# Staring Down Foreclosure: Findings from a Sample of Homeowners Seeking Assistance

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# Staring Down Foreclosure: Findings from a Sample of Homeowners Seeking Assistance*

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Preliminary Draft

**Abstract**

This paper offers a simple theoretical and empirical exploration of homeowner assistance programs. We model seeking and receiving assistance as strategic interaction between the homeowner and lender. In the absence of lender and homeowner incentives, the theory predicts that with full information, the lender's optimal action would be to offer assistance only to those who would not redefault or self-cure. In this case, assistance enables homeowners who would otherwise have been foreclosed on to remain in their homes, i.e., to be cured. We show that the introduction of incentives into the model can, under certain conditions, induce lenders to offer assistance to homeowners who subsequently redefault. We construct logit models based on the predictions of our theory to more fully evaluate the probability of being cured. We find that assistance, loan-to-value ratios and negative shocks significantly affect the probability of being cured.

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# 1 Introduction

The foreclosure crisis resulted in a record number of homeowners facing foreclosure in the U.S. The share of U.S. housing units receiving a foreclosure filing increased steadily since 2006, with one in 45 houses receiving a filing in 2010 (RealtyTrac, 2011). The policy response included an initiative known as Making Home Affordable (MHA). MHA offers several programs whose stated goal is to help struggling homeowners by offering assistance such as mortgage modifications, refinancing or repayment plans (Making Home Affordable, n.d.). For example, the Home Affordable Modification Program (HAMP) enables eligible homeowners to work with their servicers to modify the terms of their first-lien mortgage to make it more affordable (Making Home Affordable, 2010). Under HAMP, servicers can reduce interest rate, lengthen loan terms, forgive part of the principal, or offer principal forbearance.

This paper offers a simple theoretical and empirical exploration of mortgage assistance. Following Adelino, Gerardi, and Willen (2009), we think of mortgage assistance as a renegotiation between the homeowner and the lender. Adelino, Gerardi, and Willen (2009) point out that renegotiation is risky from the lenders' perspective in the sense that it potentially exposes them to homeowners to whom they would not want to offer assistance. They group such homeowners into two categories — those who would "self-cure," that is, continue to make their mortgage payments without receiving a modification and those who would "redefault," that is, fail to make their payments on time despite receiving a modification. We formalize this idea in a simple model of strategic interaction between the homeowner and lender in which the lender is potentially exposed to both types of homeowners that Adelino, Gerardi, and Willen (2009) identify. Homeowners in our model can be grouped into three categories: "seriously distressed" homeowners who would default even they received assistance, "non-distressed" homeowners who would not default even if they received no assistance, and "distressed" who could be prevented from defaulting only if they received assistance. In this setup, we show that with full information the lender's optimal strategy would be to offer assistance only to those in the distressed group.

Next, we introduce one feature of the MHA programs into our model — homeowner and lender incentives. HAMP, for example, offered servicers $1,000 for each modification completed under the program (Making Home Affordable, 2010). Additional "pay for success" incentives were offered to

homeowners and lenders for up to three years for loans that remain in good standing. We show that incentives induce lenders to offer assistance to a subset of the seriously distressed homeowners and enables these homeowners to remain in their homes. However, the incentives can, under certain conditions, induce the lender to also offer assistance to homeowners who subsequently walk away. Incentives need to be very large to induce lenders to offer assistance to homeowners who would otherwise self-cure. In other words, we derive conditions under which homeowner assistance programs can indeed expose lenders to homeowners who would redefault or self-cure.

We use the theoretical results to interpret findings from a small survey of homeowners who sought assistance with their mortgages. We contacted the homeowners at four foreclosure prevention events held in Maryland and Virginia between 2009 and 2010. We conducted three follow-up surveys of these homeowners between 2010 and 2011. In addition to collecting information about the homeowners, their houses, and their loans, we asked whether the homeowners received assistance with their mortgage and whether they were successful in becoming current on their payments (being cured).

We construct logit models based on our theoretical framework and on previous literature to analyze the data. We find that assistance, loan-to-value ratios and negative shocks significantly affect the probability of being cured. The next sections describes the theoretical and empirical models in more detail.

# 2 Theoretical Framework

We construct a simple model of strategic interaction between the homeowner and lender, similar to Wang, Young, and Zhou (2002). The players are a single lender and a continuum of homeowners of type $\alpha$.

Let $M$ denote the mortgage balance and $P$ the market price of the home. We assume that $M - P > 0$, following the literature that shows that negative equity is a trigger, but not a sufficient condition for default (see, for example, Campbell and Cocco (2011)).

Figure 1 illustrates the payoffs of the possible outcomes of the interaction between the lender and an individual homeowner. The homeowner moves first and decides whether to seek assistance (denoted by action $s$ in the figure) or not seek assistance ($ns$). If he does not seek assistance and does not walk away from his mortgage (denoted by action $nw$), his payoff is 0.

(We calculate payoffs as changes in net worth.) If, instead, he choose to walk away from his home, his payoff is $M - P - \alpha W$. This expression reflects the assumption that homeowners differ in their cost of walking away from their home. Specifically, homeowners of type $\alpha$ face a cost $\alpha W$ of walking away, where $\alpha$ is uniformly distributed on the interval $[0, 1]$. If the homeowner does not seek assistance and does not walk away, the lender receives the mortgage amount $M$ as per the original contract. If he defaults and walks away from the home, the lender's payoff is the price $P$ of the home less the cost associated with foreclosing on the home, $F$.

