

# Predatory Lending in a Rational World<sup>1</sup>

Philip Bond,  
The Wharton School,  
University of Pennsylvania

David K. Musto,  
The Wharton School,  
University of Pennsylvania

Bilge Yilmaz,  
The Wharton School,  
University of Pennsylvania

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## **Abstract**

Regulators express growing concern over “predatory lending,” which we take to mean lending that reduces the expected utility of borrowers, in particular through a high probability of foreclosure. We present a rational model of consumer credit in which the lender has superior information. Our model predicts that predatory lending arises in monopolistic credit markets or when loans are highly collateralized. Under many circumstances credit-market competition eliminates predatory lending. We use our model to analyze the effects of several prominent legislative interventions. Consumer-credit laws can combat predatory lending by fostering competition, but may inadvertently support it, even under competition, when they combat discrimination.

“While Georgia’s real estate foreclosure law has remained essentially the same since the 1880s, mortgage lending has changed dramatically during the past two decades...Leagues of homeowners are tapping into their equity to pay off credit cards, buy cars and take trips...One bump in the road — a job loss, a sick child, a divorce — could introduce homeowners to the harsh realities of Georgia’s foreclosure law.”

“Swift foreclosures dash American dream,” *Atlanta Journal and Constitution*, January 30, 2005

“Any time you’re looking at equity rather than ability to repay, you’re approaching predatory lending.” (Attorney Daniel J. Mulligan, whose law firm, Jenkins & Mulligan, San Francisco, is a member of the National Association of Consumer Advocates.)

“How unscrupulous lenders prey on the vulnerable,” *San Francisco Chronicle*, July 15, 2001.

## 1 Introduction

Consumer credit has grown significantly in recent years. So, too, have consumer delinquencies, defaults, foreclosures and bankruptcies. While some incidence of negative outcomes is natural, there is widespread concern that the observed incidence is excessive, swollen by ‘predatory lending.’ Judging from the legislative response, predatory lending occurs when a lender *expects* a negative outcome for the borrower yet lends anyway, protected by the collateral. But why would consumers enter into such loans? One possibility, popular with the media, is that they are irrational: unable to reason about loans terms, income prospects, collateral value, etc., or simply not maximizing. But falling back on irrationality is, we show, unnecessary and a missed opportunity. A model with rational agents identifies when and how predatory lending arises, and it also demonstrates the effect of competition between lenders, as well as the good and bad effects of relevant legislation.

Rational consumers do not knowingly make themselves worse off. So if a loan reduces a lender’s expectation of a borrower’s utility, the lender must have private information about the borrower’s prospects, and there must also be *other* borrowers who are made *better* off by the same terms, conditional on this private information. Thus, a necessary condition for predatory lending is the ‘informed investor’ information

structure of Rock [27], a structure which we argue is likely to prevail in the consumer-credit market. But while this structure is necessary, it is not sufficient, because the lender must also find it *optimal* to offer the same terms to these different types. Furthermore, considering the motivating concern about foreclosures and bankruptcies, the key question is whether the borrowers made worse off in this pooling equilibrium are the ones with the worse prospects.

Highly experienced lenders dominate the mortgage market.<sup>1</sup> So the typical lender has seen many loan applications similar to a new one, and has also seen how these other loans turned out, and therefore likely knows something the applicant does not know about the distribution of his own loan's outcome. Rational applicants recognize this gap and can try to close it by learning their credit scores, but since these scores reflect only a subset of credit-file data,<sup>2</sup> and nothing about assets or income, this is insufficient. Thus, both sides of a mortgage offer strategize with respect to the lender's better knowledge of what the mortgage would mean for the applicant's expected welfare.

A simple model captures the important elements of the problem. On the borrowing side are homeowners who derive private benefits from their homes, and who wish to borrow against them. On the lending side are creditors who can privately distinguish between homeowners with good and bad prospects for repayment, and who foreclose if not fully repaid. Because liquidation is costly and does not capture the private benefits, it carries a deadweight cost. Lenders offer loan terms to borrowers, and we say that predatory lending occurs if homeowners accept terms that make them worse off in expectation. We identify the equilibria of two economies, one with a monopolistic lender, and one with multiple competing lenders.

In the monopoly case, we find that the incidence of predation turns on the value of collateral: high collateral value fosters predation of bad prospects, whereas low collateral value fosters predation of good prospects. Moreover, loans used to create additional collateral, such as home-improvement and house purchase loans, are particularly susceptible to predation of bad prospects. Introducing competition between lenders mitigates predatory lending. However, loans that are fully collateralized remain at risk from predation when lending to borrowers with bad prospects is socially inefficient.

While we do not argue that every borrower is rational, our rational model delivers implications which concur with common impressions of predatory lending, namely

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<sup>1</sup>For example, in 2003, 10 lenders accounted for 61% of all mortgage originations (Pafenberg[23]).

<sup>2</sup>See, e.g., Musto[22]

that it is associated with weak competition, strong asymmetric information and high home equity. It also delivers potentially important predictions. Most immediately, it bounds the efficacy of combatting predation through borrower education campaigns and other policies geared to improving consumers' decision-making ability. It also shows the equilibrium effects of several major regulations, which are explored in the last section before the conclusion.

### *Related Literature*

Previous studies of predatory lending have generally stressed the combination of wilful misrepresentation by the lender and the borrower's inability to understand the true terms of the loan. Engel and McCoy [11], Renuart [25], and Silverman [30] are representative examples. Richardson [26] presents a formal model in which borrowers know that some lenders will deceive them, and this affects their decision to apply for credit; but once they have approached a dishonest lender, there is nothing they can do to avoid being taken advantage of. Predatory lending is often viewed as a subcategory of subprime lending, which is itself the object of study of a large literature — see, e.g., Crews-Cutts and Van Order [8], and Calem et al. [5], for recent contributions.

A number of studies by policy groups have tried to empirically assess the scope of predatory lending. For example, ACORN Fair Housing's study of Montgomery County, Pennsylvania, [1] documents the fraction of foreclosed loans that have high interest rates, balloon payments and pre-payment penalty clauses. A recent working paper by Hanson and Morgan [15] also addresses the significance of predatory lending. After first presenting a behavioral model in which lenders exaggerate households' future income in order to increase loan demand,<sup>3</sup> the authors attempt to detect predatory lending by payday lenders<sup>4</sup> by examining whether borrowers without college degrees and/or uncertain income are disproportionately more likely to be delinquent in states that are more permissive of payday loans.

More generally, our paper bears some relation to the extensive literature on competition for partially informed consumers. Prominent contributions include (but are certainly not limited to) Stigler [31], Salop and Stiglitz [28], Wilde and Schwartz [34], and Varian [32]. Subsequent papers, such as those of Beales et al. [3] and Schwartz

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<sup>3</sup>In contrast to the existing paper, borrowers are assumed to be unable to infer any useful information from the terms of the loan contract.

<sup>4</sup>For the costs associated with running a payday lending operation, see Flannery and Samolyk [12].

and Wilde [29], have sought to draw policy implications from these formal analyses. A recent article by Hynes and Posner [16] surveys a variety of issues related to the regulation of consumer finance, including the application of these models to the specific context of consumer loans. Ausubel [2] presents evidence that competition fails to eliminate profits in the credit card market, and sketches a model in which some borrowers are irrational and ignore the possibility that they will actually borrow using credit cards.

A central assumption in all these papers is that consumers are not fully and costlessly informed about the prices offered by all competing firms. This assumption can generate cases in which prices do not fall to a fully competitive level; but it cannot generate circumstances in which a consumer's welfare is actually reduced by purchasing a good. In contrast, in our model borrowers fully observe the interest rates offered to them; instead, it is their own future income process about which they are imperfectly informed. On an abstract level this assumption is isomorphic to borrowers not knowing their own preferences. In this regard, our paper shares some common ground with recent papers on competition for behavioral consumers: see, for example, Ausubel [2], Manove and Padilla [19], Della Vigna and Malmendier [17], and Gabaix and Laibson [13].

Finally, as we have discussed above, the key assumption in our model is that (at least in some respects) the lender knows more about a borrower's future income than does the borrower himself. A growing literature, which dates back at least as far as Rock [27], has studied various aspects of the "informed investor" environment.<sup>5</sup>

### *Paper Outline*

The paper proceeds as follows. Section 2 presents the model. Section 3 analyzes the incidence of predatory lending under monopolistic lending conditions. Section 4 then explores the effect of increased competition on the possibility of predation. In Section 5 we extend our basic model to cover home-improvement loans, and show that (consistent with public concern) these are particularly prone to predation. For a variety of reasons consumer credit markets are highly regulated; Section 6 analyzes the impact of three high profile legislative interventions. Section 7 concludes. All proofs omitted in the main text are given in Appendix A.

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<sup>5</sup>For recent examples in various financial contexts, see Manove et al. [20], Garmaise [14], Bernhardt and Krassa [4], Inderst and Mueller [18], and Villeneuve [33].

## 2 Model and Definitions

As noted above, concern about predatory lending focuses on situations in which a borrower's home is repossessed upon default. We present a highly stylized model of home-equity loans — that is, loans in which a borrower uses an equity-stake in his home as collateral for a new loan, often for consumption purposes. Much of our analysis applies with little alteration to the other main case of interest, namely loans made for the purpose of the initial house purchase. As we will argue in Section 5, if anything we are biasing our analysis against generating predation by focusing on consumption loans that do not create additional collateral.

### *Basic Setup*

All agents are risk neutral and require an expected return of at least 0. Borrowers have no money but have the opportunity to spend  $L$  on a project that delivers a gross non-monetary benefit in one period of  $L + S$ . Examples include health care, children's education, weddings, travel, and just general consumption. In one period, each borrower will receive, independently of undertaking the project, stochastic income of  $y \in \{0, I\}$ . In addition to the income, each borrower has collateral, which we will refer to as his house, that is worth  $H$  to the borrower and that sells for  $H - X$ , where  $X < H$ . The difference  $X$  is the social cost of foreclosure: the combination of the lender's costs of foreclosing on the house<sup>6</sup> and the borrower's private benefits from his house, such as the adaptation of the rest of his life to living there.

Lenders have unlimited funds, so they will lend  $L$  if they expect repayment of at least  $L$ . Throughout, we restrict attention to debt contracts, which are defined by their face value  $F$ . We assume throughout that the high-income realization  $I$  exceeds the face values of all equilibrium loan contracts, so that the lender is always repaid  $F$  when  $y = I$ . On the other hand, in the low-income realization the borrower is forced to sell his house for  $H - X$ . (Equivalently, the lender seizes the house.) In this case, if  $H - X \geq F$ , the lender receives  $F$  and the borrower is left with  $H - X - F$ ; while if instead  $H - X < F$  then the lender receives  $H - X$  and the borrower is left with 0.

