July 2008

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Supplement to "Predatory mortgage lending"

The key assumption in our model is that the incumbent lender has an informational advantage over the borrower. In the main paper we restrict attention to the most extreme case: at date 1, the incumbent can perfectly foresee the borrower's date 2 income, while the borrower knows only that her probability of high date 2 income is p. That is, the incumbent has perfect foresight. Here, we relax this assumption and instead model the incumbent as receiving an informative but imperfect signal of date 2 income. Our results are qualitatively unaffected. Moreover, weakening the incumbent's information has two opposing effects on the incidence of predatory lending. On the one hand, imperfect foresight means that the lender anticipates a smaller welfare loss for the borrower, since there is some chance she has high date 2 income and can repay the loan. This effect ameliorates predation. But on the other hand, imperfect foresight makes a lender more willing to lend to a borrower with a bad signal, since again there is some chance she will have high date 2 income, and this greater willingness to lend can lead to more predation.

Formally, we assume that the incumbent lender receives a signal $\sigma \in \{I, K\}$. We denote borrowers for whom the incumbent observes $\sigma = I$ (respectively, $\sigma = K$) as good-signal borrowers (respectively, bad-signal borrowers). We assume that $\Pr(\sigma = I | y_2 = I) = \Pr(\sigma = K | y_2 = K) = 1 - \varepsilon$, where $\varepsilon \in [0, \frac{1}{2})$. The case $\varepsilon = 0$ coincides with the model of the main text, while higher values of ε correspond to a reduction in the incumbent's information advantage. We write $\theta \equiv \Pr(y_2 = K | \sigma = K) = \frac{(1-p)(1-\varepsilon)}{(1-p)(1-\varepsilon)+p\varepsilon}$ and $\phi \equiv \Pr(y_2 = I | \sigma = I) = \frac{p(1-\varepsilon)}{p(1-\varepsilon)+(1-p)\varepsilon}$ for the incumbent's posterior beliefs.

Lemma 1 *The incumbent attaches a higher probability to $y_2 = K$ (respectively, $y_2 = I$) after observing signal $\sigma = K$ (respectively, $y_2 = I$),i.e., $\theta > 1 - \phi$.*

Proof: We must show $\frac{(1-p)(1-\varepsilon)}{(1-p)(1-\varepsilon)+p\varepsilon} > \frac{(1-p)\varepsilon}{p(1-\varepsilon)+(1-p)\varepsilon}$, or equivalently, $(p(1-\varepsilon) + (1-p)\varepsilon)(1-\varepsilon) > \varepsilon((1-p)(1-\varepsilon) + p\varepsilon)$. This is indeed the case since $1-\varepsilon > \varepsilon$ (in turn, since $\varepsilon < 1/2$). **QED**

Below, we discuss how our main results on the existence and severity of predation change as a function of ε. Specifically, we revisit Propositions 1, 2, 4, 7 and 8.

Proposition 1

An immediate consequence of the above lemma is that Proposition 1 extends to the case of $\varepsilon > 0$ as well, implying that the predation of good-signal borrowers is impossible . The proof of the Proposition holds as it is with the amendment that in any equilibrium in which borrowers receive the same refinancing terms independent of the incumbent's signal, given $\theta > 1 - \phi$, the expected payoff of good-signal borrowers is higher than for bad-signal borrowers.

To see this more formally, let Δ_K and Δ_I stand for the difference in the borrower's payoff due to lending, for date 2 income realization $y_2 = K$ and $y_2 = I$, respectively. From the existing (perfect foresight) proof, $\Delta_K \leq \Delta_I$. Therefore, given $\theta > 1 - \phi$, we have

$$\theta\Delta_K + (1-\theta)\Delta_I \leq (1-\phi)\Delta_K + \phi\Delta_I.$$

The left- and righthand sides are the difference in the borrower's expected payoff due to lending conditional on $\sigma = K$ and $\sigma = I$, respectively. In any equilibrium in which good and bad prospects receive the same refinancing terms, $p\Delta_K + (1-p)\Delta_I \geq 0$, since otherwise the uninformed borrower would decline the offer. So $(1-\phi)\Delta_K + \phi\Delta_I$ must be weakly positive, i.e., the good-signal borrower must be better off.

Proposition 2

We show that for any given refinancing terms the welfare loss of a bad-signal borrower decreases as the incumbent's information worsens, i.e. ε increases. Consequently, the severity of predation in Proposition 2 decreases as ε increases. Moreover, we show that it follows that the parameter set under which predation occurs shrinks.

Let Δ_K denote the borrower's welfare loss due to refinancing if $y_2 = K$, with Δ_I defined similarly. Then, conditional on a bad signal, $\sigma = K$, the expected payoff difference for the borrower is

$$\theta\Delta_K + (1-\theta)\Delta_I.$$

Given that $\frac{\partial\theta}{\partial\varepsilon} < 0$, this expression is increasing in ε, holding the refinancing terms constant. Moreover, an increase in ε has no impact on whether an uninformed borrower accepts a given set of refinancing terms, and weakly increases the lender's willingness to lend to a bad-signal borrower. Hence whenever predation exists, its severity decreases as ε increases.

