Online Appendices

Regulatory Interventions in Consumer Financial Markets: The Case of Credit Cards

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A Additional Theoretical Results

In this Appendix, we derive the distribution of the number of offers and characterize the constrained-efficient allocation.

A.1 Distribution of Offers

As pointed out in Section 5.2, survey respondents may report all offers they receive, not only those they would consider if they were not surveyed. We now derive the distribution of the number of offers and the distribution of the difference between the offers with the smallest and the largest interest rates under the assumption that respondents report all offers they receive.

The expected number of offers for a borrower who receives $n \geq 2$ offers is

$$\mathbf{E}[n|n \geq 2] = \frac{L\left(1-e^{-L}\right)}{1-e^{-L}-Le^{-L}}.$$

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Denote the probability distribution of the difference between the highest and lowest interest rate of a borrower who receives $n \geq 2$ offers by $D(x)$. Denote the probability distribution of the difference between the highest and lowest interest rates of a borrower who receives exactly n offers by $D_n(x)$ and note that

$$D(x) = \frac{1}{1-e^{-L}-Le^{-L}} \sum_{n=2}^{\infty} \frac{e^{-L}L^n}{n!} D_n(x).$$

Consider a borrower who receives n offers. Denote the lowest offer by R_L and note that its distribution follows $\bar{F}_n(R_L) = 1-(1-F(R_L))^n$. Each of the other $n-1$ offers are distributed i.i.d. according to $\hat{F}(R|R_L) = \frac{F(R)-F(R_L)}{1-F(R_L)}$, for $R \geq R_L$. The highest of these $n-1$ offers is distributed according to $\hat{F}(R_H|R_L)^{n-1}$. As a result,

$$\begin{aligned} D_n(x) &= \int_{\underline{R}}^{\overline{R}} \left(\frac{F(R_L+x)-F(R_L)}{1-F(R_L)} \right)^{n-1} d\bar{F}_n(R_L) \\ &= \int_{\underline{R}}^{\overline{R}} n \left(F(R_L+x)-F(R_L) \right)^{n-1} F'(R_L) dR_L. \end{aligned}$$

Combining the above, we obtain

$$\begin{aligned} D(x) &= \frac{1}{1-e^{-L}-Le^{-L}} \sum_{n=2}^{\infty} \frac{e^{-L}L^n}{n!} \int_{\underline{R}}^{\overline{R}} n \left(F(R_L+x)-F(R_L) \right)^{n-1} F'(R_L) dR_L \\ &= \frac{1}{1-e^{-L}-Le^{-L}} \int_{\underline{R}}^{\overline{R}} \sum_{n=2}^{\infty} \frac{e^{-L}L^n}{(n-1)!} \left(F(R_L+x)-F(R_L) \right)^{n-1} F'(R_L) dR_L \\ &= \frac{Le^{-L}}{1-e^{-L}-Le^{-L}} \int_{\underline{R}}^{\overline{R}} \left(e^{L(F_R(R_L+x)-F_R(R_L))} - 1 \right) F_R'(R_L) dR_L. \end{aligned}$$

A.2 Constrained Efficiency

We now analyze the case of a social planner whose goal is to maximize aggregate welfare subject to frictions. The planner chooses lenders' entry decisions, as well as borrowers' examination effort and trading-decision rules (the interest rate simply redistributes surplus between borrowers and lenders; thus, it does not matter for the planner's problem).

We denote by $e^*(z)$ the planner's optimal solution for the examination of a type-z borrower. The entry decision rule is, trivially, a cutoff rule, and we denote the planner's optimal cutoff cost by $\hat{k}^*$. The surplus of a loan from a type-k lender with attribute a to a type-z borrower is $b(1-\rho)\big(z - a - \frac{k}{1-\rho}\big)$, where $z = \frac{\tilde{z}-\rho\delta}{1-\rho} - 1$ and $k = \tilde{k} + \rho$, as before. The planner's optimal trading-decision rule is that the borrower trades with the lowest-cost lender as long as the surplus is positive.

The overall surplus given borrowers' effort $e(\cdot)$ and lenders' entry cutoff $\hat{k}$ is

$$\mathcal{W}\left(e(\cdot), \hat{k}\right) = \sum_{z \in Z} s_z \left(\mathcal{W}_z\left(e(z), \hat{k}\right) - q\left(e(z), L\right)\right) - \chi L, \tag{A1}$$

where $\mathcal{W}_z(e(z), \hat{k})$ is the expected surplus a type-z borrower obtains from the offers he receives; $q\big(e(z), L\big)$ is a z-borrower's examination effort cost; $L = \Lambda\Gamma(\hat{k})$ is the measure of lenders who enter the market; and χL are aggregate lenders' entry costs. Notice that no interaction occurs between borrowers regarding their examination efforts; thus, $\mathcal{W}_z$ only depends on the effort of the type-z borrower and does not depend on the full effort schedule.

The cost of a loan for the planner is $w \equiv \frac{k}{1-\rho} + a$. The planner's loan cost is distributed according to

$$\begin{aligned} F_w(w) &= \int_{\underline{k}}^{\hat{k}} F_a\left(w - \frac{k}{1-\rho}\right) dG(k) \\ &= \frac{1}{\Gamma(\hat{k})} \int_{\underline{k}}^{\hat{k}} F_a\left(w - \frac{k}{1-\rho}\right) d\Gamma(k). \end{aligned}$$

The distribution of the lowest w of n offers is

$$\bar{F}_{w,n}(w) = 1 - \left(1 - \frac{1}{\Gamma(\hat{k})} \int_{\underline{k}}^{\hat{k}} F_a\left(w - \frac{k}{1-\rho}\right) d\Gamma(k)\right)^n.$$

The social value to a type-z borrower of receiving n offers is

$$\mathcal{W}_{z,n}(\hat{k}) = b(1-\rho) \int_{-\infty}^{z} (z - w) d\bar{F}_{w,n}(w), \tag{A2}$$

where $\mathcal{W}_{z,0}(\hat{k}) = 0$. Notice these terms only depend on $\hat{k}$ and do not depend on borrowers' effort e.

The surplus a type-z borrower who examines offers with effort e generates from the offers he receives when lenders' entry cutoff is $\hat{k}$ equals

$$\mathcal{W}_z(e,\hat{k}) \;=\; \sum_{n=0}^{\infty} \frac{e^{-eL}(eL)^n}{n!}\mathcal{W}_{z,n}(\hat{k}). \tag{A3}$$

We now characterize the planner's optimal solution.

Proposition A1 *The constrained-efficient allocation is as follows:*

1. *The optimal effort for a type-z borrower $e^*(z)$ satisfies*

$$\sum_{n=0}^{\infty} \frac{e^{-\alpha(e^*(z),L^*)}(\alpha(e^*(z),L^*))^n}{n!}\left(\mathcal{W}_{z,n+1}(\hat{k}^*) - \mathcal{W}_{z,n}(\hat{k}^*)\right)\frac{\partial\alpha(e^*(z),L^*)}{\partial e} \;=\; \frac{\partial q\left(e^*(z),L^*\right)}{\partial e}, \tag{A4}$$

where $\mathcal{W}_{z,n}(\hat{k}^*)$ is defined by equation (A2), and $L^* = \Lambda\Gamma(\hat{k}^*)$ is the optimal measure of lenders in the market. A unique solution $e^*(z)$ exists for each z.