Note that since in our setting the borrower never takes a loan from more than one lender, it is irrelevant whether or not the loan is explicitly secured by the house.

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<sup>6</sup>One estimate puts the cost of foreclosure at just less than \$60,000 for loans that go through the full formal process: see Crews Cutts and Green [7].

That is, even if the lender makes an unsecured loan, he ultimately still has the right to attach any wealth belonging to a borrower who has defaulted.

The order of events is as follows. After having received a signal about the borrower's type (see below), the lender makes a take-it-or-leave-it offer to lend  $L$  to the borrower for a promised repayment  $F$ . The borrower either borrows at these terms, spending it on the project, or does not borrow. When there are multiple lenders, they make simultaneous take-it-or-leave-it offers (see Section 4).

### *Information Structure*

As discussed, a key element of our model is that lenders are better informed about the income prospects of borrowers than are the borrowers themselves. Formally, while a borrower thinks there is a probability  $p$  that he will receive income  $y = I$ , each lender receives an informative signal  $\sigma \in \{g, b\}$ . If the lender observes signal  $\sigma = b$  (respectively,  $\sigma = g$ ), the borrower's actual probability of income  $y = I$  is  $p_b$  (respectively,  $p_g$ ).

### COMMENTS

1. One possible way in which the probabilities  $p$ ,  $p_b$  and  $p_g$  are related is as follows. A fraction  $\theta$  of borrowers are type  $G$ ; for these borrowers, there is a probability  $\pi_G$  that  $y = I$ . The remaining fraction  $1 - \theta$  are type  $B$ , and have probability  $\pi_B < \pi_G$  of income  $y = I$ . Conditional on this public information, the probability that a borrower collects  $y = I$  is  $p \equiv \theta\pi_G + (1 - \theta)\pi_B$ . The signals received by lenders are (possibly noisy) indicators of a borrower's type. So conditional on both the public information and the lender's signal  $\sigma \in \{g, b\}$ , the probability that a borrower gets  $y = I$  is  $p_\sigma = \Pr(\pi = \pi_G | \sigma) \pi_G + \Pr(\pi = \pi_B | \sigma) \pi_B$ .<sup>7</sup>
2. The lender's informational advantage is most plausibly interpreted as stemming

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<sup>7</sup>For example, in the specific case in which  $\Pr(\pi = \pi_G | \sigma = g) = \Pr(\pi = \pi_B | \sigma = b) = 1 - \varepsilon$ , then

$$\begin{aligned}
 p_g &= \frac{\theta(1 - \varepsilon)\pi_G + (1 - \theta)\varepsilon\pi_B}{\theta(1 - \varepsilon) + (1 - \theta)\varepsilon} \\
 p_b &= \frac{\theta\varepsilon\pi_G + (1 - \theta)(1 - \varepsilon)\pi_B}{\theta\varepsilon + (1 - \theta)(1 - \varepsilon)}.
 \end{aligned}$$



from the observation of how a large number of previous borrowers have fared. The lender acquires this information, without cost, as part and parcel of its core business. Although in principle a borrower could conceivably collect this same information, the costs of doing so are almost certain to exceed the benefit for an individual borrower.<sup>8</sup>

3. Many plausible scenarios are consistent with this formal framework. Examples include:
  - (a) Borrowers work in one of several sectors. These sectors will be differentially affected by macroeconomic shocks. For instance, the steel industry may be more affected by exchange rate fluctuations than the food industry. Lenders understand these correlations, but borrowers do not.
  - (b) Borrowers belong to different demographic groups. Similar to above, different groups may be differentially affected by macroeconomic shocks.
  - (c) The income that matters in our model is disposable income, i.e., total income net of essential expenditures. Borrowers from different demographic and/or geographic groups may have different probabilities of experiencing a rise in essential expenditure. For example, the probability of large health expenditures may be much greater for 70-year-old men than for 65-year-old men.

If the lender observes  $\sigma = g$  then we say that the borrower has good prospects, and we refer interchangeably to lending after signal  $g$  and lending to good prospects. Analogously, after  $\sigma = b$  the borrower has bad prospects, and lending after signal  $b$  is equivalent to lending to bad prospects.

Obviously, it is plausible that borrowers also have private information of their own. However, to isolate the effects of the informational superiority of the lenders we focus on the case in which lenders know strictly more than borrowers.

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<sup>8</sup>Even if a borrower did succeed in collecting the relevant information, he/she would still have to correctly interpret it. This is not a trivial exercise. Large lending banks employ highly trained statisticians to perform this task. As such, our informational asymmetry can also be interpreted as a manifestation of bounded rationality.

### *Predatory Lending Defined*

Our question for the model is whether predatory lending arises in equilibrium. This requires a working definition. The essence of predatory lending is expected harm: a predatory loan reduces the lender's expectation of the borrower's utility. Thus, we say that an equilibrium features *predation of bad prospects* (respectively, *good prospects*), if, conditional on the lender observing signal  $b$  (respectively, signal  $g$ ), a borrower is made worse off in expectation by accepting the lender's offer. To reiterate, the expectation here is conditional on the lender's information  $\sigma$ .<sup>9</sup>

Predation of bad prospects involves borrowers suffering from defaulting more than they expect, and predation of good prospects involves borrowers suffering from repaying their loans more than they expect. To some extent, both types capture public concerns with consumer lending: the former captures the concern that foreclosure is excessive, and the latter captures the concern that consumers are treated as riskier than they are, e.g. treated as subprime when in fact they are prime. Since excessive default and foreclosure figure much more prominently than excessive repayment in public discussion and regulation, we devote more attention to predation of bad prospects in the analysis that follows.

Another question for the model is whether predatory lending causes harm to society, rather than just to the borrower. To address this question, we refer to lending that causes net harm to society as *socially inefficient*, as opposed to socially efficient, and if lending after observing  $\sigma$  is socially inefficient we say that an equilibrium in which such loans are accepted features *strong predation* after signal  $\sigma$ . Note that such loans would have to be harmful to the borrower since the *lender* would not be losing expected value conditional on his own information. Predation that is not strong we call *weak*.

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<sup>9</sup>Our definition of predatory lending begs the question of whether predation would be eliminated if the lender simply threw away all his information. However, clearly in a richer model a completely uninformed lender would be unable to profitably provide credit. Specifically, suppose that along with bad and good prospects, there is also a third group, terrible prospects, who are numerous and unprofitable to lend to, and whom the lender can distinguish from the other types only by becoming informed.

### 3 Monopoly Lending

In this section we identify and characterize the pure-strategy perfect Bayesian equilibria of the monopolist-lender economy. For this purpose we need first to establish the relevant boundaries: the boundary between social efficiency and inefficiency, and for each agent, the boundary between entering the loan and staying put. We derive these boundaries, use them to identify necessary conditions for efficiency and predation, and then solve for the equilibria.

#### *Social Efficiency of Lending*

A loan delivers surplus  $S$  to the borrower in both the income and no-income states, and also destroys  $X$  in the no-income state. As such, lending after signal  $\sigma$  is strictly socially efficient if and only if  $S > (1 - p_\sigma)X$ . For use below, likewise note that uninformed lending would be strictly socially efficient if and only if  $S > (1 - p)X$ .

If lenders and borrowers had the same information we would never see socially inefficient loans, because someone's expectations must be negative. But when borrowers base expectations on less information, this logic no longer applies; the borrower's expectations for himself will not be negative, but that does not stop the lender's expectations for the borrower from going negative.

#### *Borrowers' Break-even Face Values and their Properties*

Consider first a borrower who in equilibrium does not learn the lender's signal about him. If he does not accept a loan then he keeps his house for sure, and gets income  $I$  if the income state obtains. Thus, his reservation utility is  $H + pI$ . If he *does* accept a loan of  $L$  with face value  $F$ , then he obtains a non-monetary utility of  $L + S$ . Of course, he must also repay the loan. If his income is high he can afford to make the payment  $F$ , and so keeps his house: his total payoff is  $L + S + H + I - F$ . On the other hand, if his income is low he cannot afford to make the payment  $F$ , and so loses his house: his total payoff is  $L + S + \max\{0, H - X - F\}$ . We denote the highest face value acceptable to a borrower who does not learn the lender's signal by  $F^D$ , which is defined implicitly by the indifference equation

$$L + S + p(H + I - F^D) + (1 - p) \max\{0, H - X - F^D\} = H + pI. \quad (1)$$

Solving,<sup>10</sup>

$$F^D = \begin{cases} \frac{L+S-(1-p)H}{p} & \text{if } H - (L + S) < pX \\ L + S - (1 - p)X & \text{otherwise} \end{cases}. \quad (2)$$

As we have stressed, the borrower does not directly observe the lender's signal  $\sigma$ . However, he may learn the signal in equilibrium. In this case, the highest face value he is prepared to pay on the loan depends on the signal. We denote these reservation face values by  $F_b^D$  and  $F_g^D$ ; algebraically they take the same form as expression (2), with  $p$  simply replaced by  $p_b$  and  $p_g$  respectively.

The relative values of  $F_g^D$ ,  $F^D$  and  $F_b^D$  are central to predatory lending because they determine whether it is good or bad prospects who might accept a welfare-reducing loan. If  $F_g^D > F^D > F_b^D$  then a face value  $F \in (F_b^D, F^D]$  would be acceptable to a borrower who does not know the lender's signal (since  $F \leq F^D$ ) but reduces the welfare of bad prospects (since  $F > F_b^D$ ). Likewise, good types may suffer if  $F_g^D < F < F_b^D$ . So these relative values are crucial to predation, and straightforward manipulation of equation (2) implies that they turn on the sign of  $H - (L + S)$ :

**Lemma 1**  $F_g^D > F^D > F_b^D$  if  $H > L + S$ ,  $F_g^D = F^D = F_b^D$  if  $H = L + S$ , and  $F_b^D > F^D > F_g^D$  if  $H < L + S$ .

So better prospects have the higher tolerance for promised repayments when their collateral is worth more than the loan's payoff, and worse prospects have the higher tolerance when it is worth less. This is a natural consequence of the better prospects having the lower chance of losing the collateral, and the worse prospects having the lower chance of making the repayment.

