crisis. In each pair, the first column shows the relationship for low credit score borrowers (VantageScore below 600) while the second column shows the relationship for high credit score borrower (VantageScore above 600.) The inclusion of fixed effects is denoted beneath each column. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}\ p < .05$, $^{***}\ p < .01$.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | | | Ln(Interest Rate) | | | |
| | First Stage | | Reduced Form | | IV | |
| Share Failed Banks | -0.739$^{***}$ | -0.995$^{***}$ | 0.180$^{**}$ | -0.241 | | |
| | (0.100) | (0.133) | (0.0826) | (0.253) | | |
| ln(HHI) | | | | | -0.243$^{**}$ | 0.242 |
| | | | | | (0.0982) | (0.250) |
| Observations | 27887 | 31773 | 27887 | 31773 | 27887 | 31773 |
| $R^2$ | 0.406 | 0.418 | 0.014 | 0.012 | . | . |

## Table A.7: Concentration, Interest Rates and Failures Split by Credit Score Group

The top panel regresses HHI on the deposit share in 2008 of the three largest failed banks, Wachovia, Countrywide and Washington Mutual. The bottom panel presents 2SLS estimates of interest rates of HHI, instrumenting for HHI with the deposit share in 2008 of the three largest failed banks. The sample is split by borrowers' credit scores groups, denoted above each column. The inclusion of fixed effects is denoted beneath each column. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}\ p < .05$, $^{***}\ p < .01$.

Panel A: HHI Following Acquisition

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | | | | Credit Score | | | |
| | 300-550 | 550-600 | 600-650 | 650-700 | 700-750 | 750-800 | 800+ |
| | | | | Bank HHI | | | |
| Share Failed Banks | -0.650$^{***}$ | -0.836$^{***}$ | -1.031$^{***}$ | -1.104$^{***}$ | -1.137$^{***}$ | -1.104$^{***}$ | -0.902$^{***}$ |
| | (0.104) | (0.104) | (0.124) | (0.149) | (0.171) | (0.152) | (0.142) |
| County Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Merger Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 26049 | 27094 | 29219 | 30154 | 29864 | 29310 | 28070 |
| $R^2$ | 0.332 | 0.393 | 0.400 | 0.385 | 0.369 | 0.368 | 0.389 |

Panel B: Interest Rates Following Acquisition

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | | | | Ln(Interest Rate) | | | |
| Years Since Merger | -0.281$^{***}$ | -0.325$^{***}$ | -0.0390 | 0.103$^{*}$ | 0.195$^{***}$ | 0.283$^{***}$ | 0.349$^{***}$ |
| | (0.0742) | (0.0904) | (0.0583) | (0.0594) | (0.0582) | (0.0639) | (0.0790) |
| County Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Merger Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 26049 | 27094 | 29219 | 30154 | 29864 | 29310 | 28070 |

## Table A.8: Concentration, Interest Rates and Bank Acquisitions

The table shows estimates of HHI or log interest rates on the number of years since a bank merger or acquisition occurred, split by borrowers having credit scores below 600. The inclusion of fixed effects is denoted beneath each column. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}\ p < .05$, $^{***}\ p < .01$.

Panel A: HHI Following Acquisition

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Bank HHI | | | |
| | Credit Score 300-600 | | Credit Score 600-850 | |
| Years Since Merger | 0.00186*** | 0.00186*** | 0.00173*** | 0.00173** |
| | (0.000691) | (0.000691) | (0.000672) | (0.000672) |
| County Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| Merger Year Fixed Effects | No | Yes | No | Yes |
| Observations | 27,481 | 27,481 | 31,298 | 31,298 |
| $R^2$ | 0.958 | 0.958 | 0.959 | 0.959 |

Panel B: Interest Rates Following Acquisition

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Ln(Interest Rate) | | | |
| | Credit Score 300-600 | | Credit Score 600-850 | |
| Years Since Merger | -0.00835** | -0.00835** | 0.00175 | 0.00175 |
| | (0.00399) | (0.00399) | (0.00195) | (0.00195) |
| County Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| Merger Year Fixed Effects | No | Yes | No | Yes |
| Observations | 27,481 | 27,481 | 31,298 | 31,298 |
| $R^2$ | 0.375 | 0.375 | 0.827 | 0.827 |

## Table A.9: Concentration, Interest Rates and Bank Acquisitions Split by Credit Score Group

The table shows estimates of HHI or log interest rates on the number of years since a bank merger or acquisition occurred, split by borrowers' credit scores groups. The inclusion of fixed effects is denoted beneath each column. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}$ $p < .05$, $^{***}$ $p < .01$.

Panel A: HHI Following Acquisition

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Credit Score | | | | | | |
| | 300-550 | 550-600 | 600-650 | 650-700 | 700-750 | 750-800 | 800+ |
| | Bank HHI | | | | | | |
| Years Since Merger | 0.00181$^{**}$ | 0.00190$^{***}$ | 0.00172$^{**}$ | 0.00180$^{***}$ | 0.00177$^{***}$ | 0.00204$^{***}$ | 0.00206$^{***}$ |
| | (0.000706) | (0.000689) | (0.000687) | (0.000676) | (0.000666) | (0.000674) | (0.000666) |
| County Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Merger Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 25683 | 26689 | 28792 | 29706 | 29424 | 28877 | 27661 |
| $R^2$ | 0.957 | 0.958 | 0.958 | 0.958 | 0.957 | 0.957 | 0.955 |

Panel B: Interest Rates Following Acquisition

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Ln(Interest Rate) | | | | | | |
| Years Since Merger | -0.00774$^{**}$ | -0.00442 | -0.00174 | -0.000360 | 0.00265 | 0.00562$^{**}$ | 0.00397$^{*}$ |
| | (0.00368) | (0.00492) | (0.00261) | (0.00176) | (0.00192) | (0.00229) | (0.00235) |
| County Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Merger Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 25683 | 26689 | 28792 | 29706 | 29424 | 28877 | 27661 |
| $R^2$ | 0.309 | 0.349 | 0.568 | 0.701 | 0.757 | 0.803 | 0.801 |

## Table A.10: Interest Rates and Market Competition in the Mortgage Market

The table shows the relationship between interest rates and HHI for mortgage loans, split by credit scores being above 600. The inclusion of fixed effects is denoted beneath each column. Regressions are weighted by the number of loans. Standard errors are clustered at the county level. Credit scores are given by VantageScore ratings. Source: TransUnion. $^{*}p < .1$, $^{**}p < .05$, $^{***}p < .01$.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Ln(Interest Rate) | | | | | |
| | Credit Score 300-600 | | | Credit Score 600-850 | | |
| Ln(HHI) | 0.0110$^{***}$ | 0.0126$^{***}$ | -0.00100 | 0.0139$^{***}$ | 0.0164$^{***}$ | 0.00777$^{**}$ |
| | (0.00425) | (0.00425) | (0.00401) | (0.00324) | (0.00332) | (0.00302) |
| Year Fixed Effects | No | Yes | Yes | No | Yes | Yes |
| County Fixed Effects | No | No | Yes | No | No | Yes |
| Observations | 27,497 | 27,497 | 27,418 | 34,099 | 34,099 | 34,098 |
| $R^2$ | 0.001 | 0.017 | 0.311 | 0.005 | 0.087 | 0.631 |