2. *The optimal entry-cost cutoff $\hat{k}^*$ for lenders satisfies*

$$\sum_{z\in Z} s_z \left(\frac{\partial\mathcal{W}_z\left(e^*(z),\hat{k}^*\right)}{\partial\hat{k}} - \frac{\partial q(e^*(z),L^*)}{\partial L}\Lambda\Gamma'(\hat{k}^*)\right) \;=\; \chi\Lambda\Gamma'(\hat{k}^*), \tag{A5}$$

where

$$\begin{aligned}\frac{\partial\mathcal{W}_z(e^*(z),\hat{k}^*)}{\partial\hat{k}} \;=\;& \sum_{n=0}^{\infty} \frac{e^{-\alpha(e^*(z),L^*)}\left(\alpha(e^*(z),L^*)\right)^n}{n!}\left(b\int_{-\infty}^{z}(z-w)d\left(\frac{\partial\bar{F}_{w,n}(w)}{\partial\hat{k}}\right)\right.\\ &\left.+\frac{\partial\alpha(e^*(z),L^*)}{\partial L}\Lambda\Gamma'(\hat{k}^*)\left(\mathcal{W}_{z,n+1}(\hat{k}^*) - \mathcal{W}_{z,n}(\hat{k}^*)\right)\right),\end{aligned} \tag{A6}$$

and

$$\begin{aligned}\frac{\partial\bar{F}_{w,n}(w)}{\partial\hat{k}} \;=\;& n\left(1-\frac{1}{\Gamma(\hat{k})}\int_{\underline{k}}^{\hat{k}} F_a\left(w-\frac{k}{1-\rho}\right)d\Gamma(k)\right)^{n-1}\frac{\Gamma'(\hat{k})}{\Gamma(\hat{k})^2}\left(F_a\left(w-\frac{\hat{k}}{1-\rho}\right)\Gamma(\hat{k})\right.\\ &\left.-\int_{\underline{k}}^{\hat{k}} F_a\left(w-\frac{k}{1-\rho}\right)d\Gamma(k)\right).\end{aligned}$$

Proof. Differentiating equation (A1) with respect to e and equating to zero for every z, we obtain

$$\frac{\partial \mathcal{W}_z\big(e^*(z), \hat{k}^*\big)}{\partial e} = \frac{\partial q\big(e^*(z), L^*\big)}{\partial e}.$$

We use equation (A3) to rearrange the above equation, obtaining equation (A4). The solution is unique for reasons similar to the decentralized case.

Differentiating equation (A1) with respect to $\hat{k}$ and equating to zero, we obtain equation (A5). Notice that

$$\begin{aligned}
\frac{\partial \mathcal{W}_z(e^*(z), \hat{k}^*)}{\partial \hat{k}} &= \sum_{n=0}^{\infty} \Big[\frac{e^{-e^*(z)L^*}\big(e^*(z)L^*\big)^n}{n!} \mathcal{W}'_{z,n}(\hat{k}^*) \\
&\quad + \mathcal{W}_{z,n}(\hat{k}^*)\Big(\frac{e^{-e^*(z)L^*}\big(e^*(z)L^*\big)^{n-1} e^*(z)\Lambda\Gamma'(\hat{k}^*)}{(n-1)!} \\
&\quad - \frac{e^{-e^*(z)L^*} e^*(z)\Lambda\Gamma'(\hat{k}^*)\big(e^*(z)L^*\big)^n}{n!} \Big) \Big] \\
&= \sum_{n=0}^{\infty} \frac{e^{-e^*(z)L^*}\big(e^*(z)L^*\big)^n}{n!} \Big(\mathcal{W}'_{z,n}(\hat{k}^*) + e^*(z)\Lambda\Gamma'(\hat{k}^*)\Big(\mathcal{W}_{z,n+1}(\hat{k}^*) - \mathcal{W}_{z,n}(\hat{k}^*)\Big)\Big).
\end{aligned}$$

Furthermore,

$$\mathcal{W}'_{z,n}(\hat{k}^*) = b(1-\rho)\int_{-\infty}^{z} (z-w)d\Big(\frac{\partial \bar{F}_{w,n}(w)}{\partial \hat{k}}\Big).$$

Combining the last two equations yields equation (A6). ■

The decentralized equilibrium of the economy features two potential sources of inefficiencies relative to the planner's allocation. First, for a given measure of lenders, some meetings in which trade is efficient (i.e., $z > \frac{k}{1-\rho} + a$) feature no trade, because the interest rate of lenders is excessive (i.e., $R > z - a$) due to lenders' market power. Second, the measure of lenders is not optimal (i.e., $L \neq L^*$).

B Proofs

Proof of Proposition 1. We first show that the cost distribution for a low n first-order stochastically dominates that for a high n (thereby proving that $v_{z,n}$ is increasing in n) and that the derivative of the cost distribution for a high n first-order stochastically dominates that for a low n (thereby proving strictly decreasing differences):

$$\begin{aligned}\frac{d\bar{F}_{c,n}(c)}{dn} &= -\big(1-F_c(c)\big)^n \log\big(1-F_c(c)\big) > 0,\\ \frac{d^2\bar{F}_{c,n}(c)}{dn^2} &= -\big(1-F_c(c)\big)^n \Big(\log\big(1-F_c(c)\big)\Big)^2 < 0.\end{aligned}$$

Therefore, $v_{z,n+1} > v_{z,n}$ and $v_{z,n+2} - v_{z,n+1} < v_{z,n+1} - v_{z,n}$ for all n.

Differentiating equation (6) with respect to e (and noting that $v_{z,0} = 0$),

$$\begin{aligned}V_z'(e) &= \sum_{n=1}^{\infty}\Big(-\frac{e^{-eL}(eL)^n}{n!}v_{z,n} + \frac{e^{-eL}(eL)^{n-1}}{(n-1)!}v_{z,n}\Big)L\\ &= \Big(-\sum_{n=0}^{\infty}\frac{e^{-eL}(eL)^n}{n!}v_{z,n} + \sum_{n=0}^{\infty}\frac{e^{-eL}(eL)^n}{n!}v_{z,n+1}\Big)L\\ &= \sum_{n=0}^{\infty}\frac{e^{-eL}(eL)^n}{n!}\big(v_{z,n+1}-v_{z,n}\big)L > 0.\end{aligned}$$

As a result, the borrower's expected value of offers is strictly increasing in their examination effort, and equation (9) characterizes the optimal choice of effort.

Furthermore, the expected value of loan offers is strictly concave in examination effort:

$$\begin{aligned}V_z''(e) &= \sum_{n=1}^{\infty}\left(-\frac{e^{-eL}(eL)^n}{n!} + \frac{e^{-eL}(eL)^{n-1}}{(n-1)!}\right)(v_{z,n+1}-v_{z,n})\,L^2\\ &= \sum_{n=0}^{\infty}\frac{e^{-eL}(eL)^n}{n!}\left(v_{z,n+2}-v_{z,n+1}-(v_{z,n+1}-v_{z,n})\right)L^2 < 0.\end{aligned}$$

Therefore, equation (7) has a unique solution $e(z)$, which yields the optimal examination effort for a type-z borrower.

Finally, notice that

$$\begin{aligned}\frac{\partial v_{z,n}}{\partial z} &= b\,(1-\rho)\int_{-\infty}^{z} d\bar{F}_{c,n}(c) = b\,(1-\rho)\,(1-(1-F_c(z))^n) > 0,\\ \Rightarrow \frac{\partial V_z(e)}{\partial z} &= \sum_{n=1}^{\infty}\frac{e^{-eL}(eL)^n}{n!}b\,(1-\rho)\,(1-(1-F_c(z))^n) > 0.\end{aligned}$$

Thus, higher-marginal-utility borrowers exert more examination effort, because they gain more from an increase in the effective arrival rate of offers.

We now calculate the distribution of accepted offers. Denote the probability that a type-z borrower gets a loan by Q_z and the probability that he gets a loan with interest rate less than R by $Q_z(R)$. Note that a type-z borrower gets a loan if he receives at least one offer with cost below z. Therefore

$$\begin{aligned} Q_z &= 1 - e^{-e(z)LF_c(z)} \\ &= 1 - e^{-e(z)L\int_{\underline{R}}^{\overline{R}} F_a(z-x)dF_R(x)}, \\ Q_z(R) &= 1 - e^{-e(z)L\int_{\underline{R}}^{R} F_a(z-x)dF_R(x)}. \end{aligned}$$

Denote the probability that a borrower gets a loan by Q and the probability that he gets a loan with interest rate less than R by $Q(R)$:

$$\begin{aligned} Q &= \sum_{z\in Z} Q_z \\ &= 1 - \sum_{z\in Z} e^{-e(z)L\int_{\underline{R}}^{\overline{R}} F_a(z-x)dF_R(x)}, \\ Q(R) &= 1 - \sum_{z\in Z} e^{-e(z)L\int_{\underline{R}}^{R} F_a(z-x)dF_R(x)}. \end{aligned}$$