Once the homeowner decides to seek assistance, the lender has to choose whether to offer assistance $A$ or not. If the lender does not offer assistance ($na$), the homeowner incurs a cost $\alpha\varepsilon$ of seeking assistance but otherwise his payoffs are the same as in the case where he chose not to seek assistance.[1] In other words, the payoff to the homeowner of seeking but not receiving assistance and then choosing not to walk away is $-\alpha\varepsilon$ while the payoff from walking away is $M - P - \alpha W - \alpha\varepsilon$. There is no change to the lender's payoff; she receives $M$ if the homeowner does not walk away and $P - F$ if he does. We assume that the cost of walking away exceeds the cost of seeking assistance, that is $W > \varepsilon$.

If the lender offers assistance $A$, denoted by action $a$, and the homeowner does not walk away from the home, the homeowner's payoff is $A - \alpha\varepsilon$. In this case, the lender receives the full mortgage payment less the amount of assistance given: $M - A$. If the homeowner receives assistance and still walks away from the home, his payoff is $M - P - \alpha W - \alpha\varepsilon + \rho A$. Since we do not have time in our model, $\rho$ loosely captures what might occur during the assistance process. Consider an example in which a homeowner receives assistance in the form of a lower interest rate. We can think of the total assistance amount, $A$ as the difference between the original payments and the new, lower payments under the new interest rate over the full length of

[1] Making the cost of seeking assistance a function of $\alpha$ in effect means that those who find it less costly to walk away from their home also find it less costly to seek assistance. We think this is a reasonable assumption. Most homeowners who seek assistance are delinquent on their mortgage payments. We think that those who find it costlier to default on their payments are also more likely to find it costly to eventually walk away from their home, since walking away begins with defaulting on payments. This specific assumption, however, does not qualitatively change our results. We would achieve comparable outcomes under the assumption that the cost of seeking assistance was different across households randomly.

the loan term. However, if the homeowner defaults and walks away after making a few of the new payments, he receives in effect only a fraction of the assistance, i.e., $\rho A$. In this case, the lender's payoff is $P - F - \rho A$.

## 2.1 No Incentives

In principle, it is possible for the lender to choose both whether or not to offer assistance and how much assistance to offer. However, to avoid the complexities associated with a continuum of strategies, we assume for now that the lender has only two choices — offer no assistance ($na$) or offer assistance $A = M - P$. The payoffs under this specific assumption are shown in Figure 2.

We assume that there are homeowners who would not walk away even if they sought and did not receive assistance (or, equivalently, even if they did not seek assistance). For these homeowners, $\alpha \in [\bar{\alpha}, 1]$, where

$$\bar{\alpha} = \frac{M - P}{W}$$

Also observe that there are homeowners who would get a higher payoff from walking away even when offered the maximum level of assistance. For these homeowners, $\alpha \in [0, \underline{\alpha})$, where

$$\underline{\alpha} = \frac{\rho(M - P)}{W}$$

. We assume that $0 < \underline{\alpha} < \bar{\alpha} < 1$. In other words, homeowners can be grouped into three categories: (i) those with $\alpha \in [0, \underline{\alpha})$ who would walk away even they received assistance, (ii) those with $\alpha \in [\bar{\alpha}, 1]$ who would not walk away even if they received no assistance and (iii) those with $\alpha \in [\underline{\alpha}, \bar{\alpha})$ who would would walk away if they received no assistance but not if they received assistance.

In the absence of an assistance program, all homeowners with $\alpha \in [0, \bar{\alpha})$ would default on their mortgages and walk away from their home while all homeowners with $\alpha \in [\bar{\alpha}, 1]$ would not. The lender's payoff in this case would be

$$\bar{\alpha}(P - F) + (1 - \bar{\alpha})M \tag{1}$$

We know formally describe the solution to the model, by characterizing the subgame perfect Nash equilibrium. This requires specifying the strategy

profile that includes strategies of every player. Since there is a continuum of homeowners, we describe strategy profiles over intervals within $[0, 1]$.

**Proposition 1.** *Assume full information (the homeowners' type and the lenders actions are observable). Let* $\underline{\alpha} = \frac{\rho(M-P)}{W}$ *and assume* $W > \varepsilon$. *Then the strategy profile*[2]

$$\begin{aligned} \{(ns\ Always\ choose\ w), na\} \quad & \forall \quad \alpha \in [0, \underline{\alpha}) \\ \{(s\ nw|A = M - P\ w|otherwise), a\} \quad & \forall \quad \alpha \in [\underline{\alpha}, \bar{\alpha}) \\ \{(ns\ Always\ choose\ nw, na\} \quad & \forall \quad \alpha \in [\bar{\alpha}, 1] \end{aligned}$$

*is a subgame perfect Nash equilibrium of the game in Figure 2.*

*Proof.* See Appendix. □

The above result shows that in equilibrium, the only homeowners who seek and receive assistance are of type $\alpha \in [\underline{\alpha}, \bar{\alpha})$. These are homeowners who would have walked away in the absence of assistance but remain in their homes because they receive assistance. The lender does not offer assistance to homeowners of type $\alpha \in [0, \underline{\alpha})$ because they would walk away from their homes even if they received the maximum level of assistance that the lender was willing to offer. As a result, the lender's payoff from offering assistance, $P - F - \rho A$, would be strictly less than her payoff from not doing so, $P - F$. The lender also does not assist homeowners of type $\alpha \in [\bar{\alpha}, 1]$ because her payoff from not offering assistance, $M$, is strictly higher than her payoff from offering assistance, $M - A$.

It can be shown that the payoff to the lender from the above solution exceeds the payoff from the solution with no assistance offered as described by (1).