### *Lenders' Break-even Face Values and their Properties*

If the lender makes a loan with face value  $F$  then in the high-income state he gets  $F$  and in the low income state he gets  $H - X$  if  $H - X < F$  and  $F$  otherwise. Thus, if we let  $F^C$  be the lowest face value acceptable to the creditor when lending is unconditional on the signal, then  $F^C$  solves<sup>11</sup>

$$pF^C + (1 - p) \min \{F^C, H - X\} = L. \quad (3)$$

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<sup>10</sup>Note that the condition  $H - (L + S) < pX$  is equivalent to  $H - X < F$  when  $F = \frac{L+S-(1-p)H}{p}$ . Also,  $F^D$  can alternatively be written as  $F^D = \max \left\{ \frac{L+S-(1-p)H}{p}, L + S - (1 - p)X \right\}$ .

<sup>11</sup>Recall that we have normalized the net interest rate to 0.

Solving explicitly,<sup>12</sup>

$$F^C = \begin{cases} \frac{L-(1-p)(H-X)}{p} & \text{if } H - X < L \\ L & \text{otherwise} \end{cases} \quad (4)$$

Likewise, let  $F_b^C$  and  $F_g^C$  denote the lowest face values acceptable after observing signals  $b$  and  $g$  respectively; algebraically they take the same form as expression (4), with  $p$  simply replaced by  $p_b$  and  $p_g$  respectively.

It is immediate that  $F_b^C > F^C > F_g^C$  when  $H - X < L$ , i.e., the loan is undercollateralized, and  $F_b^C = F^C = F_g^C$  otherwise. Thus, any loan that is profitable to make after a bad signal is also profitable after a good signal, while the reverse need not be true.

#### *Relation between Lenders' and Borrowers' Break-even Face Values*

How do these break-even conditions relate to efficiency and predation? Efficiency is simple. Bearing in mind that the lenders' break-even face values are lower bounds and the borrowers' break-even face values are upper bounds, it is straightforward that if lending is socially inefficient then the lenders' and borrowers' break-even face values, conditional on the same information, must not overlap. In fact, this is not only sufficient but necessary:

**Lemma 2**  $F^C > F^D$  if and only if  $S < (1 - p)X$ , and  $F_\sigma^C > F_\sigma^D$  if and only if  $S < (1 - p_\sigma)X$ .

How do they relate to predation? As we discussed in the introduction, predation can arise only in a pooling equilibrium with lending. In turn, a pooling equilibrium with lending can arise only if  $F_b^C \leq F^D$ , as follows. On the one hand, the borrower would not accept an offer  $F > F^D$  unless he learns the lender's information, which he does not in a pooling equilibrium. On the other hand, if a pooling equilibrium were to feature  $F < F_b^C$  the lender would be losing money after seeing the bad signal, and would prefer not to lend.

With the functional forms of  $F_b^C$  and  $F^D$  we can identify the subset of the parameter space where this holds. A necessary condition for  $F_b^C \leq F^D$  is  $F^C \leq F^D$ , which is

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<sup>12</sup>Equivalently,  $F^C = \max \left\{ L, \frac{L-(1-p)(H-X)}{p} \right\}$ .

simply the condition that uninformed lending be socially efficient, i.e.  $X \leq S/(1-p)$ . If a loan of  $L$  can be fully collateralized, i.e.  $H \geq L + X$ , then  $F_b^C = F^C$  and so this condition is also sufficient. If a loan of  $L$  *cannot* be fully collateralized, i.e.  $H < L + X$ , and therefore the creditor must collect more than  $L$  in the income state to offset his loss in the no-income state, then  $F_b^C = (L - (1 - p_b)(H - X))/p_b$  and  $F^D = (L + S - (1 - p)H)/p$ .<sup>13</sup> Note that as  $H$  decreases,  $F_b^C$  increases at the rate  $(1 - p_b)/p_b$  whereas  $F^D$  increases at the slower rate  $(1 - p)/p$ . This is because the debtor with bad prospects exchanges too little income-state payoff for a unit of no-income-state payoff, valuing the former at  $p > p_b$  and the latter at  $(1 - p) < (1 - p_b)$ . The lender trades these states at the right price. Since  $F_b^C$  increases with  $X$ , this implies that the range of  $X$  satisfying  $F_b^C \leq F^D$  shrinks as  $H$  decreases. Formally, we have:

**Lemma 3**  $F_b^C \leq F^D$  if and only if

$$X \leq \bar{X} \equiv \min \left\{ \frac{(p - p_b)(H - L) + p_b S}{p(1 - p_b)}, \frac{S}{1 - p} \right\}.$$

For predation after signal  $\sigma$  to be *strong* we need the additional condition that  $F_\sigma^D < F_\sigma^C$ . So if  $F_\sigma^D < F_\sigma^C$  then strong predation after signal  $\sigma$  is possible, but if  $F_\sigma^C \leq F_\sigma^D$  then only weak predation is possible.

We now have what we need to find the equilibria.

### *Pooling Equilibria with Lending*

Given our assumptions about the borrower's rationality, predatory lending can arise in our model only if, in equilibrium, the borrower fails to learn the lender's information about him. That is, predation is inherently a pooling equilibrium phenomenon. Moreover, borrowers with good and bad prospects cannot simultaneously be victims of predatory lending.

In this subsection we analyze the incidence of pooling equilibria with lending, and then inspect these equilibria for predation. In the subsection following we address the incidence of separating and no-lending equilibria.

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<sup>13</sup>Observe that when  $X \leq S/(1-p)$  then  $H - (L + S) < pX$  whenever  $H - L < X$ .

The complete set of pooling equilibria with lending turns out to correspond precisely to the restriction  $X \leq \bar{X}$ . By Lemma 3, the necessity of this restriction is straightforward; to reiterate, any pooling equilibrium with lending needs  $F_b^C \leq F^D$  because if  $F > F^D$  then borrowers would not accept, and the lender would not offer  $F < F_b^C$  after observing  $\sigma = b$ .

For sufficiency it is enough to show that  $F_b^C \leq F^D$  implies at least one pooling equilibrium. Consider the case  $H > L + S$ , under which (by Lemma 1)  $F_b^D < F^D < F_g^D$ ; so there exists an  $F$  such that  $F^D \geq F \geq F_b^D$  and  $F \geq F_b^C$ . If borrowers believe that the creditor offers  $F$  after either signal *and* they believe sufficiently strongly that any out-of-equilibrium offer higher than  $F$  implies  $\sigma = b$ , then the creditor is best off offering  $F$  and the borrowers accept.<sup>14</sup> Parallel arguments apply for  $H \leq L + S$ . Thus, we have:

**Proposition 1** *A pooling equilibrium with lending at face value  $F$  exists if and only if  $F \in [\max\{F_b^C, \min\{F_b^D, F_g^D\}\}, F^D]$ . This range is non-empty precisely when  $X \leq \bar{X}$ .*

It can be easily verified that all of the equilibrium outcomes identified by the above proposition satisfy the intuitive criterion of Cho and Kreps [6]. Moreover, the pooling equilibrium outcome that involves the highest  $F$ ,  $F = F^D$ , is the unique perfect sequential equilibrium outcome.<sup>15</sup>

Do the pooling equilibria of Proposition 1 entail predation, and if so, of what form? By definition, predation of bad prospects — weak or strong — requires  $F > F_b^D$ . We also know from the proposition above that, in the space of pooling equilibria,  $F > F_b^D$  requires  $F^D > F_b^D$ , which corresponds to  $H > L + S$ .<sup>16</sup> Thus, we have a corollary to Proposition 1:

**Corollary 1** *An equilibrium with predation of bad prospects exists if and only if  $X \leq \bar{X}$  and  $H > L + S$ .*

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<sup>14</sup>Conversely, there is no pooling equilibrium in which with  $F < F_b^D$ . For in this case, the creditor could deviate and offer  $\tilde{F} \in (F, F_b^D)$ . The borrower will accept such an offer *regardless* of his out-of-equilibrium beliefs. Consequently,  $\tilde{F}$  represents a profitable deviation for the creditor.

<sup>15</sup>A proof is available from the authors.

<sup>16</sup>Conversely, if  $H > L + S$  then  $F_b^D < F^D < F_g^D$ , and so provided  $X \geq \bar{X}$  there exists a pooling equilibrium with  $F > F_b^D$ .

Is this strong predation that hurts society's wealth, or is it weak predation that redistributes the borrower's wealth to the lender? From Lemma 2, this depends on whether  $F_b^C$  is greater or less, respectively, than  $F_b^D$ , or equivalently, whether  $X$  is greater or less than  $S/(1 - p_b)$ :

**Corollary 2** *An equilibrium with strong predation of bad types exists if and only if  $S/(1 - p_b) < X \leq \bar{X}$  and  $H > L + S$ . An equilibrium with weak predation of bad prospects exists if and only if  $X \leq \min\{\bar{X}, S/(1 - p_b)\}$  and  $H > L + S$ .*

We can see already that if  $H > L + S$  and lending to bad prospects is strictly socially efficient, then no *other* type of equilibrium exists. Observe that in any separating equilibrium at most one of the offers is accepted — since if both were accepted, there would be no reason for the lender ever to propose the lower of the face values. However, nor is there an equilibrium in which lending occurs after just one of the signal realizations: since lending to bad prospects is strictly socially efficient,  $F_g^C \leq F_b^C < F_b^D$ , and so the offer  $\tilde{F} = F_b^D - \varepsilon$  is strictly preferred to not lending.<sup>17</sup> Finally, for the same reason no-lending cannot be an equilibrium either. Formally,

**Corollary 3** *If  $X \leq \bar{X}$ ,  $X < S/(1 - p_b)$  and  $H > L + S$  then the only equilibria are pooling equilibria where the lender's offer is  $F \in [F_b^D, F^D]$ . Of these, all except  $F = F_b^D$  feature weak predation of bad prospects.*

When  $H > L + S$  and lending to bad prospects is socially inefficient, other equilibria may exist (see below). However, every pooling equilibrium necessarily entails strong predation of bad prospects:

**Corollary 4** *If  $S/(1 - p_b) < X \leq \bar{X}$  and  $H > L + S$  then every pooling equilibrium features strong predation of bad prospects.*

It is worth pausing at this point to highlight a pair of (related) properties of equilibria featuring predation of bad prospects. First, and as we have noted repeatedly, such equilibria are pooling equilibria. Any pooling equilibrium entails a welfare transfer

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<sup>17</sup>Since  $F_b^D < F_g^D$  when  $H > L + S$ , the borrower will accept the offer  $\tilde{F} < F_b^D$  regardless of his beliefs.



from one type of agent to another (holding the welfare of the principal fixed). What is important here is that welfare moves from bad prospects to good prospects. As we shall see immediately below, the transfer is in this direction only because the borrower possesses substantial collateral. If instead the borrower's collateral  $H$  were less valuable, welfare would move in the opposite direction in a pooling equilibrium. In this respect, predation of good prospects is a manifestation of the standard result that asymmetric information delivers informational rent to the less productive "types;" in contrast, the existence of collateral means that predation of bad prospects does not fall in this category.