The distribution of accepted interest rates $H_R(R)$ gives the proportion of borrowers who get a loan with interest rate less than R among the borrowers who get a loan:

$$\begin{aligned} H_R(R) &= \frac{Q(R)}{Q} \\ &= \frac{1 - \sum_{z\in Z} e^{-e(z)L\int_{\underline{R}}^{R} F_a(z-x)dF_R(x)}}{1 - \sum_{z\in Z} e^{-e(z)L\int_{\underline{R}}^{\overline{R}} F_a(z-x)dF_R(x)}}. \end{aligned}$$

The density of the accepted-rate distribution is

$$H'_R(R) = \frac{1}{Q}\sum_{z\in Z} e^{-e(z)L\int_{\underline{R}}^{R} F_a(z-x)dF_R(x)} e(z)LF_a(z-R)F'_R(R).$$

This completes the proof of Proposition 1. ■

Proof of Lemma 1. Denote the probability that a type-z borrower accepts a loan offer with total cost c by $P_c(c,z)$. If $c \leq z$, the borrower accepts the offer if it is the lowest-cost offer received, which occurs with probability $\big(1-F_c(c)\big)^n$ when the borrower examines n additional offers. If $c > z$, the borrower does not accept that offer. Therefore

$$\begin{aligned} P_c(c,z) &= \sum_{n=0}^{\infty} \frac{e^{-\alpha(z)}\alpha(z)^n}{n!}\big(1-F_c(c)\big)^n \\ &= e^{-\alpha(z)F_c(c)} \\ &= e^{-\alpha(z)\int_{\underline{R}}^{\overline{R}} F_a(c-x)dF_R(x)}, \quad \text{if} \quad c \leq z, \qquad \text{(B1)} \\ P_c(c,z) &= 0, \qquad\qquad \text{if} \quad c > z. \qquad \text{(B2)} \end{aligned}$$

Denote by $P_R(R,z)$ the probability that a type-z borrower accepts a loan offer with interest rate R. A borrower with valuation z accepts this offer if its cost (including the idiosyncratic attribute) is less than z and if all other offers he examines have higher costs. Integrating over the potential values of the idiosyncratic utility draw yields

$$\begin{aligned} P_R(R,z) &= \int_{-\infty}^{\infty} P_c(R+a,z)dF_a(a) \\ &= \int_{-\infty}^{z-R} e^{-\alpha(z)\int_{\underline{R}}^{\overline{R}} F_a(R+a-x)dF_R(x)} dF_a(a). \qquad \text{(B3)} \end{aligned}$$

A borrower of type z accepts a loan offer with interest rate R if he examines the offer (probability $e(z)$) and the offer is better than any other offer he examines (probability $P_R(R,z)$). Therefore, the probability that a randomly drawn borrower accepts a loan with interest rate R equals

$$\begin{aligned} P(R) &= \sum_{z\in Z} s_z e(z) P_R(R,z) \\ &= \sum_{z\in Z} s_z e(z) \int_{-\infty}^{z-R} e^{-\alpha(z)\int_{\underline{R}}^{\overline{R}} F_a(R+a-x)dF_R(x)} dF_a(a), \end{aligned}$$

which yields equation (12).

Because $F_a(\cdot)$ is smooth, $P(R)$ is continuous and differentiable in R. Differentiating

$P(R)$ with respect to R yields

$$P'(R) = -\sum_{z\in Z} s_z e(z) \left(\int_{-\infty}^{z-R} e^{-\alpha(z)\int_{\underline{R}}^{\overline{R}} F_a(R+a-x)dF_R(x)} \left(\alpha(z)\int_{\underline{R}}^{\overline{R}} F_a'(R+a-x)dF_R(x)\right) dF_a(a) \right.$$
$$\left. + e^{-\alpha(z)\int_{\underline{R}}^{\overline{R}} F_a(z-x)dF_R(x)} F_a'(z-R) \right) < 0.$$

Hence, the probability that borrowers accept a loan is strictly decreasing in the interest rate R. This completes the proof of lemma 1. ■

Proof of Proposition 2. Since $\pi_k(R) \leq 0$ for $R \leq k/(1-\rho)$, $\pi_k(k/(1-\rho)+\epsilon) > 0$ for small $\epsilon > 0$ and $\pi_k(\overline{z} - \underline{a}) = 0$, the profit-maximizing interest rate for a type-k lender satisfies $R \in (k/(1-\rho), z_N - \underline{a})$ and is characterized by:

$$\pi_k'(R) = b(1-\rho)P(R) + b\left(R(1-\rho)-k\right)P'(R) = 0.$$

where, in the case of multiple roots, the lender chooses the solution that yields higher profits. Denote the solution by $R(k)$. Notice that if $k > k'$ then $\pi_k'(R) < \pi_{k'}'(R)$ for any R and, therefore, $R(k) > R(k')$.

Because the optimal interest rate is strictly increasing in the lender's cost k, we have $F_R\big(R(k)\big) = G(k)$ for $k \in [\underline{k}, \overline{k}]$. Hence,

$$F_R(x) = G\big(R^{-1}(x)\big).$$

Using this feature, we can rewrite equation (12) as follows:

$$P\big(R(k)\big) = \sum_{z\in Z} s_z e(z) \int_{-\infty}^{z-R(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}} F_a\left(R(k)+a-R(x)\right)dG(x)} dF_a(a). \tag{B4}$$

Equation (B4) defines the probability that borrowers accept the loan of the cost-k lender when all lenders make their equilibrium choice. This probability does not directly depend on the interest-rate distribution, because it incorporates the result whereby the offered interest rate is strictly decreasing in a lender cost k.

The profits of a type-k lender who follows the strategy of a type-$\tilde{k}$ lender are

$$\pi_k\big(R(\tilde{k})\big) = b\Big(R(\tilde{k})(1-\rho)-k\Big)\sum_{z\in Z}s_z e(z)\int_{-\infty}^{z-R(\tilde{k})} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a\left(R(\tilde{k})+a-R(x)\right)dG(x)}dF_a(a).$$

Differentiating profits with respect to $\tilde{k}$, we obtain

$$\begin{aligned}\frac{\partial \pi_k(R(\tilde{k}))}{\partial \tilde{k}} = {} & bR'(\tilde{k})(1-\rho)\sum_{z\in Z}s_z e(z)\int_{-\infty}^{z-R(\tilde{k})} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a\left(R(\tilde{k})+a-R(x)\right)dG(x)}dF_a(a) \\ & -b\left(R(\tilde{k})(1-\rho)-k\right)\sum_{z\in Z}s_z e(z)\left(\int_{-\infty}^{z-R(\tilde{k})} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a\left(R(\tilde{k})+a-R(x)\right)dG(x)}\right. \\ & \left(\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a'\left(R(\tilde{k})+a-R(x)\right)R'(\tilde{k})dG(x)\right)dF_a(a) \\ & \left.+R'(\tilde{k})e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a(z-R(x))dG(x)}F_a'\left(z-R(\tilde{k})\right)\right).\end{aligned}$$

where we used the feature that $R(k)$ is continuous and differentiable in k because $\pi_k(R)$ is continuously differentiable in k.

This derivative equals zero when $\tilde{k}=k$. Therefore

$$\begin{aligned}&(1-\rho)\sum_{z\in Z}s_z e(z)\int_{-\infty}^{z-R(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a\left(R(k)+a-R(x)\right)dG(x)}dF_a(a) \\ &= \big(R(k)(1-\rho)-k\big)\sum_{z\in Z}s_z e(z)\left(\int_{-\infty}^{z-R(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a\left(R(k)+a-R(x)\right)dG(x)}\Big(\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a'\big(R(k)+a\right. \\ &\left. -R(x)\big)dG(x)\Big)dF_a(a)+e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a\left(z-R(x)\right)dG(x)}F_a'\big(z-R(k)\big)\right),\end{aligned}$$

which yields equation (13), which defines the interest-rate schedule $R(k)$. This completes the proof of Proposition 2. ■

Proof of Proposition 3. A lender's expected profits are strictly decreasing in his cost k, because a lender can always mimic the action of a higher-cost lender and make strictly higher profits.