Certain parametrizations of the model can yield results consistent with empirical observations. For example, Adelino, Gerardi, and Willen (2009) point out that lenders renegotiate only a small fraction of delinquent loans. Our model can obtain a qualitatively similar result if the interval $[0, \underline{\alpha})$ is large relative to the interval $[\underline{\alpha}, \bar{\alpha})$, that is, if the number of distressed borrowers who can be prevented from walking away is small relative to the number of seriously distressed who cannot.

[2]The strategy profile is of the form {(Homeowners strategy at initial node homeowners conditional strategy at terminal nodes), lenders strategy}

Our model also suggests that cure rates among those who do not receive assistance can be high, which implies that comparing cure rates among those who receive and do not receive assistance may not be informative about the effectiveness of the assistance program. We say that a homeowner is "cured" if the outcome is that they do not walk away from their home. In the solution described by Proposition 1, the cure rate conditional on receiving assistance would be 1, and the cure rate conditional on not receiving assistance would be $\frac{1-\bar{\alpha}}{1-\bar{\alpha}+\underline{\alpha}}$. The latter number can be close to 1 if the interval $[\bar{\alpha}, 1]$ is large relative to the interval $[0, \underline{\alpha}]$.

On the other hand, the prediction that the cure rate conditional on receiving assistance is 1 is counterfactual. In our data set, we observe that lenders do offer assistance to homeowners who subsequently redefault and are foreclosed upon. In the next section, we show that the introduction of incentives into the model can deliver this result under certain assumptions.

## 2.2 Homeowner and Lender Incentives

We consider whether the above results change with the introduction of incentives to the homeowner and lender. We are particularly interested in solutions in which homeowners who were not receiving assistance in the above solution receive assistance in the solution with incentives. We derive conditions under which such a solution exists; however, we show that this solution can include a group of homeowners who receive assistance and yet walk away from their home. Further, we show that lenders may offer assistance to homeowners who would otherwise have self-cured without assistance.

We model the incentives around the rules that were prevalent at the time of our data collection. Specifically, the HAMP program offered incentive compensation of \$1,000 to servicers for each successful permanent modification completed (Making Home Affordable, 2010). In addition, it offered up to \$1,000 each to the homeowner and servicer for every year that the loan remained in good standing (or \$83.33 monthly), for a maximum of three years. We introduce this incentive compensation structure into our model as follows. The lender receives $I_1$ for offering assistance, regardless of whether or not the homeowner subsequently walks away from the home. If the homeowner remains in his home, the lender receives an additional $I_2$ as "pay-for-success". The revised payoffs are shown in Figure 3.

We first show that under certain assumptions, an equilibrium exists in which the only effect of the incentive payments is to induce lenders to offer

assistance to homeowners who were previously in the seriously delinquent category. The homeowners who receive this assistance choose to remain in their homes. In this case, the incentives thus have the effect of bringing additional homeowners under the umbrella of the assistance program, which was probably their intent. The following results characterizes the equilibrium.

**Proposition 2.** *Assume full information. Let* $\underline{\alpha}' = \frac{\rho(M-P)-I_2}{W}$. *Assume that* $\rho(M-P) \geq I_2 > I_1$ *and that* $I_1 + I_2 < M - P$. *Then the strategy profile*

$$\{(ns\ Always\ choose\ w), na\}\forall\alpha \in [0, \underline{\alpha}')$$
$$\{(s\ nw|A = M - P\ w|otherwise), a\}\forall\alpha \in [\underline{\alpha}', \bar{\alpha})$$
$$\{(ns\ Always\ choose\ nw, na\}\forall\alpha \in [\bar{\alpha}, 1]$$

*is a subgame perfect Nash equilibrium of the game in Figure 3.*

*Proof.* See Appendix. □

Comparing Proposition 2 to Proposition 1, we see that the results are similar but for the fact that a larger fraction of homeowners receives assistance and remains in their home. This follows from the fact that $\underline{\alpha}' < \underline{\alpha}$. As before, the cure rate among those receiving assistance is 1, and the cure rate among those not receiving assistance is $\frac{1-\bar{\alpha}}{1-\bar{\alpha}+\underline{\alpha}'}$.[3].

The next result shows that under a certain incentive structure, lenders may be induced to offer assistance to homeowners of type $\alpha \in [0, \underline{\alpha}')$ in addition, and that these homeowners will still choose to walk away from their homes.

**Proposition 3.** *Assume full information. Let* $\underline{\alpha}' = \frac{\rho(M-P)-I_2}{W}$. *Assume that* $I_1 \geq \rho(M-P) \geq I_2$ *and that* $I_1 + I_2 < M - P$. *Then the strategy profile*

$$\{(s\ Always\ choose\ w), a\}\forall\alpha \in [0, \underline{\alpha}')$$
$$\{(s\ nw|A = M - P\ w|otherwise), a\}\forall\alpha \in [\underline{\alpha}', \bar{\alpha})$$
$$\{(ns\ Always\ choose\ nw, na\}\forall\alpha \in [\bar{\alpha}, 1]$$

*is a subgame perfect Nash equilibrium of the game in Figure 3.*

*Proof.* See Appendix. □

[3] An interesting aside — incentives in this case increase the cure rate among those not receiving assistance!

Observe that in the equilibrium characterized by Proposition 3, the cure rate among those receiving assistance is no longer 1; it is $\frac{\bar{\alpha}-\underline{\alpha}'}{\bar{\alpha}}$. Having a cure rate less than one among those receiving assistance is more consistent with the data. However, this consistency comes at a price — the cure rate in this case among those not receiving assistance is 1 (since non-distressed homeowners are the only ones who do not receive assistance) which is not true in the data. In any case, the take-away is that cure rates should be interpreted with caution when judging the success of homeowner assistance programs.