Second, the monopolist lender makes no more in this predatory-lending equilibrium than he would if his private information were instead public. At a glance this may seem un predatory, but the comparison is misleading: without private information, he wouldn't be a monopolist. It would be straightforward to formalize this in a bigger model. In this sense, predation is *how* a lender with private information profits from the market power it imparts.

Turning now to the case in which  $H < L + S$ , any predation must be at the expense of borrowers with good prospects. However, strong predation only ever affects bad prospects, and never good prospects. To see this, simply observe that if a loan to good prospects is socially inefficient, then so is a loan to bad prospects, and so no pooling equilibrium can exist.<sup>18</sup>

We collect these observations regarding the predation of good prospects into the following corollary, along with the analogous uniqueness result to Corollary 3 (the proof of which is given in the appendix):

### Corollary 5

1. *An equilibrium with predation of good prospects exists if and only if  $X \leq \bar{X}$  and  $H < L + S$ .*
2. *When it occurs, predation against good prospects is always weak.*
3. *When  $X \leq \bar{X}$ ,  $H < L + S$  and  $X < \frac{(p_g - p_b)(H - L) + p_b S}{p_g(1 - p_b)}$ , all equilibria are pooling equilibria. Of these, all except  $F = F_g^D$  feature weak predation of good prospects.*

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<sup>18</sup>Formally, if a loan to good prospects is socially inefficient, then  $F_g^C > F_g^D$ , which implies  $F_b^C \geq F^C > F^D$ .

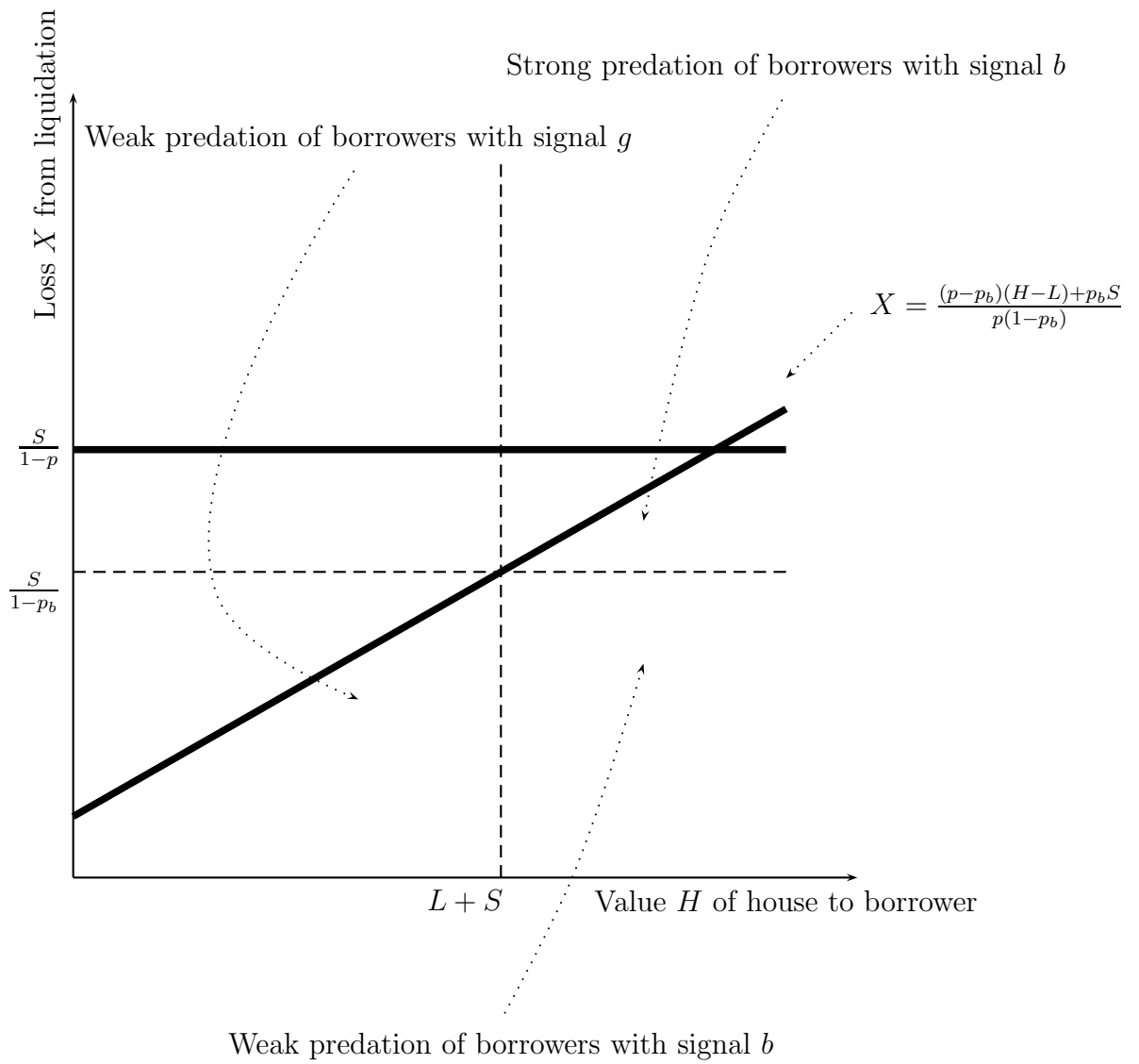


Figure 1: Pooling equilibrium under monopolistic lending

Figure 1 shows how the three forms of predation divide the parameter space. Collateral value  $H$  is on the horizontal axis, and social cost of foreclosure  $X$  on the vertical. To interpret the graph, recall that when  $H$  is high and loans can be fully collateralized, the requirement  $X \leq \bar{X}$  coincides with the social efficiency condition  $X \leq \frac{S}{1-p}$ . On the other hand, when  $H$  is lower then predation can only occur when the social loss associated with liquidation is also lower. The condition  $X \leq \bar{X}$  is represented by the lower envelope of the two bold lines.

The dashed horizontal line separates the region where lending to bad prospects is socially efficient (below) from the region where it is socially inefficient (above). Thus, under the lower envelope of the bold lines we see the three regions: weak predation of good types to the left of  $H = L + S$ , and predation of bad types to the right, strong above  $S/(1 - p_b)$  and weak below.

The figure summarizes our results so far. Predatory lending requires sufficiently low social cost of foreclosure, and predation of bad prospects also requires high collateralization. As collateralization decreases, repayment shifts toward the income state, thereby shifting the harm to good prospects. Socially destructive predation of bad prospects is possible if collateralization and social cost of foreclosure are high enough; everybody could be better off in this situation if lenders could commit not to lend after  $\sigma = b$ , but without a commitment device, their incentives not to lend are too weak when collateral is high.

To summarize, we find pooling equilibria that admit predation of both good and bad prospects, depending on collateral and social cost of foreclosure. We conclude this subsection with a brief discussion of comparative statics. First, observe that predatory lending cannot arise if the foreclosure cost  $X$  is very high. The reason is simple: if  $X$  is high, the lender recovers very little in foreclosure, and consequently is not prepared to lend to borrowers with bad prospects. Nonetheless, *moderate* foreclosure costs are entirely compatible with predation. That is, a lender is prepared to extend credit to an individual with little chance of repaying even if the costs of foreclosing are significant.

Turning to the effects of  $H$  and  $L$ :

**Corollary 6** *If  $H - L > S$  (respectively,  $H - L < S$ ) then any predation is predation of bad prospects (respectively, good prospects). For a given set of parameters, if there exists an equilibrium with predatory lending for house and loan value  $H$  and  $L$  then there exists an equilibrium with predatory lending whenever the house and loan values  $H'$  and  $L'$  are such that  $S \neq H' - L' > H - L$ .*

The first part of this result follows immediately from Corollary 1; the second part is an implication of Lemma 3. Greater collateralization, as measured by  $H - L$  — small loans against valuable houses — fosters predation, and in particular predation of bad prospects.

**Corollary 7** *For given  $H$  and  $L$ , if there exists an equilibrium with predatory lending when the surplus is  $S$  then there exists an equilibrium with predatory lending whenever the surplus  $S'$  is such that  $H - L \neq S' > S$ .*

This result follows immediately from Lemma 3. Again, to a large extent it conforms with conventional wisdom concerning predatory lending: the individuals most at risk are those who attach a high value to being able to borrow. That said, it is worth noting that an increase in  $S$  can move us from an area of the parameter space in which predation is against bad prospects to one in which it is against good prospects. The reason is that an increase in  $S$  is in many ways akin to a reduction in  $H - L$ , which, as we have just seen, is associated with predation of good prospects.

Finally, what happens as the lender's informational quality increases, i.e., as  $p_g$  increases and  $p_b$  decreases? Here two considerations are important. On the one hand, predation becomes harder to support. The reason is clear: predation arises only if the price at which the lender is prepared to supply funds to bad prospects is lower than the price that an uninformed borrower is willing to pay. As  $p_b$  decreases the lender becomes less willing to lend to bad prospects.

On the other hand, as the lender's information quality increases the "crime" that the lender is guilty of grows more serious. Recall that we have defined a predatory loan as one in which the lender *knowingly* makes a borrower worse off. As the lender's information improves the size of the expected welfare reduction likewise grows.

### *Other Equilibria*

To this point we have characterized all the pooling equilibria with lending, and identified a region of the parameter space, i.e.,  $H > L + S$  and  $X < S/(1 - p_b)$ , that admits only this type of equilibrium. In this subsection we consider the other possible types: pooling without lending, and lending only to good prospects.