Denote the highest-cost lender who enters the market by $\hat{k}$, where $\hat{k}\leq\overline{k}$, and note that the measure of lenders who enter the market is $L=\Lambda\Gamma(\hat{k})$. Denote the profits of the highest-cost lender by $\underline{\pi}_{\hat{k}}$:

$$\underline{\pi}_{\hat{k}}(R(\hat{k})) \;=\; b\Big(R(\hat{k})(1-\rho)-\hat{k}\Big)P(R(\hat{k})),$$

where

$$P(R(\hat{k})) \;=\; \sum_{z\in Z} s_z e(z)\int_{-\infty}^{z-R(\hat{k})} e^{-e(z)\Lambda\Gamma(\hat{k})\int_{\underline{k}}^{\hat{k}} F_a\left(R(\hat{k})+a-R(x)\right)d\frac{\Gamma(x)}{\Gamma(\hat{k})}}\,dF_a(a).$$

This equation makes explicit the dependence of L and $G(\cdot)$ on $\hat{k}$.

The profits of the highest-cost lender are decreasing in his type:

$$\frac{d\underline{\pi}_{\hat{k}}}{d\hat{k}} \;=\; \frac{\partial\underline{\pi}_{\hat{k}}}{\partial R}R'(\hat{k}) - bP\big(R(\hat{k})\big) + b\Big(R(\hat{k})\big(1-\rho\big)-\hat{k}\Big)\frac{\partial P(R(\hat{k}))}{\partial L}\Lambda\Gamma'(\hat{k}),$$

which is negative because the first term equals zero by the envelope theorem, the second term reflects the cost increase, and the third term reflects that an increase in $\hat{k}$ increases the measure of lenders in the market, which reduces the probability that borrowers accept a loan offer. Therefore, given $e(\cdot)$, a unique $\hat{k}$ exists that characterizes lenders' cutoff cost $\hat{k}$.

The cutoff $\hat{k}$ is determined by equating the profits of the highest-cost lender with the entry cost χ, as equation (14) shows. ■

C Additional Figures

Figure C1 displays displays lenders' and borrowers' equilibrium policies in the subprime (first row), prime (second row), and super-prime market (third row).

Figure C2 displays the probabilities $P_j(R)$ that borrowers accept a credit card offer with an interest rate R.

Figure C3 displays the distributions $F_{R_j}(R)$ of offered rates (dotted lines) and the distributions $H_{R_j}(R)$ of accepted rates (solid lines).

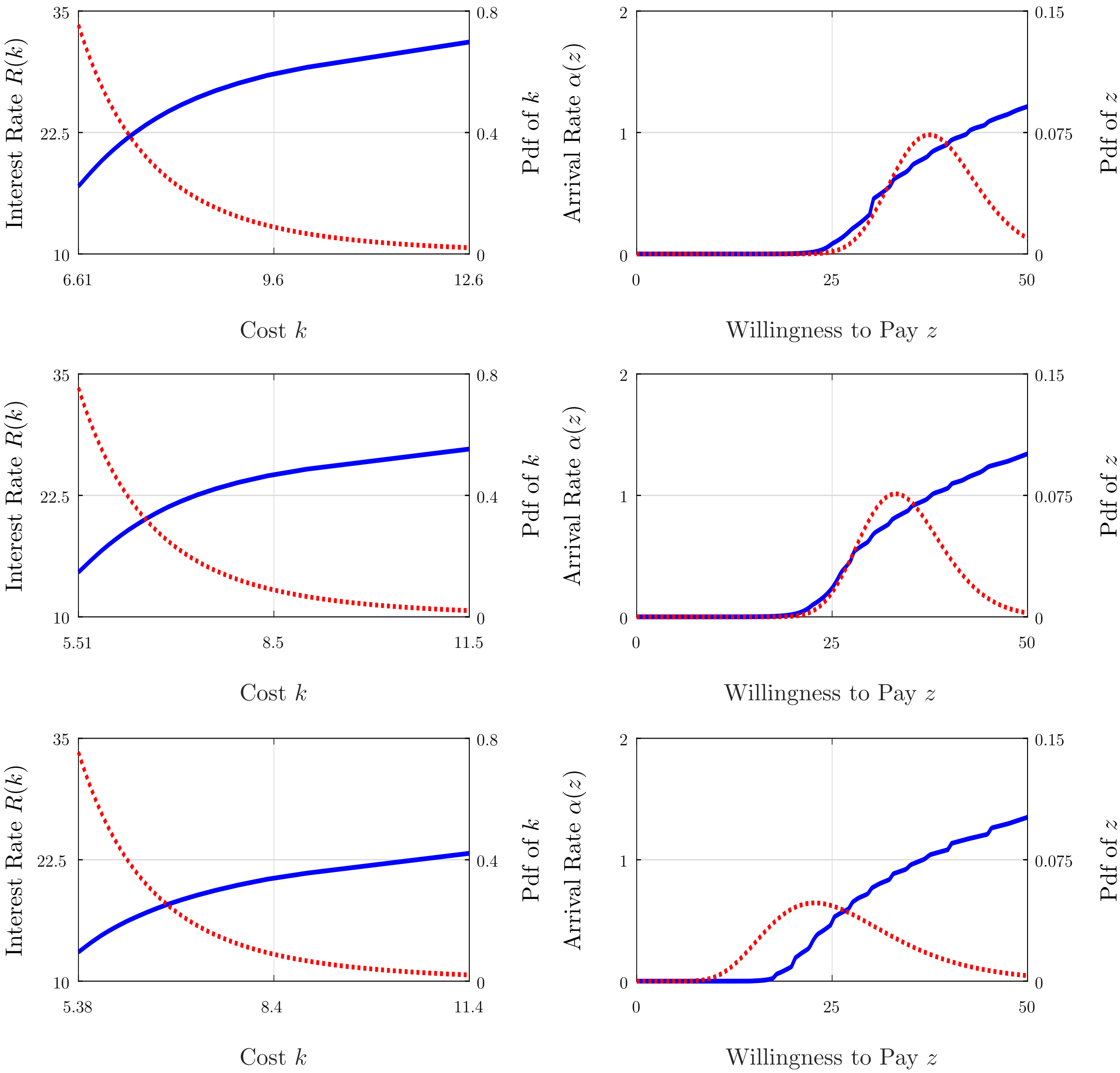

Figure C1: The left panels display lenders' optimal interest rate $R(k)$ (solid line, left axis) and the density of their cost k (dotted line, right axis). The right panels display borrowers' optimal arrival rate $\alpha(z)$ (solid line, left axis) and the density of their willingness to pay z (dotted line, left axis). The first row refers to the subprime market, the second row to the prime market, and the third row to the super-prime market.