Finally observe that it is possible in theory but unlikely in practice to have incentives large enough to induce lenders to assist non-distressed homeowners. This can be seen if the proof of Proposition 2 was reworked under the assumption that $I_1 + I_2 \geq M - P$. This is a somewhat unlikely assumption in practice; it requires that the incentive payments exceed the assistance that the lender offers.

# 3 Empirical Model

We now construct our empirical model based on the theoretical framework described above. The goal of the model is to determine what factors affect the probability of being cured. Our dependent variable is thus a binomial variable that equals 1 if the homeowner was current on their mortgage payments at the last known status and 0 if the homeowner was not.

One clear prediction of our theoretical model is that the receipt of assistance enables some homeowners to be cured. We thus include an indicator for the receipt of assistance as an independent variable. It also follows from the model that homeowners who face lower costs of walking away are more likely to do so. These are homeowners for whom $\alpha W$ is small relative to $M - P$. An empirical parallel might be homeowners with large loan-to-value (LTV) ratios ($\frac{M}{P}$), so we include these ratios in our independent variables. Recent theoretical literature has shown that homeowners with positive equity (or relatively low loan-to-value ratios) may also default in the face of frictions in the housing market that prevent them from selling their house (Hedlund, 2011). Such homeowners are possibly constrained by their income flow, so we include income as a control. Finally, previous literature (Foote, Gerardi, and Willen, 2008; Vandell, 1995) suggests that homeowners tend to default when they are faced with both negative equity and an adverse shock

— a double trigger. We therefore also include an indicator for experiencing such a shock, which includes death or illness of a member of the household, job loss, divorce, etc.

We estimate the following model by logit. $c_i$ is the dependent variable that equals 1 if the homeowner's last known mortgage status was current. $a_i$ is an indicator that equals 1 if assistance was received. $ltv_i$ is the loan-to-value ratio, calculated by dividing the mortgage balance by the value of the home. $y_i$ is household income. $z_i$ in an indicator that equals 1 if the household faced a shock. $X_i$ is a vector of additional controls.

$$Pr(c_i = 1|\text{event attendance}) = \Phi(\beta_0 + \beta_1 a_i + \beta_2 ltv_i + \beta_3 y_i + \beta_4 z_i + \beta_5 X_i) \quad (2)$$

# 4 Data

The data used in this paper was collected by surveying homeowners who attended one of four foreclosure prevention events held in Maryland and Virginia in 2009–2010. Of the 2,552 homeowners who attended the events, 203 completed a short contact information survey. Table 1 shows the date, location, and number of participants at each event as well as the response rate for the contact information survey.

Between 2010 and 2011, we conducted three rounds of follow-up surveys of the homeowners we contacted at the foreclosure prevention events. In addition to collecting information about the homeowners, their houses, and their loans, we asked whether the homeowners received assistance with their mortgage and whether they were successful in becoming current on their payments. We also obtained information about their property values from public records and used RealtyTrac data to determine whether they were in

Table 1: Foreclosure Prevention Event Details and Response Rates

| Date | Location | Attendance | Surveys Completed | Response Rate |
|---|---|---|---|---|
| 27-Aug-09 | Prince William, VA | 720 | 49 | 7% |
| 29-Aug-09 | Prince Georges, MD | 1,100 | 61 | 6% |
| 20-Feb-10 | Gwynn Oak, MD | 500 | 32 | 6% |
| 17-Apr-10 | Richmond, VA | 232 | 61 | 26% |
| Total | | 2552 | 203 | 8% |

foreclosure.[4]

Of the 203 homeowners who responded to at least one survey, we drop 126 from the sample because they do not report one or more of the variables needed for our analysis — their mortgage status (current, delinquent or in foreclosure), whether or not they received assistance, mortgage amount, home value, income and employment status. Our analysis is thus based on the 77 observations that do contain all of this information.

Table 2 provides a description of the sample. For comparison, we also include a description of all homeowners who lived in the Washington metropolitan area, since the majority of our sample resided in that region.[5] Most homeowners in our sample were in the 44-64 age group, making them slightly older than the Washington sample. Homeowners in our sample were predominantly black. Nearly half were college graduates. The average household income of $63,239 in our sample was considerably lower than the mean in the Washington area. Nearly 17% of the sample was unemployed. Three-fourths of the sample was at least 30 days delinquent on its mortgage payment at the time of the event, which was our first contact with them.

We can also use the sample to calculate cure rates, which, as we discussed in the theory section, should be interpreted with caution. We define the cure rate as the fraction of the sample whose last known mortgage status is current on their payments. The last known mortgage status is based on the latest available response from the three rounds of follow-up surveys, and is therefore distinct from the first-known mortgage status that we obtained at the event. We find that cure rates are 54% among those receiving assistance and 36% among those not receiving assistance.

Finally, since our variable of interest is whether or not the homeowner was cured, we compare the sample along this dimension. Table 3 shows the results. Those who were cured were more likely to have received assistance, more likely to be employed and less likely to have faced an adverse shock compared to homeowners who were not cured. The average LTV ratio was lower and the average income was higher among those who were cured.

[4]RealtyTrac is an online resource for foreclosure listings as well as detailed property, loan and home sales data. Data obtained from RealtyTrac was through their "Match & Append" data product and current as of December 9, 2011. See `http://www.realtytrac.com`.

[5]The data is from the American Housing Survey for Washington Metropolitan Area, 2007.