Equilibria without lending are not particularly interesting, but for completeness it is worth mentioning that they are possible when lending after signal  $b$  is socially

inefficient. In such equilibria the borrowers reject the equilibrium offers, and interpret any deviations as coming from a lender who has observed the signal  $\sigma$  such that  $F_\sigma^D < F^D$ , and so reject these deviations also. However, provided that lending after signal  $\sigma = g$  is socially efficient, these equilibria are not very robust. In particular, under a slight perturbation of our model to one in which there is a small cost  $\gamma$  of making an offer, the no-lending equilibrium would fail the intuitive criterion.<sup>19</sup>

Of more interest are equilibria with lending to only good prospects. If  $H > L + S$  but lending after  $\sigma = b$  is socially inefficient, though lending after  $\sigma = g$  is still socially efficient, then separating equilibria are possible:

**Proposition 2** *If  $H > L + S$  and lending after the good signal is socially efficient but lending after the bad signal is socially inefficient, i.e.  $\frac{S}{1-p_b} < X \leq \frac{S}{1-p_g}$ , then there exist separating equilibria in which the lender offers  $F_g \in [\max\{F_b^D, F_g^C\}, \min\{F_g^D, F_b^C\}]$  after observing  $\sigma = g$ , and  $F_b \neq F_g$  such that  $F_b > F_b^D$  after observing  $\sigma = b$ ; and in which the borrower accepts  $F_g$  but rejects  $F_b$ . There are no other separating equilibria in which lending occurs.*

In these equilibria, all the positive-NPV loans are made, and all the negative-NPV loans are not, an appealing outcome. However, it is worth noting that with the exception of the equilibrium with  $F_g = \min\{F_g^D, F_b^C\}$ , the separating equilibrium of Proposition 2 are not at all robust. Specifically, consider a separating equilibrium with  $F_g < \min\{F_g^D, F_b^C\}$ . To support this equilibrium, the borrower must interpret an out-of-equilibrium offer  $\tilde{F} \in (F_g, \min\{F_g^D, F_b^C\})$  as coming from a lender who has observed  $\sigma = b$ . However, since  $\tilde{F} < F_b^C$ , this means the borrower believes a lender is offering a loss-making loan. This is clearly a problematic assumption to make. More precisely, under the small offer-cost perturbation of the model discussed above, no separating equilibrium with  $F_g < \min\{F_g^D, F_b^C\}$  satisfies the intuitive criterion (the intuition is similar to footnote 19 above).

We turn now to separating equilibria when  $H < L + S$ .

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<sup>19</sup>A proof is available from the authors upon request. For a rough intuition, take the case where  $H > L + S$  and consider an offer by the lender after signal  $g$  of  $\tilde{F} = F_b^D - \delta$ , where  $\delta$  is small. The signal  $g$  lender could argue: “Borrower, you should infer from this that I observed  $\sigma = g$ , since if I had instead observed  $\sigma = b$  I will lose money on this loan, and so would have no incentive to try to convince you that I instead observed  $\sigma = g$ .” Provided the borrower finds this speech convincing, he will accept the offer  $\tilde{F}$ , giving the lender positive profits. A similar argument applies in the case  $H < L + S$ .

**Proposition 3** *If  $H < L + S$ , and lending after the good signal is socially efficient,  $X \leq \frac{S}{1-p_g}$ , and moreover  $X \geq \frac{(p_g-p_b)(H-L)+p_bS}{p_g(1-p_b)}$ , then there exist separating equilibria in which the lender offers  $F_g = F_g^D$  after observing  $\sigma = g$ , and  $F_b \neq F_g$  such that  $F_b > F_b^D$  after observing  $\sigma = b$ ; and in which the borrower accepts  $F_g$  but rejects  $F_b$ . There are no other separating equilibria in which lending occurs.*

In this case, all loans that are made are positive-NPV but if lending to bad prospects is socially efficient then some positive-NPV loans are not made. Lending after the bad signal does not occur even if it is socially efficient because the deviating offer would have to lie between  $F_b^C > F_g$  and  $F_b^D < F_b$ , and the borrower's out-of-equilibrium beliefs associate such a deviation with  $\sigma = g$ .

## 4 Competition

As discussed, predatory lending is often attributed to monopolistic lending practices. In this section we explore whether or not predatory lending can occur in environments with several competing lenders.

In keeping with the main thrust of public and legislative concern, we focus on the case in which any predation is at the expense of bad prospects. From Corollary 1 we know that this is equivalent to the parameter condition  $H > L + S$ . It would be straightforward to extend our analysis to cover the case  $H < L + S$ .

Formally, we extend our model to one with  $n$  identical lenders. The number of lenders  $n$  should be thought of as indexing the *degree* of competition, with larger values corresponding to fiercer competition.

We assume that all lenders receive the same signal  $\sigma$  about the borrower. This is consistent with our main interpretations about the source of the lender's informational advantage (see earlier). After observing the signal, each of the  $n$  lenders simultaneously announces the face value at which they are willing to lend to the borrower.

Throughout, we restrict attention to symmetric (pure strategy) perfect Bayesian equilibrium. We adopt the standard assumption that if a borrower receives an identical offer from  $k$  different lenders, and chooses to accept this offer, then the probability that he accepts a loan from each individual lender is  $1/k$ .

### *A Benchmark Competitive Equilibrium*

A natural equilibrium to consider under competition is that in which lenders offer to provide funds at marginal cost, and make zero profits. That is, lenders offer  $F_g^C$  after  $\sigma = g$  and  $F_b^C$  after  $\sigma = b$ :

**Proposition 4** *If  $H - L < X$  (and so  $F_b^C > F_g^C$ ) then it is an equilibrium for lenders to offer  $F_\sigma^C$  after  $\sigma = b, g$ , and for the borrower to accept  $F_\sigma^C$  if  $F_\sigma^D \geq F_\sigma^C$ .*

*If  $H - L \geq X$  (and so  $F^C = F_b^C = F_g^C$ ) and  $X \leq \frac{S}{1-p}$ , then it is an equilibrium for lenders to offer  $F^C$  after both  $\sigma = g, b$ , and for the borrower to accept.*

### *Predation under Competition*

Is predation possible under competition? That is, is there a pooling equilibrium in which lenders offer  $F > F_b^D$ ? It turns out there are two separate cases to consider:

First, suppose that  $F_b^D > F_g^C$ . This condition is obviously satisfied if lending after a bad signal is socially efficient ( $F_b^D > F_b^C$ ), and even if lending after a bad signal is socially inefficient, it will still often be satisfied.

When this condition holds, no predation is possible when the degree of competition is large enough. This can be easily seen as follows.

Suppose to the contrary that equilibria with predation exist even as  $n$  grows arbitrarily large. That is, for  $n$  large there exists a pooling equilibrium in which the equilibrium face value  $F$  exceeds  $F_b^D$ . The probability that each lender's offer  $F$  is accepted,  $1/n$ , converges to 0 as  $n$  grows large. Consequently, even conditional on observing a good signal each lender's payoff from offering  $F$  shrinks to 0 as  $n \rightarrow \infty$ .

In contrast, a lender has the option of instead offering  $\tilde{F} = \frac{1}{2}(F_b^D + F_g^C)$  when he sees signal  $g$ . Since  $\tilde{F} < F_b^D$ , a borrower will accept this offer regardless of his off-equilibrium path beliefs. Moreover, the borrower will accept this offer in preference to the  $n - 1$  other offers of  $F$ . Finally, since  $F_b^D > F_g^C$  the lender's profits under this deviation are bounded away from 0. But this contradicts the observation above that each lender's equilibrium profits converge to 0.

The above argument establishes:

**Proposition 5** *Suppose that  $H > L + S$ . If  $F_b^D > F_g^C$  then there exists an  $\hat{n}$  such that predatory lending does not exist in any equilibrium when  $n > \hat{n}$ .*

The second case to consider is that in which  $F_b^D \leq F_g^C$ . Under such parameter configurations pooling (and thus predatory lending) equilibria exist under any degree of competition. Specifically, for any  $F \in [F_b^C, F^D]$  there is a pooling equilibrium in which all lenders offer  $F$  regardless of the signal observed, and the borrower accepts.

Once again, this is straightforward to see. Since both lenders and the borrower all have weakly positive payoffs under the behavior described, it suffices to check that no lender has a profitable deviation available. But for this, just note that clearly no offer  $\tilde{F} > F$  will be accepted; while if borrowers interpret offers  $\tilde{F} < F$  as indicating that the signal was  $b$ , then no offer  $\tilde{F} > F_b^D$  will be accepted. Finally, offers  $\tilde{F} \leq F_b^D$  are unprofitable even if they are accepted, since by assumption  $F_b^D \leq F_g^C$ .

Thus we have established:

**Proposition 6** *If  $F_b^D \leq F_g^C$  then for any number of lenders  $n \geq 2$  and  $F \in [F_b^C, F^D]$  there exists a pooling equilibrium in which all lenders offer  $F$  regardless of the signal observed, and the borrower accepts. There are no other pooling equilibria in which lending occurs. Except for the case in which  $F_b^C = F_g^C = F_b^D$ , all of these equilibria entail predation of bad prospects.*

When lending following a bad signal destroys sufficient value, then predatory lending cannot be precluded in equilibrium by competition. However, when loans cannot be fully collateralized, i.e.  $H - L < X$ , the plausibility of these equilibria is weak, as follows.

When  $H - L < X$  then  $F_g^C < F_b^C$ . In this case, no equilibrium with  $F > F_b^C$  satisfies the intuitive criterion. A rough argument is as follows.<sup>20</sup> Instead of making the equilibrium offer  $F$ , a lender always has the option of undercutting the competition and offering  $\tilde{F} \in (F_g^C, F_b^C)$ . If accepted, this will generate higher profits when competition is fierce ( $n$  large). So to support an equilibrium with  $F > F_b^C$ , the borrower must believe that some lenders make a loss-making offer  $\tilde{F} < F_b^C$  after seeing  $\sigma = b$ . By a similar argument, the remaining possibility  $F = F_b^C$  fails the intuitive criterion in the small offer-cost perturbation of the model that we have discussed previously.

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<sup>20</sup>A full proof is available from the authors.



One of the main messages delivered by our model is that predatory lending at the expense of borrowers with bad prospects is fundamentally associated with high collateral values. The above discussion only serves to reinforce this conclusion.

**Corollary 8** *The only circumstances under which predation of bad prospects is a robust equilibrium phenomenon under arbitrarily fierce competition is when loans can be fully collateralized, i.e.,  $H - L \geq X$ .*

## 5 Home-Improvement and House Purchase Loans

In our benchmark model, we assumed that the borrower spent the loan  $L$  on consumption generating a surplus of  $L + S$ . Importantly, while the borrower's house can be seized in the event of default, his consumption of  $L + S$  cannot be. However, in practice loans made for the purposes of house purchase and home-improvement figure prominently in criticisms of sub-prime lending practices. In this section we extend our basic model and argue that this focus is well-founded.

### *Home-Improvement Loans*

We start by analyzing home-improvement loans. We consider the following variant of our model. Instead of spending the loan  $L$  on consumption, the borrower spends the loan to increase his personal valuation of his home from  $H$  to  $H + \Delta H$ , and to increase the bank's recovery in foreclosure from  $H - X$  to  $H + \Delta H - X - \Delta X$ . The borrower's expected utility from taking the loan is now

$$p(H + \Delta H + I - F) + (1 - p) \max \{H + \Delta H - X - \Delta X - F, 0\},$$

while his expected utility if he does not take the loan is simply  $H + pI$ . Similarly, the lender's expected payoff from making a loan is

$$pF + (1 - p) \min \{H + \Delta H - X - \Delta X, F\}.$$

The key differences with respect to our standard model are that now the benefit to the loan is  $\Delta H$  instead of  $L + S$ , the borrower loses this benefit in the event of default, and an additional  $\Delta H - \Delta X$  is available for the lender to recover.