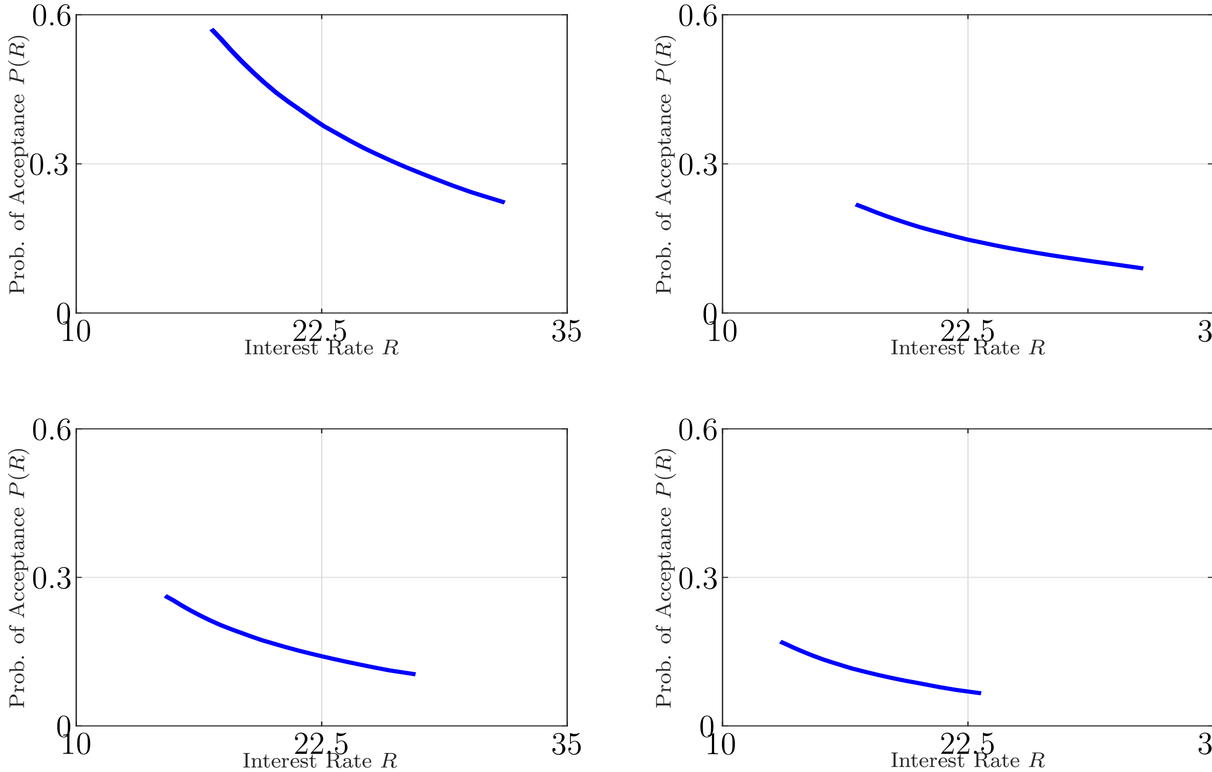

Figure C2: Probability $P(R)$ that borrowers accept an offer with interest R for subprime borrowers (top-left panel), near-prime borrowers (top-right panel), prime borrowers (bottom-left panel), and super-prime borrowers (bottom-right panel).

D Correlation between R and a

In this Appendix, we extend the baseline model to consider the case in which the attribute of a credit card is, in equilibrium, positively correlated with its interest rate R, which might, in principle, account for some of the interest-rate dispersion we observe in the data. We derive the equilibrium conditions for this extension of the model. We then calibrate it to investigate how the extended model with correlation between attribute a and the interest rate fits the data. Finally, we study the welfare effects of price caps in this extended model at its calibrated parameters.

D.1 Assumptions and Equilibrium Conditions

The matching process between borrowers and lenders is the same as in the baseline model. The cost of a loan now has three components: the interest rate R, the idiosyncratic component of the attribute a (distributed according to the zero-mean exogenous distribution

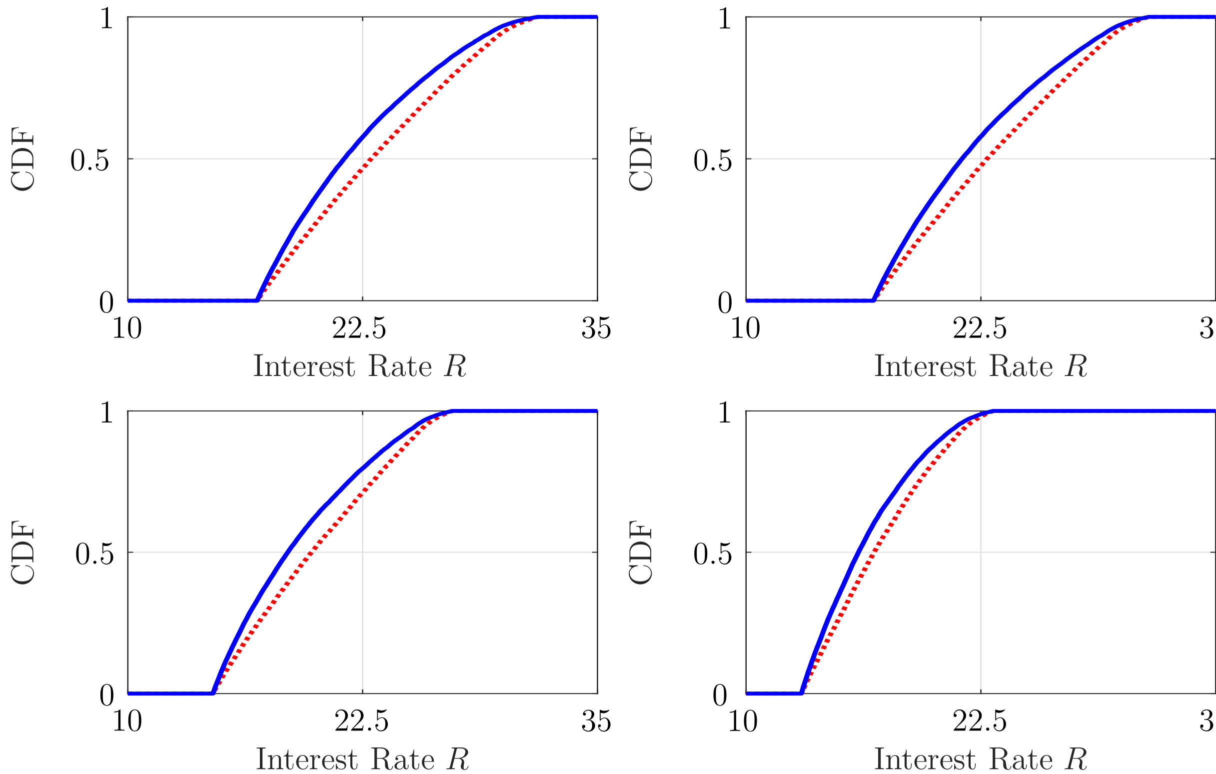

Figure C3: The solid line displays the cumulative distribution function $H_R(R)$ of accepted interest rates and the dotted line displays the cumulative distribution function $F_R(R)$ of offered rates, for subprime borrowers (top-left panel), near-prime borrowers (top-right panel), prime borrowers (bottom-left panel), and super-prime borrowers (bottom-right panel).

$F_a(\cdot)$), and a deterministic component $\tau(k)$, which depends on the lender's type and acts as a mean-shifter of the overall attribute realization. The total cost of a loan is $c = R - \tau(k) + a$. We assume that $\tau(k)$ is a smooth function with $0 < \tau'(k) < 1$.

The additional feature of this extension, $\tau(k)$, captures the possibility that a lender with a higher funding cost might offer some additional desirable features that we do not observe in our data, leading to a higher acceptance rate than in the baseline model.

Let $R(k)$ denote the optimal strategy of a type-k lender. The cost of a loan, then, depends on the draw of two independent random variables: the lender type k from distribution $G(\cdot)$, which determines $R(k)$ and $\tau(k)$, and the draw of the attribute a from distribution $F_a(\cdot)$. Hence, c is distributed according to

$$F_c(c) = \int_{\underline{k}}^{\overline{k}} F_a\big(c - R(x) + \tau(x)\big) dG(x). \tag{D1}$$

Using the amended definition for the cost distribution, the results regarding borrowers' choice are essentially identical to the baseline model. They are summarized in the following proposition (we omit all proofs, because all derivations are identical to those of the baseline case).

Proposition D1 *Given $G(\cdot)$, $R(k)$, and L, optimal effort $e(z)$ is characterized by the following equations:*

$$\begin{aligned}\sum_{n=0}^{\infty}\frac{e^{-eL}(eL)^n}{n!}\left(v_{z,n+1}-v_{z,n}\right)L &= \frac{\partial q(e,L)}{\partial e},\\ v_{z,n} &= b\int_{-\infty}^{z}(z-c)\,d\bar{F}_{c,n}(c),\\ \bar{F}_{c,n}(c) &= 1-(1-F_c(c))^n.\end{aligned}$$

Turning to the side of the lenders, the probability that a loan of cost c is accepted by a type-z borrower is defined similarly to the baseline case:

$$\begin{aligned}P_c(c,z) &= e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a(c-R(x)+\tau(x))dG(x)} && \text{if} \quad c\leq z,\\ P_c(c,z) &= 0 && \text{if} \quad c>z.\end{aligned}$$

A loan from a type-k lender with interest rate R is accepted by a type-z borrower with probability

$$P_{k,R}(R,z) = \int_{-\infty}^{z-R+\tau(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a(R-\tau(k)+a-R(x)+\tau(x))dG(x)}dF_a(a).$$

A loan from a type-k lender with interest rate R is accepted with probability

$$P_k(R) = \sum_{z\in Z}s_z e(z)\int_{-\infty}^{z-R+\tau(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}}F_a(R-\tau(k)+a-R(x)+\tau(x))dG(x)}dF_a(a),$$

where $P_k'(R)<0$ for the same reasons as in the baseline model.