Table 2: Description of Sample

| Characteristic | Sample (n=77) | DC MSA All Homeowners |
|---|---|---|
| *Age* | | |
| 25-34 | 4% | 14% |
| 35-44 | 13% | 21% |
| 45-54 | 39% | 27% |
| 55-64 | 35% | 22% |
| 65-74 | 5% | 9% |
| Not available | 4% | - |
| *Race* | | |
| Asian | 4% | 7% |
| Black | 66% | 20% |
| White | 22% | 70% |
| Other | 8% | 3% |
| *Education* | | |
| College graduate | 49% | 55% |
| Some college | 31% | 17% |
| High school or less | 20% | 28% |
| *Household Income* | | |
| Mean | $63,239 | $99,433 |
| *Employment Status* | | |
| Employed | 77% | |
| Unemployed | 17% | |
| Not in labor force | 6% | |
| Not available | 1% | |
| *Mortgage Status at Event* | | |
| Current | 22% | |
| 30-90 delinquent | 42% | |
| 90+ delinquent | 35% | |
| Not available | 1% | |

Table 3: Comparison of Cured and Not Cured Homeowners

| | All (N=77) | Cured (N=37) | Not Cured (N=40) |
|---|---|---|---|
| Received assistance | 68% | 75% | 60% |
| LTV ratio (mean) | 1.15 | 1.09 | 1.21 |
| Income (mean) | $63239.17 | $71054.05 | $56010.4 |
| Faced shock | 88% | 81% | 95% |
| Had an ARM | 46% | 41% | 50% |
| Employed | 77% | 87% | 68% |

# 5 Results

Table 4 presents the results of logistic regressions fitting the probability of being cured. The column labeled Model 1 shows the results of the estimation without additional controls while Model 2 includes controls for whether the homeowner was employed and had an adjustable rate mortgage (ARM). The results are presented in terms of marginal effects estimated at means. For factor variables the marginal effects are given as discrete changes in probabilities from the baseline level. Based on the results, assistance from lenders, the level of borrowers' income and employment status were positively associated with one's likelihood of being cured. A homeowner with average characteristics who also received assistance from their lenders had around a 25 percent higher chance of not defaulting on his mortgage. In terms of odds ratios, the odds of being cured were more than twice as high for borrowers who had received assistance from their lenders than for those who had not.[6] Likewise, a homeowner who was employed had around 22 percent higher chance of being cured. While we found a positive association between the levels of income and borrower being cured, this effect was rather small. Based on our estimates, a thousand dollar increase in income from its mean would imply an increase in the probability of being cured by 0.003. We also found that adverse shocks were negatively associated with one's ability to stay current on one's mortgage. The probability of being cured was nearly 42 percent lower for those who had experienced some kind of a shock and the odds was approximately seven times higher compared to those who had not experienced any shocks. These results were highly significant and consistent

[6]The odds ratios are not reported but are available from the authors upon request.

Table 4: Logit Estimates for Probability of Being Cured

| Variable | Model 1 ME | | Model 2 ME | | Model 3 ME | | Model 4 ME | |
|---|---|---|---|---|---|---|---|---|
| Assistance | 0.2460 | * | 0.2292 | * | 0.2136 | * | 0.1884 | |
| | (0.1276) | | (0.1452) | | (0.1284) | | (0.1349) | |
| LTV ratio | -0.2718 | * | -0.2764 | * | -0.3321 | ** | -0.3260 | ** |
| | (0.1401) | | (0.1436) | | (0.1527) | | (0.1542) | |
| Income($1,000) | 0.0031 | * | 0.0020 | | 0.0032 | * | 0.0024 | |
| | (0.0018) | | (0.0020) | | (0.0018) | | (0.0020) | |
| Shock | -0.4196 | *** | -0.4121 | *** | | | | |
| | (0.1374) | | (0.1439) | | | | | |
| Big shock | | | | | -0.3849 | *** | -0.3857 | *** |
| | | | | | (0.1307) | | (0.1370) | |
| ARM | | | -0.0595 | | | | -0.1176 | |
| | | | (0.1302) | | | | (0.1332) | |
| Employed | | | 0.2255 | | | | 0.1780 | |
| | | | (0.1520) | | | | (0.1595) | |
| N | 77 | | 77 | | 77 | | 77 | |
| Pseudo-$R^2$ | 0.1197 | | 0.1392 | | 0.1327 | | 0.1503 | |

across model specifications. A higher loan to value ratio (LTV) was also negatively associated with borrower being cured - a unit increase in LTV from its mean suggested an increase in the probability of default between 23 and 25 percent. We did not find any difference in the likelihood of being cured for borrowers with adjustable or fixed rate mortgages.

Since shocks are somewhat subjectively measured, we consider alternative specifications in which only "big" shocks are included. For example, big shocks exclude unexpected increases in expenditures on items such as food and gas. The results are reported in Models 3 and 4. The effect of assistance is dampened for these more serious shocks. In the models with big shocks, lower LTV ratios have a bigger and more significant impact on the likelihood of being cured.

# 6 Conclusion

This paper provides a theoretical and empirical exploration of homeowner assistance programs. These programs were introduced in response to the foreclosure crisis to enable homeowners to remain in their homes if possible. We show using our theoretical models that cure rates may not be very informative in assessing the success of these programs. Specifically, we show that under different assumptions it is possible for the cure rate with or without assistance to be 1. Our theoretical model also shows that in the absence of incentives, assistance would indeed go to homeowners who need it, i.e., those who remain in their homes because of the assistance received but would have walked away without it. The introduction of incentives expands this set, but can have the additional effect of inducing lenders to offer assistance to homeowners who subsequently redefault.