Parallel to before, straightforward algebra implies that the highest face value an uninformed borrower will agree to is

$$\hat{F}^D = \begin{cases} \frac{\Delta H - (1-p)(X + \Delta X)}{\frac{p\Delta H - (1-p)H}{p}} & \text{if } H \geq p(X + \Delta X) \\ \text{otherwise} & \end{cases}$$

while the lowest face value that a lender who has observed  $\sigma = b$  will agree to is

$$\hat{F}_b^C = \begin{cases} L & \text{if } H + \Delta H - X - \Delta X \geq L \\ \frac{L - (1-p_b)(H + \Delta H - X - \Delta X)}{p_b} & \text{otherwise.} \end{cases}$$

Our main result is that, other things equal, a home-improvement loan is more likely to allow predatory lending than a loan made for consumption purposes. By “other things equal” we mean that the home-improvement loan generates the same surplus to the borrower in the non-default state,  $\Delta H = L + S$ , and that the wedge between the borrower’s and lender’s valuations of the house remains unchanged,  $\Delta X = 0$ .

**Proposition 7** *Suppose  $\Delta H = L + S$  and  $\Delta X = 0$ . Then  $\hat{F}_b^C \leq \hat{F}^D$  whenever  $F_b^C \leq F^D$ , while the reverse is not true.*

That is, if predatory lending is a possible equilibrium outcome for a consumption loan, it is for a home-improvement loan also (all else remaining equal).

### *House Purchase Loans*

We turn now to loans made for the purposes of house purchase. Observe first that in our benchmark model such loans cannot possibly be predatory. If a borrower begins without a house, then in the zero-income state his utility from taking the loan is 0.<sup>21</sup> On the other hand, taking the loan must weakly improve the borrower’s welfare in the state where his income is  $I > 0$ , for otherwise he would not take the loan at all. Given this, there is no way for taking the loan to make the borrower worse off.

To allow for the possibility of predatory lending in this context, then, we must change our model to one in which the borrower’s utility in the low-income state is affected by whether or not he takes the loan. One possibility would be to extend the model to

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<sup>21</sup>The only case where this would not be true is if  $H - X > L$ . However, in this case the lender would prefer to buy the house directly.

cover more than one period, which would allow the borrower to derive surplus from living in his house before it is repossessed.<sup>22</sup> A second possibility, which is the one we adopt here, is simply to change the borrower’s possible income realizations from  $\{0, I\}$  to  $\{I'_1, I'_2\}$ , where  $I'_2 > I'_1 > 0$ .<sup>23</sup>

This model is in fact isomorphic to the home-improvement model we developed immediately above: simply take  $I'_1 = H$ ,  $I'_2 = L + H$ , let the borrower’s valuation of the house be  $H' = \Delta H$ , and let the lender’s valuation of the house be  $H' - X' = \Delta H - X - \Delta X$ .

By the same logic as Proposition 7, we can conclude that other things equal loans made for the purpose of house purchase are more exposed to predation than consumption loans backed by housing equity.

## 6 Policy Experiments

Consumers borrow in the context of considerable state and federal regulation. Some of this regulation originated in predatory-lending concerns, and some in other concerns. In this section we consider the equilibrium effects of three high-profile regulations: state-level legislation aimed at combatting predatory lending, the Federal Equal Credit Opportunity Act, and the Federal Community Reinvestment Act.

### *Interest-Rate Constraints*

There are two groups of laws constraining consumer-loan pricing: usury laws, which date back centuries, and more recent laws explicitly aimed at combatting predatory lending. Usury laws are hard constraints on interest rates, whereas the predatory-lending laws are, to some extent, soft constraints. The standard form of predatory lending laws is two-part: loans with sufficiently high interest rates or fees are labeled “high-cost,” and then the form of high-cost loans is tightly restricted.<sup>24</sup> The reg-

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<sup>22</sup>A model of this type is available from the authors upon request.

<sup>23</sup>We assume that  $I'_1 < L$ , so that as in the benchmark model the borrower defaults in the low-income state.

<sup>24</sup>See, for example, the North Carolina Predatory Lending Law of 1999, widely regarded as the model for other states’ laws. Loans of no more than \$300,000 with interest rates at least 8 percent above Treasuries are considered high cost, and with high-cost loans there can be no call provision, balloon payment, negative amortization, interest-rate increase after default, ad-

ulators' motive appears to be concern that the restricted features exploit borrower confusion, which is outside our model. But to the extent the restrictions discourage loans that trigger them, they are soft constraints on interest rates, which we can analyze.<sup>25</sup> Since these laws specifically target abusive lending, their equilibrium effect on predation is especially relevant to our analysis. For conciseness, we analyze only the region of the parameter space where predation of bad prospects is possible, i.e.,  $H > L + S$  and  $X \leq \bar{X}$ .

In some respects, the effects of putting a cap on the interest rate that a monopolist can charge are standard. If the cap is high it has no effect. If it is very low it eliminates the market. For some levels in between, the effect of the cap is to reduce the interest rate charged, while leaving the basic structure of the equilibrium unchanged — i.e., a straightforward wealth transfer from the lender to the borrower. In Appendix B we detail these effects; here, we focus on the effect of an interest rate cap  $\bar{F}$  in the interval  $(F_g^C, F_b^C)$ , where the effects are less standard.

Consider first the case in which lending to bad prospects is socially efficient, i.e.  $F_b^D > F_b^C$ . From Corollary 3 we know that, absent the interest rate cap, the only equilibria are pooling equilibria. In contrast, after the cap is introduced the creditor is no longer prepared to lend after observed  $\sigma = b$ , and so a pooling equilibrium no longer exists. Instead, there is a unique separating equilibrium in which the lender offers  $F_g = \bar{F}$  to good prospects, and they accept. Consequently the cap has eliminated predation of bad prospects while preserving lending to good prospects. However, overall social surplus is reduced, since the predatory loans to bad prospects were socially efficient.

Next, consider the case in which lending to bad prospects is socially inefficient, i.e.  $F_b^D < F_b^C$ . Absent the interest cap there exist both pooling equilibria featuring predation, and separating equilibria in which good prospects receive loans. As above, the interest cap eliminates the pooling equilibrium, and leaves only a separating equilibrium in which the lender offers  $F_g = \bar{F}$  to good prospects. Again, the cap has eliminated predation of bad prospects while preserving lending to good prospects. This time, though, overall social surplus is also increased.

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vance payments or modification or deferral fees. Furthermore, there can be no lending without home-ownership counseling, or without due regard to repayment ability (though repayment ability is presumed if the borrower's debt payments are  $\leq 50\%$  of his current income) (see <http://www.responsiblelending.org/pdfs/longsumm.pdf>) The Federal Home Ownership and Equity Protection Act (HOEPA) of 1994 is similar.

<sup>25</sup>There is evidence that anti-predatory lending laws have indeed reduced the volume of high-cost loans. See, e.g., Ernst, Farris and Stein [10], Elliehausen and Staten [9], and Quercia, Stegman and Davis [24], which debate the effect of North Carolina's recent anti-predatory lending law.

### *The Community Reinvestment Act (CRA)*

In the words of the official website, the Community Reinvestment Act of 1977 (CRA) “is intended to encourage depository institutions to help meet the credit needs of the communities in which they operate.”<sup>26</sup> It operates by tracking banks’ local credit provision, and weighing it when considering applications for deposit facilities.<sup>27</sup> Thus, the CRA adds a benefit to local lending, which amounts in our model to lowering banks’ break-even expected returns below zero.

This law is not a response to predatory lending but, as others have noted,<sup>28</sup> it may have unintended consequences in that direction. To the extent it succeeds, the CRA induces lenders to provide credit to communities they previously ignored. By our analysis, the consequences of predation depend on whether other lenders are already active locally. If not, then the CRA delivers the monopoly case and its associated dangers of predation. But if other banks are already lending then the CRA creates or increases competition, and therefore tends to decrease predation.

It is notable that this decrease in predation could involve a decrease in total lending; if lending to bad prospects is socially inefficient, then (see Proposition 5) it may arise under monopoly but not competition. So the CRA could *reduce* lending, which seems contrary to the spirit of the law but is actually beneficial to the affected borrowers. Similarly, while it may be most desirable to foster lending where none exists, this is when the danger of inadvertently fostering predation is greatest.

All of these effects are subject to the caveat that the informational advantage of a lender just starting to lend to a community is likely to start small and then grow with experience.

### *The Equal Credit Opportunity Act (ECOA)*

The Equal Credit Opportunity Act (ECOA) of 1974 (amended 1976) combats discriminatory lending. In particular, it “prohibits creditors from discriminating against credit applicants on the basis of race, color, religion, national origin, sex, marital status, age, or because an applicant receives income from a public assistance program.”<sup>29</sup>

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<sup>26</sup>[www.ffiec.gov/cra/history.htm](http://www.ffiec.gov/cra/history.htm)

<sup>27</sup>Ibid.

<sup>28</sup>For example, Marisco [21].

<sup>29</sup>See [www.usdoj.gov/crt/housing/housing\\_ecoa.htm](http://www.usdoj.gov/crt/housing/housing_ecoa.htm).

This law is not about predatory lending but could be relevant to it nonetheless. To the extent that the lender's signal about future income correlates with one of these partitions, the ECOA prevents him from conditioning on it. To gauge the effect on predation, we impose this constraint on our model.

Suppose the model's  $b$  and  $g$  now stand for *blue* and *green*, respectively, and the lender's private information is that blue borrowers are more likely to have low incomes in the future. That is, observing that a borrower is blue is akin to observing  $\sigma = b$  in our model. However, whether a consumer is blue or green is publicly observable and verifiable. Finally, suppose that the ECOA obliges the lender not to condition on blue *vs.* green, so his offer must be either the same  $F$  to both or no  $F$  at all.

If the lender is a monopolist, it is easily seen that the regulation expands the incidence of predation. Without the regulation, we know that predation can arise if and only if  $F_b^C \leq F^D$ . But with the regulation forcing the same offer to both types, the only equilibrium with lending is that in which the lender offers  $F^D$ , and it exists if and only if  $F^C \leq F^D$ . And aside from the knife-edge case  $H = L + S$ , the equilibrium is necessarily predatory for either blue or green. The predatory region of the parameter space has annexed the region where  $F^C \leq F^D < F_b^C$  because while the creditor would rather *not* lend after  $\sigma = b$ , he is willing to pay this price for the right to profit after  $\sigma = g$ .