Notice that, in contrast to the baseline model, a lender's probability of giving a loan depends on his type k directly (i.e., over and above his interest-rate choice R) because k determines the value of the mean-shifter. More precisely, the probability of a loan *increases* in k:

$$\frac{\partial P_k(R)}{\partial k} = \sum_{z\in Z} s_z e(z)\Bigg(\int_{-\infty}^{z-R+\tau(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}} F_a(R-\tau(k)+a-R(x)+\tau(x))dG(x)} \Big(\alpha(z) * \int_{\underline{k}}^{\overline{k}} F_a'(R-\tau(k)+a-R(x)+\tau(x))\tau'(k)dG(x)\Big)dF_a(a) + \tau'(k)e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}} F_a(z-R(x)+\tau(x))dG(x)} F_a'(z-R+\tau(k))\Bigg) > 0,$$

which is intuitive since higher-k lenders have higher mean-shifters. Furthermore:

$$\frac{\partial P_k(R)}{\partial k} = -\tau'(k)P_k'(R).$$

The expected profits of a lender of type k who offers interest rate R are

$$\pi_k(R) = bP_k(R)\left(R(1-\rho)-k\right).$$

The optimal choice $R(k)$ is characterized, as before, by

$$\pi_k'(R) = bP_k'(R)\big(R(1-\rho)-k\big) + bP_k(R)(1-\rho) = 0.$$

Note that equilibrium profits are declining in k:

$$\begin{aligned}\frac{\pi_k(R(k))}{\partial k} &= b\frac{\partial P_k(R(k))}{\partial k}\big(R(k)(1-\rho)-k\big) - bP_k(R(k)) \\ &= -\Big(\tau'(k)bP_k'(R)\big(R(k)(1-\rho)-k\big) + bP_k(R(k))\Big) < 0.\end{aligned}$$

Hence, lender entry follows a cutoff rule, as in the baseline model.

The cross-partial derivative of profits with respect to R and k is

$$\frac{\partial \pi_k'(R)}{\partial k} = \frac{\partial P_k'(R)}{\partial k}\big(R(1-\rho)-k\big) + \frac{\partial P_k(R)}{\partial k}(1-\rho) - P_k'(R).$$

The second and third terms are positive. It is not possible to sign the first term:

$$\frac{\partial P_k'(R)}{\partial k} = \tau'(k)\sum_{z\in Z} s_z e(z)\Bigg(\int_{-\infty}^{z-R+\tau(k)} e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}} F_a(R-\tau(k)+a-R(x)+\tau(x))dG(x)}\Big(-\big(\alpha(z) *$$
$$\int_{\underline{k}}^{\overline{k}} F_a'(R-\tau(k)+a-R(x)+\tau(x))dG(x)\big)^2 +$$
$$\alpha(z)\int_{\underline{k}}^{\overline{k}} F_a''(R-\tau(k)+a-R(x)+\tau(x))dG(x)\Big)dF_a(a) -$$
$$e^{-\alpha(z)\int_{\underline{k}}^{\overline{k}} F_a(z-R(x)+\tau(x))dG(x)} F_a''(z-R+\tau(k))\Bigg).$$

We will, from now on, assume that the cross-partial is positive and numerically confirm that this assumption holds for our parameter values.

Under our assumption, higher-cost lenders choose higher interest rates: $R'(k) > 0$. We characterize the optimal interest rate choice and entry by the lenders in the next proposition, following the same steps as in the baseline model.

Proposition D2 *Lenders' choices are characterized as follows:*

1. *Given borrowers' effort $e(\cdot)$, the optimal interest rate choice by lenders $R(\cdot)$ solves*

$$\sum_{z\in Z} s_z e(z)\int_{-\infty}^{z-R(k)+\tau(k)} e^{-\alpha(z)\int_{\underline{k}}^{\hat{k}} F_a(R(k)-\tau(k)+a-R(x)+\tau(x))dG(x)} dF_a(a)$$
$$= \Big(R(k)-\frac{k}{1-\rho}\Big)\sum_{z\in Z} s_z e(z)\Bigg(\int_{-\infty}^{z-R(k)+\tau(k)} e^{-\alpha(z)\int_{\underline{k}}^{\hat{k}} F_a(R(k)-\tau(k)+a-R(x)+\tau(x))dG(x)} *$$
$$\Big(\alpha(z)\int_{\underline{k}}^{\hat{k}} F_a'(R(k)-\tau(k)+a-R(x)+\tau(x))dG(x)\Big)dF_a(a) + \tag{D2}$$
$$e^{-\alpha(z)\int_{\underline{k}}^{\hat{k}} F_a(z-R(x)+\tau(x))dG(x)} F_a'\left(z-R(k)+\tau(k)\right)\Bigg).$$

2. *The marginal lender type who enters the market $\hat{k}$ is defined by*

$$b\left(R(\hat{k})(1-\rho)-\hat{k}\right)\sum_{z\in Z} s_z e(z) *$$
$$\int_{-\infty}^{z-R(\hat{k})+\tau(\hat{k})} e^{-e(z)\Lambda\Gamma(\hat{k})\int_{\underline{k}}^{\hat{k}} F_a\left(R(\hat{k})-\tau(\hat{k})+a-R(\hat{k})+\tau(\hat{k})\right)d\frac{\Gamma(x)}{\Gamma(\hat{k})}} dF_a(a) = \chi.$$

D.2 Calibration

We calibrate the model by making the same functional form assumptions we made in the baseline case of no correlation. In addition, we specify the function $\tau(k)$ to equal $\gamma(k - E(k))$, where $E(k) = \int_{k_{min}}^{\hat{k}} k dG(k)$ is the average cost.

We perform three calibrations for three separate values of γ: (1) $\gamma = 0.8$, which implies that the variance of the term $\tau(k)$ is large; (2) $\gamma = 0.4$, which implies that the variance of $\tau(k)$ is intermediate; and (3) $\gamma = 0.2$, which implies that the variance of $\tau(k)$ is small. Of course, the baseline calibration of Section 5 corresponds to the case with $\gamma = 0$.

Table D1 reports the parameters of these three cases and Table D2 reports how each case fits the data. These tables show the following: (1) The case with $\gamma = 0.8$ fits the data considerably worse than all other cases, including the baseline case with $\gamma = 0$. (2) The best fit of the data in Table D2 obtains with $\gamma = 0.4$, which corresponds to a moderate variance of $\tau(k)$. However, the value of the criterion function in the baseline case with $\gamma = 0$ reported in Table 4 is lower than that with $\gamma = 0.4$. (3) The values of the other parameters—most notably, those of the cost-of-effort parameters β_{0j}—obtained in the best-fit case with $\gamma = 0.4$ are very similar to those obtained in the baseline case with $\gamma = 0$, thereby leading to implications similar to those of the baseline case.

Table D3 reports market outcomes and welfare for the counterfactual analyses in which we cap interest rates using the parameters in Panel B of Table D1 with $\gamma = 0.4$. These counterfactual analyses correspond to those of Section 6, with the only differences being that they use the parameters reported in Panel B of Table D1 rather than those reported in Panel A of Table 3.

Table D3 confirms the robustness of our results in Section 6, whereby price caps have positive effects on consumer surplus and negative effects on lenders' profits.