We also examine the probability of being cured empirically, using data from a sample of homeowners who attended foreclosure prevention events in 2009-2010. Using follow-up surveys, we were able to observe homeowners' mortgage status and, in particular, whether they succeeded in becoming current on their payments. Using this as the indicator for being cured, we find, consistent with previous literature, that shocks have the most significant negative effect on the likelihood of being cured. As expected, lower LTV ratios increase the likelihood of being cured. Assistance increases the likelihood of being cured, but its effect is dampened for more serious shocks. In the models with big shocks, lower LTV ratios have a bigger impact on the

likelihood of being cured.

We conclude by pointing out limitations of the current theoretical and empirical work. The theoretical models in this paper assume that the homeowners' types can be observed by the lender. In practice, it is likely that lenders have to screen homeowners to obtain this information. It would be interesting to see how the results evolve under the assumption that types are private information to the homeowner. On the empirical side, while our results are consistent with the theoretical predictions and with previous literature, it must be noted that they are based on a small sample of observations. A larger sample can be obtained from loan level data; however this data lacks important information about individual homeowners such as employment status and income. Nonetheless, it would be useful to examine whether qualitatively similar results can be obtained from large loan level data sets. All of these suggest fruitful directions for future research.

Figure 1: Homeowner and Lender Payoffs

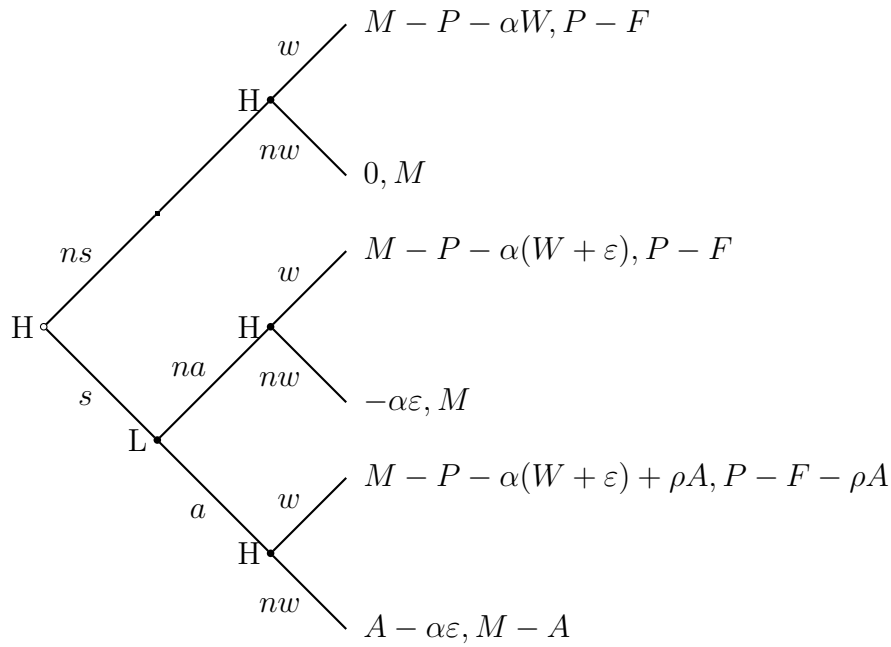



Figure 2: Homeowner and Lender Payoffs With $A = M - P$

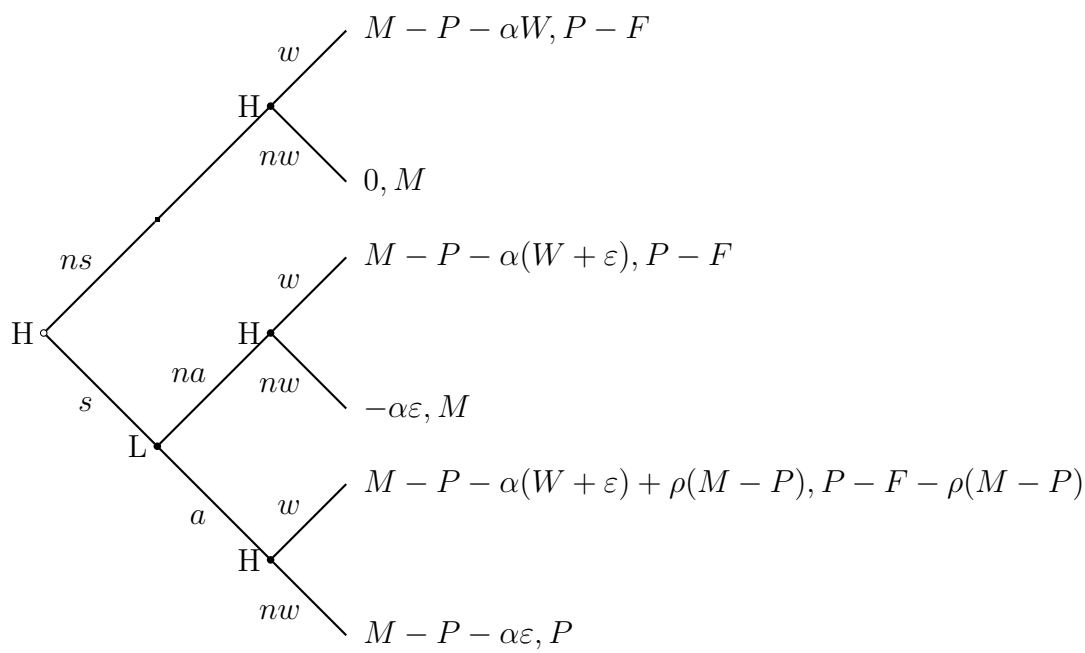
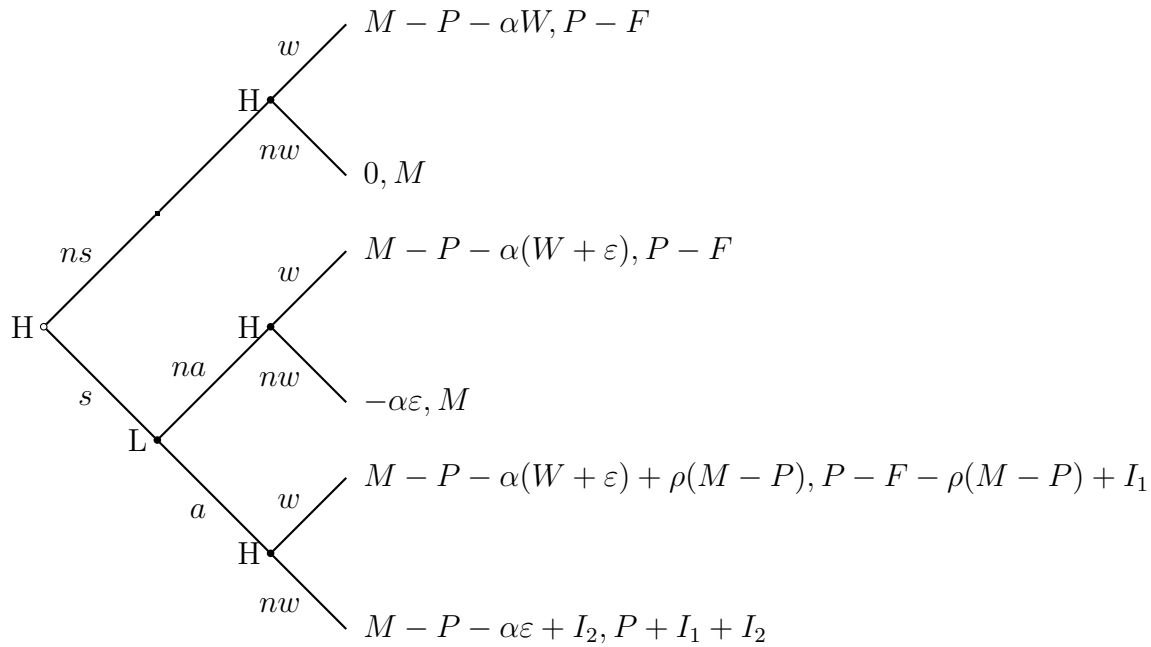