The borrower benefits from refinancing because it allows her to retain her house if $y_2 = I$, worth a surplus of X, but loses from refinancing if $y_2 = K$, since in this case she simply increases her payment to the lender. When X is small[1] the lender can set the refinancing terms so that the uninformed borrower is indifferent between refinancing and immediate foreclosure, and in this case refinancing is certainly predatory. However, when X is large the uninformed borrower strictly benefits from refinancing because even if the lender extracts all the borrower's income, the benefit from keeping her house still outweighs the increase in payments. As we show in the main text, when the lender has perfect foresight predation still always arises, since a bad-prospects borrower has no chance of keeping her house. However, in the imperfect foresight case predation may be impossible for X large enough, as we formally show now. For conciseness, we restrict attention to the case $I \leq H$.

Define $\overline{X}$ as the borrower surplus associated with the house such that $p\overline{X} = I + K + S_K - \min\{RL_0, H\}$. So on the one hand, for $X \leq \bar{X}$ the lender can find refinancing terms that make an uninformed borrower indifferent between refinancing and immediate default. Under such terms $p\Delta_I + (1-p)\Delta_K = 0$, and so refinancing changes the bad-signal borrower's welfare by $(1-\theta)\Delta_I + \theta\Delta_K < 0$. So for $X < \bar{X}$ predation is possible, independent of the lender's information advantage.

On the other hand, if $X > \bar{X}$ then the borrower accepts even the most profitable refinancing terms, $P_1 = K$ and $P_2 = I$. Refinancing changes the bad-signal borrower's welfare by

$$-I - K + \theta X - S_K - (-\min\{RL_0, H\}) = \theta X - p\bar{X}.$$

This is increasing in ε, with $\theta \to p$ as $\varepsilon \to 1/2$. So for any $X > \bar{X}$ there exist values of ε such that the bad-signal borrower benefits from refinancing, and predation is impossible.

Proposition 4

In the perfect foresight case ($\varepsilon = 0$) there are two inequalities, $H \geq \overline{P}_2 \equiv (RL_0 - I)R + M$ and $S - (1-p)X \geq 0$, that are in combination necessary and sufficient for predation to exist. The second condition is still necessary when $\varepsilon > 0$, as it says that an uninformed borrower values the expenditure enough to justify a $1-p$ probability of losing her house. However, the first condition, which guarantees the lender can at least recover his additional loan even from a bad-prospects borrower, is no longer

[1] As discussed in the main text, we analyze the case of X small in an earlier draft.

necessary. The reason is that now a bad-signal borrower has a $1-\theta$ chance of high income at date 2, and the lender is prepared to take a loss on borrowers who end up with low-income, provided he makes an offsetting profit on borrowers who have high income. This effect becomes more important as the probability that a bad-signal borrower has high date 2 income increases, i.e., as ε increases. Since the conditions for predation become weaker, an increase in ε can lead to an increase in predation.

On the other hand, the effects discussed in Proposition 2 are present here as well. Specifically, if the binding constraint on the lender's highest profit when $\varepsilon = 0$ is the borrower's income, then an increase in ε can potentially eliminate predation: with a high enough ε a bad-signal borrower has a good chance of retaining her house, and this outweighs the increase in payments she makes to the lender.

Consequently, the overall effect of a change in lender information on the incidence of predation is ambiguous.

Proposition 7

Part (A) does not change, since for low H and I values the uninformed entrants cannot break even and so competition has no effect on predatory lending. Part (B) quantitatively changes. First note that the equilibrium payments are not a function of ε as the break-even level for uninformed lenders does not depend on ε. Consequently, any change in Part (B) comes from a bad-signal borrower having a probability $1-\theta$ of high date 2 income and retaining her house. So the welfare loss of a bad-signal borrower is reduced by $(1-\theta)[X - \max\{0, RL_0 - H\}]$ due to the incumbent's imperfect foresight. For sufficiently large X, this term may exceed the loss established in Proposition 2. In such cases, the incumbent's imperfect foresight lowers the incidence of predation. In sum, parallel to changes in Proposition 2, both the incidence and severity of predation are reduced as the incumbent's information becomes worse (higher ε). Hence imperfect incumbent foresight reduces the severity and incidence of predation both under monopoly and competition. Finally, since the second period payment is still lower under competition compared to the monopoly case when $P_2^K < I$, competition still reduces the severity of predation for high H. Therefore, Part (C) continues to hold with an additional qualifier on the existence of predation in the monopoly case.

Proposition 8

In the perfect foresight case ($\varepsilon = 0$) there are three inequalities, $H \geq RL_0 - I + M$, $S-(1-p)X \geq 0$ and $(R-1)(RL_0-I) < X-S$, that are in combination necessary and sufficient for predation to exist. The second condition is still necessary when $\varepsilon > 0$, as it says that an uninformed borrower values the expenditure enough to justify a $1-p$ probability of losing her house. However, a new set of conditions replace the first and the third for $\varepsilon > 0$. The third condition has the benefit of refinancing on the left hand side and the cost on the right hand side for a borrower with bad prospects. So when $\varepsilon > 0$ the right hand becomes $\theta X - S$, and so a necessary condition is $(R-1)(RL_0 - I) < \theta X - S$. This is a stronger condition. The first condition guarantees the lender can at least recover his additional loan even from a bad-prospects borrower. Exactly as in Proposition 4, this condition is replaced by a weaker one when $\varepsilon > 0$, since a bad-signal borrower has a $1-\theta$ probability of high date 2 income. Overall, imperfect lender foresight has an ambiguous effect on the incidence of predation. The severity of predation is reduced as the maximum loss is $(\theta X - S) - (R-1)(RL_0 - I)$ as opposed to $(X-S) - (R-1)(RL_0 - I)$.