E Higher Compliance Costs

An additional set of regulations that have been introduced since the 2008 financial crisis has broadly increased lenders' compliance costs. While many of these regulations may have potential benefits, such as greater financial stability and/or fewer abusive lending practices, through the lens of our model, higher compliance costs can be interpreted as an increase

Table D1: Calibrated Parameters, Correlation between R and a

Panel B: Large Variance			
μ_{z_1}	3.659	σ_{z_1}	0.123
μ_{z_2}	3.605	σ_{z_2}	0.089
μ_{z_3}	3.360	σ_{z_3}	0.124
μ_{z_4}	3.173	σ_{z_4}	0.340
ξ	3.642	$\hat{k}$	9.145
L_1	1.534	L_2	3.974
L_3	3.199	L_4	3.076
ρ_1	0.055	ρ_2	0.055
ρ_3	0.055	ρ_4	0.050
σ_{a_1}	0.095	σ_{a_2}	0.111
σ_{a_3}	0.138	σ_{a_4}	0.137
β_{01}	9.335	β_{02}	38.944
β_{03}	30.072	β_{04}	29.544
β_1	1.658	γ	0.800

Panel B: Medium Variance			
μ_{z_1}	3.614	σ_{z_1}	0.117
μ_{z_2}	3.544	σ_{z_2}	0.087
μ_{z_3}	3.460	σ_{z_3}	0.114
μ_{z_4}	3.207	σ_{z_4}	0.342
ξ	3.792	$\hat{k}$	10.387
L_1	1.493	L_2	3.768
L_3	3.216	L_4	3.042
ρ_1	0.031	ρ_2	0.022
ρ_3	0.017	ρ_4	0.013
σ_{a_1}	0.112	σ_{a_2}	0.127
σ_{a_3}	0.133	σ_{a_4}	0.136
β_{01}	8.866	β_{02}	35.878
β_{03}	27.598	β_{04}	27.601
β_1	1.634	γ	0.400

Panel B: Small Variance			
μ_{z_1}	3.612	σ_{z_1}	0.113
μ_{z_2}	3.550	σ_{z_2}	0.080
μ_{z_3}	3.478	σ_{z_3}	0.117
μ_{z_4}	3.213	σ_{z_4}	0.373
ξ	3.747	$\hat{k}$	9.873
L_1	1.507	L_2	3.766
L_3	3.217	L_4	3.050
ρ_1	0.027	ρ_2	0.018
ρ_3	0.014	ρ_4	0.010
σ_{a_1}	0.146	σ_{a_2}	0.124
σ_{a_3}	0.127	σ_{a_4}	0.149
β_{01}	9.050	β_{02}	35.482
β_{03}	27.643	β_{04}	26.911
β_1	1.612	γ	0.200

Notes: This table reports the calibrated parameters. Panel A refers to the version with $\gamma = 0.8$, Panel B to the version with $\gamma = 0.4$, and Panel C to the version with $\gamma = 0.2$.

in lenders' fixed costs χ_j. Hence, we wish to understand the effect of these cost-increasing regulations on borrower outcomes.

The increase in the fixed costs shares and our counterfactual regarding the introduction of an interest rate cap of Section 6 share the feature whreby highest-costs lenders will exit the market; thus, this counterfactual with larger fixed costs allows us to understand how much the results displayed in Figure 4 obtain because of the exit of these highest-cost lenders. Moreover, Janssen and Moraga-González (2004) show that a decrease in the number of active sellers could increase examination effort because fewer sellers may decrease price dispersion, possibly leading to higher average prices.[1] Thus our model is well suited to understand these effects.

To facilitate comparison with our price-cap experiment in Section 6, we increase the fixed cost χ so that the marginal lender has marginal cost equal to $\hat{k}'$—i.e., the marginal cost of the lender that satisfies the free entry (14) condition in the case of the price caps considered in Section 6.[2] We further decrease the aggregate arrival rate of offers to a new

[1] Similarly, Armstrong and Chen (2009) show that a decrease in the number of sellers could increase welfare in a search model with inattentive consumers.

[2] As we explain in Section 6, in the case of the 22.5-pp cap and the super-prime market, we observe

Table D2: Model Fit, Correlation between R and a

	Data	Model $\gamma = 0.8$	Model $\gamma = 0.4$	Model $\gamma = 0.2$
10th Percentile Accepted Rate, Subprime Borrowers	13.22	19.38	18.02	18.12
25th Percentile Accepted Rate, Subprime Borrowers	16.43	20.45	19.14	19.25
50th Percentile Accepted Rate, Subprime Borrowers	22.05	22.59	21.59	21.70
75th Percentile Accepted Rate, Subprime Borrowers	27.75	25.53	25.13	25.26
90th Percentile Accepted Rate, Subprime Borrowers	30.27	28.09	28.24	28.19
10th Percentile Accepted Rate, Near-prime Borrowers	13.73	19.20	17.17	17.38
25th Percentile Accepted Rate, Near-prime Borrowers	16.99	20.22	18.29	18.55
50th Percentile Accepted Rate, Near-prime Borrowers	20.96	22.27	20.75	21.06
75th Percentile Accepted Rate, Near-prime Borrowers	25.67	25.10	24.37	24.73
90th Percentile Accepted Rate, Near-prime Borrowers	29.81	27.64	27.50	27.70
10th Percentile Accepted Rate, Prime Borrowers	11.63	17.83	15.49	15.60
25th Percentile Accepted Rate, Prime Borrowers	14.73	18.38	16.46	16.60
50th Percentile Accepted Rate, Prime Borrowers	18.00	19.53	18.56	18.78
75th Percentile Accepted Rate, Prime Borrowers	21.84	21.11	21.72	21.95
90th Percentile Accepted Rate, Prime Borrowers	28.88	22.51	24.49	24.58
10th Percentile Accepted Rate, Super-prime Borrowers	10.53	15.76	13.63	13.55
25th Percentile Accepted Rate, Super-prime Borrowers	13.07	16.34	14.45	14.38
50th Percentile Accepted Rate, Super-prime Borrowers	16.63	17.54	16.16	16.16
75th Percentile Accepted Rate, Super-prime Borrowers	19.76	19.15	18.60	18.69
90th Percentile Accepted Rate, Super-prime Borrowers	24.67	20.61	20.94	21.11
Fraction Receiving 2+ Offers (%)	75.00	75.10	74.38	74.53
Median Number of Offers Received, Conditional on 2+ Offers	3.00	3.00	3.00	3.00
Average Number of Offers Received, Conditional on 2+ Offers	4.00	3.52	3.48	3.49
10th Percentile Distribution of Differences in Offered Rates	0.00	1.12	1.62	1.66
30th Percentile Distribution of Differences in Offered Rates	2.25	2.62	3.97	4.10
50th Percentile Distribution of Differences in Offered Rates	4.34	3.85	5.89	6.05
70th Percentile Distribution of Differences in Offered Rates	7.25	5.06	7.78	7.97
90th Percentile Distribution of Differences in Offered Rates	9.25	7.46	10.17	10.27
Fraction with Credit Card Debt, Subprime Borrowers	54.56	55.20	55.17	55.06
Fraction with Credit Card Debt, Near-Prime Borrowers	55.33	56.55	55.99	56.07
Fraction with Credit Card Debt, Prime Borrowers	54.00	51.74	54.42	54.99
Fraction with Credit Card Debt, Super-prime Borrowers	36.02	35.61	35.59	35.94
Charge-Off Rate	4.01	5.32	2.00	1.64
Average Funding Cost	7.02	6.02	6.10	6.05
Criterion Function		281.93	142.54	146.33

Notes: This table reports the values of the empirical moments and of the moments calculated at the calibrated parameters reported in the panels of Table D1.

Table D3: Market Outcomes and Welfare with a Price Cap, Correlation between R and a

	Sub-	Near-	Prime	Super-
Panel A: Cap=27.5 pps				
Average Number of Offers per Borrower	0.93	0.96	1.01	1.00
Average Accepted Rate	0.92	0.94	1.03	1.00
Standard Deviation of Accepted Rates	0.83	0.88	1.01	1.00
Fraction of Borrowers	1.00	1.01	0.97	1.00
Consumer Surplus	1.11	1.11	0.91	1.00
Lender Profits	0.58	0.71	1.14	1.00
Welfare	1.02	1.03	0.95	1.00
Panel B: Cap=25 pps				
Average Number of Offers per Borrower	0.82	0.87	0.98	1.00
Average Accepted Rate	0.87	0.89	0.95	1.00
Standard Deviation of Accepted Rates	0.68	0.74	0.91	1.00
Fraction of Borrowers	0.93	0.97	1.02	1.00
Consumer Surplus	1.09	1.15	1.11	1.00
Lender Profits	0.33	0.43	0.76	1.00
Welfare	0.96	1.01	1.04	1.00
Panel C: Cap=22.5 pps				
Average Number of Offers per Borrower	0.65	0.74	0.89	1.00
Average Accepted Rate	0.84	0.84	0.88	1.00
Standard Deviation of Accepted Rates	0.46	0.59	0.77	1.00
Fraction of Borrowers	0.76	0.87	1.00	1.00
Consumer Surplus	0.87	1.06	1.18	1.00
Lender Profits	0.17	0.22	0.45	1.00
Welfare	0.75	0.90	1.03	1.00

Notes: This table reports market outcomes and welfare in each market when interest rates are capped at $R_{max} = 25$ percent and R is correlated with the attribute a.