Figure 3: Homeowner and Lender Payoffs With Incentives



# A Appendix

## A.1 Proof of Proposition 1

*Proof.* We show that the strategy profile is a subgame perfect Nash equilibrium by solving the game in Figure 2 by backwards induction.
For homeowners of type $\alpha \in [0, \underline{\alpha})$, we show that the payoff from action $w$ exceeds the payoff from action $nw$ at each terminal node in Figure 2, working from top to bottom.

1. $M - P - \alpha W > 0$ by assumption
2. $M - P - \alpha W > 0 \Rightarrow M - P - \alpha(W + \varepsilon) > -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P)}{W}$$

which is true because in this case $\alpha \in [0, \underline{\alpha})$ and $\underline{\alpha} = \frac{\rho(M-P)}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ always choose action $w$, the homeowner will choose action $na$ because his payoff from doing so, $P - F$ strictly exceeds his payoff from offering $a$, $P - F - \rho(M - P)$. By backwards induction, knowing that the lender will choose $na$, the homeowner will choose $ns$ at the initial node because $M - P - \alpha W > M - P - \alpha W - \alpha\varepsilon$.
For homeowners of type $\alpha \in [\underline{\alpha}, \bar{\alpha})$, we show that the payoff from action $w$ exceeds the payoff from action $nw$ at the top two terminal nodes and the payoff from $nw$ exceeds the payoff from $w$ at the bottom terminal node:

1. $M - P - \alpha W > 0$ by assumption
2. $M - P - \alpha W > 0 \Rightarrow M - P - \alpha(W + \varepsilon) > -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon$ and from $w$ is $M - P - \alpha W -$

$\alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon$$
$$\Leftrightarrow \alpha \leq \frac{\rho(M - P)}{W}$$

which is false because in this case $\alpha \in [\underline{\alpha}, \bar{\alpha})$ and $\underline{\alpha} = \frac{\rho(M-P)}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ choose action $nw|A = M - P$ and $w$ otherwise, the homeowner will choose action $a$ because his payoff from doing so, $P$ strictly exceeds his payoff from $na$, $P - F$. By backwards induction, knowing that the lender will choose $a$, the homeowner will choose $s$ at the initial node because $W > \varepsilon \Rightarrow M - P - \alpha\varepsilon > M - P - \alpha W$.
For homeowners of type $\alpha \in [\bar{\alpha}, 1]$, we show that the payoff from action $nw$ exceeds the payoff from action $w$ at each terminal node in Figure 2, working from top to bottom.

1. $M - P - \alpha W < 0$ by assumption
2. $M - P - \alpha W < 0 \Rightarrow M - P - \alpha(W + \varepsilon) < -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P)}{W}$$

which is false because in this case $\alpha \in [\bar{\alpha}, 1]$ and $\bar{\alpha} = \frac{(M-P)}{W} > \frac{\rho(M-P)}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ always choose action $nw$, the homeowner will choose action $na$ because his payoff from doing so, $M$ strictly exceeds his payoff from offering $a$, $P$. By backwards induction, knowing that the lender will choose $na$, the homeowner will choose $ns$ at the initial node because $0 > -\alpha\varepsilon$. □

## A.2 Proof of Proposition 2

*Proof.* We show that the strategy profile is a subgame perfect Nash equilibrium by solving the game in Figure 3 by backwards induction. The assumption that $\rho(M - P) \geq I_2$ ensures that $\underline{\alpha}' \in [0, \underline{\alpha})$.