More striking, perhaps, is that under some circumstances in which competition eliminates predatory lending, ECOA-style regulation can allow predation to survive. When lenders compete subject to this regulation, lending at a face value  $F > F^C$  cannot occur in equilibrium, because any one lender can slightly undercut and capture the whole market. There is no longer any disincentive to undercut provided by borrowers' off-equilibrium beliefs about  $\sigma$ , because the regulation removes all information about  $\sigma$  from the offer. Thus the only equilibrium with lending after either signal is at a face value of  $F^C$ , and this equilibrium exists whenever  $F^C \leq F^D$ . This is predatory if either  $F_b^D$  or  $F_g^D$  is strictly below  $F^C$ .<sup>30</sup>

To summarize, laws against discriminatory lending can have an unintended adverse consequence. The incidence of welfare-reducing lending can rise, even under arbitrarily stiff competition.

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<sup>30</sup>Appendix C gives a numerical example.

## 7 Conclusion

Consumers tend to borrow from very active creditors with long and wide experience. It is therefore likely that creditors have private information about borrowers' prospects. Starting from this observation, we provide both a definition and a working model of predatory lending.

Overall, our analysis associates predatory lending with monopolistic lending and high collateral values. Loans for creating collateral, such as those for home purchase and improvement, are particularly susceptible. Competition generally ameliorates predation, but loans that are fully collateralized continue to risk predation when lending to borrowers with bad prospects is socially inefficient.

In an ideal world, predatory lending of the form predicted by our model would be eliminated if lenders were forced to disclose their private information to borrowers. For example, one can imagine a law that stipulates that loan documents include a statement of the form: "Our experience indicates that borrowers who share your characteristics default on their loans with a probability of 20 percent." Of course, whether or not such a regulation is actually enforceable is a quite different matter.

In practice, the main legislative response to predatory lending has been to subject high-interest consumer loans to tight scrutiny; and legal constraints are placed on the use of an assortment of practices, such as balloon payments, which legislators believe facilitate predation. To the extent to which these constraints function as a soft interest-rate ceiling, our model predicts that such legislation can be effective in reducing the incidence of predation. It is worth reiterating, however, that successful implementation of such a policy requires that the implicit interest-rate ceiling is set neither too high, nor too low.

Another regulation, the Community Reinvestment Act, serves other purposes but we find that it relates to predation as well, both positively and negatively. If it increases competition then it generally reduces both the incidence of predation and the volume of lending. But if it produces a monopoly lender then it can increase both the incidence of predation and the volume of lending. This means that the initial conditions of the community are key to the effect of the CRA on predation, and it also means that a reduction in lending could indicate a positive outcome.

The Equal Credit Opportunity Act combats discrimination, but its direct positive effect may compete with an unintended indirect negative effect. To the extent the prohibited dimensions of discrimination correspond to the dimensions of lenders' pri-

vate signals, the prohibition may cause predation, even under strong competition. The magnitudes of these regulatory effects are a promising area for future research.



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## A Appendix: Omitted Proofs

*Proof of Lemma 3*

Observe that

$$\bar{X} \equiv \min \left\{ \frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)}, \frac{S}{1-p} \right\} = \begin{cases} \frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)} & \text{if } H-L < \frac{S}{1-p} \\ \frac{S}{1-p} & \text{otherwise} \end{cases}.$$

First, consider the case in which  $H-L \geq \frac{S}{1-p}$  and so  $\bar{X} = \frac{S}{1-p}$ . Consequently, if  $X \leq \bar{X} = \frac{S}{1-p}$  then (i) the loan can be fully collateralized, so  $F_b^C = F^C$ , and (ii)  $F^C \leq F^D$ . Consequently  $F_b^C \leq F^D$ . Conversely, if  $X > \bar{X}$  then  $F_b^C \geq F^C > F^D$ .

Second, consider the case in which  $H-L < \frac{S}{1-p}$  and so  $\bar{X} = \frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)}$ . As a preliminary, observe that in this range

$$\frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)} > \max \left\{ \frac{H-L-S}{p}, H-L \right\}, \quad (5)$$

as follows. The condition  $H-L < \frac{S}{1-p}$  is equivalent to  $\max \left\{ \frac{H-L-S}{p}, H-L \right\} = H-L$ . Moreover, if  $H-L < \frac{S}{1-p}$  then

$$\frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)} - (H-L) = \frac{-p_b(1-p)(H-L) + p_b S}{p(1-p_b)} > 0.$$

Given inequality (5), if  $X > \bar{X}$  then  $X > \max \left\{ \frac{H-L-S}{p}, H-L \right\}$ . But for such values the pooling condition  $F^D \geq F_b^C$  is

$$\frac{L+S-(1-p)H}{p} \geq \frac{L-(1-p_b)(H-X)}{p_b} \quad (6)$$

which rewrites to

$$X \leq \frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)} = \bar{X}.$$

Thus no pooling equilibrium exists.

On the other hand, if  $X \leq \bar{X}$  then since  $H-L < \frac{S}{1-p}$ , it follows that  $\bar{X} = \frac{(p-p_b)(H-L) + p_b S}{p(1-p_b)} < S/(1-p)$ , and so  $F^C \leq F^D$ . If  $X \leq \max \left\{ \frac{H-L-S}{p}, H-L \right\} =$

$H - L$  then the loan is fully collateralized and so  $F_b^C = F^C \leq F^D$ . Finally, if  $X > \max \left\{ \frac{H-L-S}{p}, H-L \right\}$ , then  $F_b^C \leq F^D$  is equivalent to inequality (6), which holds since  $X \leq \bar{X}$ .

*Proof of Corollary 5*

Throughout, we make use of the observation that since  $F_g^D < F_b^D$ , a borrower will accept an offer of  $\tilde{F} = F_g^D - \varepsilon$  regardless of his beliefs.

First, observe that there can be no separating equilibrium in which only borrowers with bad prospects receive a loan. For if this were the case, lending to bad prospects would need to be weakly socially efficient, and so lending to good prospects would be strongly socially efficient, i.e.,  $F_g^C < F_g^D$ . But then the offer  $\tilde{F}$  is a strictly profitable deviation for the lender after  $\sigma = g$ .

Second, if  $F_b^C < F_g^D$  then there is no equilibrium in which no lending occurs. This is almost immediate: since  $F_g^C \leq F_b^C < F_g^D < F_b^D$ , the offer  $\tilde{F}$  is strictly profitable deviation for the lender after both signals.

Third, if  $F_b^C < F_g^D$  then there is no separating equilibrium in which only borrowers with good prospects receive a loan. For suppose such an equilibrium existed, with the good prospects receiving a loan with face value  $F_g$ . Clearly  $F_g \leq F_g^D$ . In fact, it must be that  $F_g = F_g^D$ , since otherwise the lender could profitably deviate by offering  $\tilde{F}$ . Finally, it must be that  $F_g \geq F_b^C$ , since otherwise the lender could profitably offer  $F_g$  after observing  $\sigma = b$ .

The above establishes that when  $F_b^C < F_g^D$  the only equilibria are pooling. Finally, by an argument exactly analogous to Lemma 3, the condition  $F_b^C < F_g^D$  is equivalent to  $X < \min \left\{ \frac{(p_g - p_b)(H-L) + p_b S}{p_g(1-p_b)}, \frac{S}{1-p_g} \right\}$ . Moreover, since  $H - L < S < \frac{S}{1-p_g}$ , in this range  $\min \left\{ \frac{(p_g - p_b)(H-L) + p_b S}{p_g(1-p_b)}, \frac{S}{1-p_g} \right\} = \frac{(p_g - p_b)(H-L) + p_b S}{p_g(1-p_b)}$ .

*Proof of Proposition 2*

First, note that  $F_g^C \leq F_g^D$  given it is socially efficient to lend after signal  $g$ . Furthermore, we know that  $F_g^C \leq F_b^C$  and  $F_b^D < F_g^D$ . Finally,  $F_b^D < F_b^C$  by the assumption

that lending is socially inefficient after the signal  $\sigma = b$  is observed. So the interval  $[\max\{F_b^D, F_g^C\}, \min\{F_g^D, F_b^C\}]$  is non-empty.

Next, we argue that for any pair  $(F_g, F_b)$  with  $F_g \in [\max\{F_b^D, F_g^C\}, \min\{F_g^D, F_b^C\}]$ ,  $F_b \neq F_g$  and  $F_b \geq F_b^D$ , a separating equilibrium of the following form exists: the lender offers  $F_g$  and  $F_b$  after signals  $\sigma = g, b$  respectively, and the borrower accepts the offer  $F_g$  but rejects the offer  $F_b$ . Since  $F_g \leq F_g^D$  and  $F_b \geq F_b^D$ , the borrower's strategy clearly constitutes a best response. For the lender, it is not profitable to offer  $F_b$  after  $\sigma = g$ , since it is rejected while  $F \geq F_g^C$  is profitable and is accepted; and it is not profitable to offer  $F_g$  after  $\sigma = b$ , since  $F \leq F_b^C$ . It remains only to consider lender deviations to offers  $\tilde{F} \notin \{F_b, F_g\}$ . We assume that the borrower believes out-of-equilibrium offers of this type come only from a lender who has seen a bad signal. Consequently, under these beliefs it is a best response for the borrower to reject any offer  $\tilde{F} \geq F_b^D$ . So the only offers  $\tilde{F} \notin \{F_b, F_g\}$  that would be accepted are those below  $F_b^D$ . But since  $F_b^D \leq F$  the lender prefers to offer  $F_g$  after  $\sigma = g$ . Finally, after  $\sigma = b$  the lender prefers having the offer  $F_b$  rejected to having an offer  $\tilde{F} < F_b^D \leq F_b^C$  accepted.

Finally, we argue there is no other separating equilibrium in which lending occurs. If it is strictly socially inefficient to lend after a bad signal,  $X > \frac{S}{1-p_b}$ , then there cannot be a separating equilibrium in which  $F_b$  is accepted. Therefore, in a separating equilibrium in which lending occurs, it must be that  $F_g$  is accepted. Borrower and lender individual rationality imply  $F_g \in [F_g^C, F_g^D]$ . Moreover,  $F_g \leq F_b^C$  since otherwise the lender would deviate and offer  $F_g$  after  $\sigma = b$ . Finally, we must have  $F \geq F_b^D$ : for if instead  $F < F_b^D$ , after  $\sigma = g$  a lender would prefer to offer  $\tilde{F} \in (F_g, F_b^D)$  instead of  $F_g$ , since the borrower is sure to accept any offer below  $F_b^D$ .