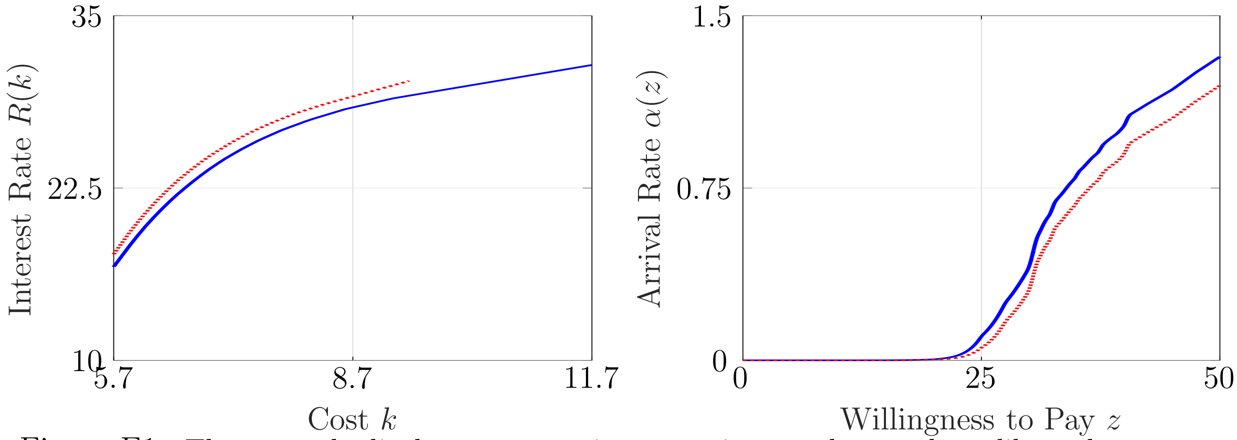

Figure E1: These panels display outcomes in near-prime market at the calibrated parameters (solid line) and in the case when the fixed cost is higher. The left panel displays lenders' optimal interest rate $R(k)$ as a function of their cost k; the right panel displays borrowers' effective arrival rate $\alpha(z)$ as a function of their willingness to pay z.

value L'_j correspondingly; that is, the new arrival rate equals $L'_j = \Lambda_j G(\hat{k}')$.

Figure E1 compares outcomes of the model at the calibrated parameters for the near-prime market (solid line) with those of the model with a higher fixed cost χ' chosen such that the marginal cost $\hat{k}'$ equals that of the lender that satisfies the free entry (14) condition in the case of the 25-pp cap in Section 6. It displays interesting patterns. Notably, the exit of high-cost lenders reduces interest-rate dispersion (left panel), but it does not reduce the level of interest rates, since surviving lenders increased their rates due to lower competition. Hence, borrowers consider fewer offers than in the baseline case (right panel) for two reasons: (1) they receive fewer offers; and (2) they choose not to exert much effort because price dispersion is lower, and thus the benefits of considering multiple offers are lower. In turn, the probability $P(R)$ that borrowers accept an offer with a given interest rate R increases relative to the baseline case, because high and low offers are no longer available. However, the average acceptance probability across lenders decreases relative to the baseline case. Similarly, the fraction of borrowers declines to 0.50 from 0.55 in the baseline.

The distributions of offered rates and of accepted rates in a market with a higher fixed cost χ' intersect the corresponding distributions obtained in the baseline case, as lenders no longer offer the lowest and the highest rates. The average offered and accepted rates are higher than those of the baseline, whereas the standard deviations of offered and accepted

additional entry of higher-cost lenders relative to the baseline market. In this case, we keep the fixed cost χ as in the baseline market.

Table E1: Market Outcomes and Welfare with Higher Compliance Costs

	Sub-	Near-	Prime	Super-
Panel A: Higher Fixed Cost Corresponding to Cap=27.5 pps				
Average Number of Offers per Borrower	0.97	0.98	1.00	1.00
Average Accepted Rate	1.00	1.01	1.00	1.00
Standard Deviation of Accepted Rates	0.97	0.98	1.00	1.00
Fraction of Borrowers	0.98	0.98	1.00	1.00
Consumer Surplus	0.98	0.96	1.00	1.00
Lender Profits	0.74	0.83	1.00	1.00
Welfare	0.92	0.92	1.00	1.00
Panel B: Higher Fixed Cost Corresponding to Cap=25 pps				
Average Number of Offers per Borrower	0.90	0.91	0.99	1.00
Average Accepted Rate	0.99	1.02	1.00	1.00
Standard Deviation of Accepted Rates	0.88	0.89	1.00	1.00
Fraction of Borrowers	0.92	0.90	0.99	1.00
Consumer Surplus	0.90	0.84	0.99	1.00
Lender Profits	0.45	0.51	0.91	1.00
Welfare	0.79	0.73	0.97	1.00
Panel C: Higher Fixed Cost Corresponding to Cap=22.5 pps				
Average Number of Offers per Borrower	0.80	0.82	0.94	1.00
Average Accepted Rate	1.01	1.07	1.01	1.00
Standard Deviation of Accepted Rates	0.73	0.75	0.94	1.00
Fraction of Borrowers	0.80	0.76	0.94	1.00
Consumer Surplus	0.75	0.63	0.92	1.00
Lender Profits	0.28	0.27	0.57	1.00
Welfare	0.63	0.51	0.83	1.00

Notes: This table reports market outcomes and welfare in each market, as ratios of those of the baseline case.

rates are lower.

Table E1 reports summary statistics of market outcomes, as well as consumer surplus, lenders' profits, and aggregate welfare for each group of borrowers when fixed costs are higher, as ratios of those of the baseline case. Higher fixed costs reduce lender profits, as the price cap did, but they also decrease consumer surplus, with large negative welfare effects. Specifically, consumer surplus decreases in all markets in which the cap is binding. Similarly, aggregate lender profits decline. As a result, aggregate welfare declines.

Moreover, Table E2 reports market outcomes and welfare for the counterfactual analyses with higher compliance costs and the unobserved attribute a is correlated with the interest rate R, using the parameters in Panel B of Table D1 with $\gamma = 0.4$. These counterfactual analyses correspond to those of Table E1, with the only differences being that they use the parameters reported in Panel B of Table D1 rather than those reported in Panel A of Table

Table E2: Market Outcomes and Welfare with Higher Compliance Costs, Correlation between R and a

	Sub-	Near-	Prime	Super-
Panel A: Higher Fixed Cost Corresponding to Cap=27.5 pps				
Average Number of Offers per Borrower	0.93	0.96	1.00	1.00
Average Accepted Rate	0.98	1.02	1.00	1.00
Standard Deviation of Accepted Rates	0.88	0.94	1.00	1.00
Fraction of Borrowers	0.95	0.95	1.00	1.00
Consumer Surplus	0.97	0.91	1.00	1.00
Lender Profits	0.50	0.76	1.00	1.00
Welfare	0.89	0.88	1.00	1.00
Panel B: Higher Fixed Cost Corresponding to Cap=25 pps				
Average Number of Offers per Borrower	0.82	0.87	0.98	1.00
Average Accepted Rate	0.98	1.05	1.01	1.00
Standard Deviation of Accepted Rates	0.72	0.82	0.97	1.00
Fraction of Borrowers	0.85	0.84	0.97	1.00
Consumer Surplus	0.84	0.73	0.96	1.00
Lender Profits	0.30	0.44	0.83	1.00
Welfare	0.74	0.68	0.93	1.00
Panel C: Higher Fixed Cost Corresponding to Cap=22.5 pps				
Average Number of Offers per Borrower	0.65	0.74	0.89	1.00
Average Accepted Rate	1.17	1.11	1.04	1.00
Standard Deviation of Accepted Rates	0.53	0.65	0.87	1.00
Fraction of Borrowers	0.50	0.64	0.87	1.00
Consumer Surplus	0.34	0.48	0.79	1.00
Lender Profits	0.15	0.15	0.47	1.00
Welfare	0.31	0.42	0.73	1.00

Notes: This table reports market outcomes and welfare in each market when compliance costs are higher and R is correlated with the attribute a.

3. Table E2 confirms the robustness of our results, whereby higher compliance costs have negative (and large) effects on consumers and on lenders.

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