### *Proof of Proposition 3*

Observe first that when  $H < L + S$ , the condition  $\frac{(p_g - p_b)(H - L) + p_b S}{p_g(1 - p_b)} \leq X$  is equivalent to  $F_g^D \leq F_b^C$  — see the proof of Corollary 5. From Corollary 5, we also know that if  $\frac{(p_g - p_b)(H - L) + p_b S}{p_g(1 - p_b)} > X$  then no separating equilibrium exists.

Suppose now that  $\frac{(p_g - p_b)(H - L) + p_b S}{p_g(1 - p_b)} \leq X$  and so  $F_g^D \leq F_b^C$ . We claim an equilibrium exists in which the lender offers  $F_g = F_g^D$  after signal  $g$  and  $F_b > F_b^D$  after signal  $b$ , and the borrower accepts  $F_g$  but not  $F_b$ . Given the offers, the borrower's acceptance behavior is clearly a best response. By construction, offering  $F_g = F_g^D$  is weakly

profitable for a lender who has seen  $g$ , but weakly unprofitable for a lender who has seen  $b$ . Finally, if the borrower's off-equilibrium-path beliefs are that an offer above  $F_g^D$  comes from a lender who has observed the signal  $g$ , then no offer higher than  $F_g^D$  will be accepted. Meanwhile, deviating to an offer below  $F_g^D$  is clearly unprofitable for a lender who has seen  $g$ , and since  $F_g^D \leq F_b^C$  is also unprofitable for a lender who has seen  $b$ .

*Proof of Proposition 4*

By construction the borrower's accept/reject decision is a best response, and the lender makes zero profits. If the lender deviates by offering  $\tilde{F} > F_\sigma^C$  after  $\sigma$ , the borrower will reject the offer since he has  $n - 1$  more attractive offers to choose among. Clearly no profitable downwards deviations are possible.

*Proof of Proposition 7*

A numerical example suffices to establish that  $\hat{F}_b^C \leq \hat{F}^D$  can hold even when  $F_b^C > F^D$ . Consider the following:  $L = \$100K$ ,  $H = \$120K$ ,  $X = \$23K$ ,  $I = \$120K$ ,  $S = \$14K$ ,  $p_g = 0.7$ ,  $p_b = 0.3$ ,  $p = 0.4$ . Under these parameters,  $F^D = \max \left\{ 114 - 0.6 \times 23, \frac{114 - 0.6 \times 120}{0.4} \right\} = \$105K$  and  $F_b^C = \max \left\{ 100, \frac{100 - 0.7 \times (120 - 23)}{0.3} \right\} = \$107K$ , so that  $F_b^C > F^D$ . On the other hand,  $\hat{F}^D = \max \left\{ 114 - 0.6 \times 23, \frac{0.4 \times 114 - 0.6 \times 120}{0.4} \right\} = \$100.2K$  and  $\hat{F}_b^C = \max \left\{ 100, \frac{100 - 0.7 \times (120 + 114 - 23)}{0.3} \right\} = \$100K$ , so that  $\hat{F}_b^C \leq \hat{F}^D$ .

We next prove that whenever  $F_b^C \leq F^D$  then  $\hat{F}_b^C \leq \hat{F}^D$  holds also. The proof requires consideration of three distinct cases, each of which is straightforward:

**Case:**  $H - \Delta H \geq pX$

Here,  $H \geq pX$  also, so  $F^D = \hat{F}^D = \Delta H - (1 - p)X$ . Certainly  $\hat{F}_b^C \leq \hat{F}_b^C$  (this is strict if  $H + \Delta H - X < L$ ). So if  $F_b^C \leq F^D$  then  $\hat{F}_b^C \leq \hat{F}^D$  also.

**Case:**  $H - \Delta H < pX$  and  $H - X \geq L$

First, note that  $H \geq pX$ ; for if  $H < pX$ , then  $L \leq H - X < 0$ . Second, observe that certainly  $H + \Delta H - X \geq L$ . So  $\hat{F}_b^C = L$  and  $\hat{F}^D = \Delta H - (1 - p)X$ . In this case,

$\hat{F}_b^C \leq \hat{F}^D$  holds since

$$L \leq H - X = H - pX - (1 - p)X < \Delta H - (1 - p)X.$$

**Case:**  $H - \Delta H < pX$  and  $H - X < L$

Here,

$$\begin{aligned} F^D &= \frac{\Delta H - (1 - p)H}{p} \\ F_b^C &= \frac{L - (1 - p_b)(H - X)}{p_b} \end{aligned}$$

If  $H + \Delta H - X < L$  then  $\hat{F}_b^C = \frac{L - (1 - p_b)(H + \Delta H - X)}{p_b}$  and so

$$F_b^C - \hat{F}_b^C = \frac{1 - p_b}{p_b} \Delta H$$

while

$$\begin{aligned} F^D - \hat{F}^D &\leq \frac{\Delta H - (1 - p)H}{p} - \frac{p\Delta H - (1 - p)H}{p} = \frac{1 - p}{p} \Delta H \\ &\leq F_b^C - \hat{F}_b^C \end{aligned}$$

since  $p_b < p$ . Thus  $\hat{F}_b^C \leq \hat{F}^D$  whenever  $F_b^C \leq F^D$ .

If  $H + \Delta H - X \geq L$  and  $H < pX$  then  $\hat{F}_b^C = L$  and  $\hat{F}^D = \frac{p\Delta H - (1 - p)H}{p}$ , and so  $\hat{F}_b^C \leq \hat{F}^D$  holds since

$$pL - p\Delta H \leq p(H - X) < -(1 - p)H.$$

Finally, if  $H + \Delta H - X \geq L$  and  $H \geq pX$  then

$$\begin{aligned} \hat{F}^D &= \Delta H - (1 - p)(X + \Delta X) \\ \hat{F}_b^C &= L. \end{aligned}$$

So we must show that if

$$\frac{L - (1 - p_b)(H - X)}{p_b} \leq \frac{\Delta H - (1 - p)H}{p}$$



then

$$L \leq \Delta H - (1 - p) X.$$

Rewriting the first inequality,

$$pL \leq p_b \Delta H + (p - p_b) H - p(1 - p_b) X.$$

It is thus sufficient to show that

$$p_b \Delta H + (p - p_b) H - p(1 - p_b) X \leq p(\Delta H - (1 - p) X),$$

i.e.,

$$(p - p_b) H + (p_b - p) \Delta H \leq (p(1 - p_b) - p(1 - p)) X,$$

i.e.,

$$H - \Delta H \leq pX,$$

which does indeed hold. So again,  $\hat{F}_b^C \leq \hat{F}^D$  whenever  $F_b^C \leq F^D$ .

## B Appendix: Analysis of the effect of interest-rate constraints

In the model, an interest-rate cap is an upper bound  $\bar{F}$  on allowable face values. We consider its effect first when lending to bad prospects is socially efficient, i.e.  $F_b^D > F_b^C$ . In this case we have  $F_b^C < F_b^D < F^D$ , and (from Corollary 3) the only equilibria are pooling equilibria with  $F \in [F_b^D, F^D]$ . The question is what effect  $\bar{F}$  has on the interest rate or on the type of equilibrium, and the answer depends on which interval it falls in:

1.  $\bar{F} > F^D$ : The cap has no effect.
2.  $F^D > \bar{F} > F_b^D$ : The range of pooling equilibria shrinks to  $[F_b^D, \bar{F}]$ , but there is no separating equilibrium.
3.  $F_b^D > \bar{F} > F_b^C$ : There is a pooling equilibrium at  $\bar{F}$  (but no others). There is no separating equilibrium.
4.  $F_b^C \geq \bar{F} \geq F_g^C$ : There is no pooling equilibrium. Instead there is a unique separating equilibrium in which the lender offers  $F_g = \bar{F}$  to good prospects.
5.  $F_g^C > \bar{F}$ : There is no lending.

Now suppose lending after the bad signal  $b$  is socially inefficient ( $F_b^D < F_b^C$ ). Absent an interest rate cap, there exists both a range of pooling equilibria  $[F_b^C, F^D]$ , and a range of separating equilibria in which the lender offers  $F_g \in [\max\{F_b^D, F_g^C\}, \min\{F_b^C, F_g^D\}] = [\max\{F_b^D, F_g^C\}, F_b^C]$  (given our parameter assumptions) to good prospects.

The effect of an interest rate cap on the *pooling* equilibria is as follows:

1.  $\bar{F} > F^D$ : The cap has no effect.
2.  $F^D > \bar{F} > F_b^C$ : The range of pooling equilibria shrinks to  $[F_b^C, \bar{F}]$ .
3.  $F_b^C > \bar{F}$ : There is no pooling equilibrium.

The effect of an interest rate cap on the *separating* equilibria is as follows:

1.  $\bar{F} > F_b^C$ : The cap has no effect.
2.  $F_b^C > \bar{F} > \max\{F_b^D, F_g^C\}$ : The range of separating equilibria shrinks to  $[F_b^C, \bar{F}]$ .
3.  $F_b^D \geq \bar{F} \geq F_g^C$ : There is a separating equilibrium at  $F_g = \bar{F}$ .
4.  $F_g^C > \bar{F}$ : There is no lending.

## C Appendix: Numerical example illustrating the potential effects of ECOA

A borrower has a house he values at \$120K but from which a lender would derive only \$97K in the event of foreclosure. He seeks a loan of \$100K, from which he will derive a net surplus of \$15K. The income he has available for meeting the loan repayments over the life of the loan is either  $I = \$150K$  or  $\$0K$ ; the probability of the former is given by  $p_g = .7$ ,  $p = 0.4$ ,  $p_b = .3$ .

Given these parameter values,  $F^D = \max \left\{ 115 - .6 \times 23, \frac{115 - .6 \times 120}{.4} \right\} = \$107.5K$  and  $F_b^C = \max \left\{ 100, \frac{100 - .7 \times 97}{.3} \right\} = \$107$ . Since  $F_b^C < F^D$ , predation of blue borrowers is an equilibrium outcome under monopolistic lending (see Proposition 1).

Similarly,  $F_b^D = \max \left\{ 115 - .7 \times 23, \frac{115 - .7 \times 120}{.3} \right\} = \$103.33K$  and  $F_g^C = \max \left\{ 100, \frac{100 - .3 \times 97}{.7} \right\} = \$101.29$ . Since  $F_g^C < F_b^D$ , a sufficient degree of competition eliminates predatory lending (see Proposition 5).

Finally,  $F^C = \max \left\{ 100, \frac{100 - .6 \times 97}{.4} \right\} = \$104.5$ . Since  $F_b^D < F^C < F^D$ , predatory lending occurs under the ECOA, even under competition.