For homeowners of type $\alpha \in [0, \underline{\alpha}')$, we show that the payoff from action $w$ exceeds the payoff from action $nw$ at each terminal node in Figure 3, working from top to bottom.

1. $M - P - \alpha W > 0$ by assumption
2. $M - P - \alpha W > 0 \Rightarrow M - P - \alpha(W + \varepsilon) > -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon + I_2$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon + I_2$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P) - I_2}{W}$$

which is true because in this case $\alpha \in [0, \underline{\alpha}')$ and $\underline{\alpha}' = \frac{\rho(M-P)-I_2}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha}')$ always choose action $w$, the homeowner will compare his payoff from $a$, which is $P - F - \rho(M - P) + I_1$, to his payoff from choosing action $na$ which is P-F. The lender will choose $a$ if and only if

$$P - F - \rho(M - P) + I_1 \geq P - F,$$
$$\text{that is, } \Leftrightarrow I_1 \geq \rho(M - P)$$

which is false by assumption. Hence the lender will choose $na$. By backwards induction, knowing that the lender will choose $na$, the homeowner will choose $ns$ at the initial node because $M - P - \alpha W > M - P - \alpha W - \alpha\varepsilon$.
For homeowners of type $\alpha \in [\underline{\alpha}', \bar{\alpha})$, we show that the payoff from action $w$ exceeds the payoff from action $nw$ at the top two terminal nodes and the payoff from $nw$ exceeds the payoff from $w$ at the bottom terminal node:

1. $M - P - \alpha W > 0$ by assumption
2. $M - P - \alpha W > 0 \Rightarrow M - P - \alpha(W + \varepsilon) > -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon + I_2$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon + I_2$$
$$\Leftrightarrow \alpha \leq \frac{\rho(M - P) - I_2}{W}$$

which is false because in this case $\alpha \in [\underline{\alpha}', \bar{\alpha})$ and $\underline{\alpha}' = \frac{\rho(M-P)-I_2}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ choose action $nw|A = M - P$ and $w$ otherwise, the homeowner will choose action $a$ because his payoff from doing so, $P+I_1+I_2$ strictly exceeds his payoff from $na$, $P-F$. By backwards induction, knowing that the lender will choose $a$, the homeowner will choose $s$ at the initial node because $W > \varepsilon \Rightarrow M - P - \alpha\varepsilon + I_2 > M - P - \alpha W$. For homeowners of type $\alpha \in [\bar{\alpha}, 1]$, we show that the payoff from action $nw$ exceeds the payoff from action $w$ at each terminal node in Figure 2, working from top to bottom.

1. $M - P - \alpha W < 0$ by assumption

2. $M - P - \alpha W < 0 \Rightarrow M - P - \alpha(W + \varepsilon) < -\alpha\varepsilon$

3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon + I_2$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon + I_2$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P) - I_2}{W}$$

   which is false because in this case $\alpha \in [\bar{\alpha}, 1]$ and $\bar{\alpha} = \frac{(M-P)}{W} > \frac{\rho(M-P)-I_2}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ always choose action $nw$, the homeowner will compare his payoff from $a$, which is $P + I_1 + I_2$, to his payoff from choosing action $na$ which is $M$. The lender will choose $a$ if and only if

$$P + I_1 + I_2 \geq M,$$
$$\text{that is} \Leftrightarrow I_1 + I_2 \geq M - P,$$

which is false by assumption. Thus the lender will choose $na$ in this case. By backwards induction, knowing that the lender will choose $na$, the homeowner will choose $ns$ at the initial node because $0 > -\alpha\varepsilon$. □

## A.3 Proof of Proposition 3

*Proof.* We show that the strategy profile is a subgame perfect Nash equilibrium by solving the game in Figure 3 by backwards induction. The assumption that $\rho(M-P) \geq I_2$ ensures that $\underline{\alpha}' \in [0, \underline{\alpha})$.
For homeowners of type $\alpha \in [0, \underline{\alpha}')$, we show that the payoff from action $w$ exceeds the payoff from action $nw$ at each terminal node in Figure 3, working from top to bottom.

1. $M - P - \alpha W > 0$ by assumption
2. $M - P - \alpha W > 0 \Rightarrow M - P - \alpha(W + \varepsilon) > -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon + I_2$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon + I_2$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P) - I_2}{W}$$

which is true because in this case $\alpha \in [0, \underline{\alpha}')$ and $\underline{\alpha}' = \frac{\rho(M-P)-I_2}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha}')$ always choose action $w$, the homeowner will compare his payoff from $a$, which is $P - F - \rho(M - P) + I_1$, to his payoff from choosing action $na$ which is P-F. The lender will choose $a$ if and only if

$$P - F - \rho(M - P) + I_1 \geq P - F,$$
$$\text{that is, } \Leftrightarrow I_1 \geq \rho(M - P)$$

which is true by assumption. Hence the lender will choose $a$. By backwards induction, knowing that the lender will choose $a$, the homeowner will compare choosing $ns$ with choosing $s$. He will choose the latter if and only if

$$M - P - \alpha W \geq M - P - \alpha W - \alpha\varepsilon + \rho(M - P),$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P)}{\varepsilon}$$

Note that here $\alpha < \underline{\alpha}' < \underline{\alpha} = \rho(M - P)W < \rho(M - P)\varepsilon \because W > \varepsilon$. Hence the homeowner will indeed choose $s$.

For homeowners of type $\alpha \in [\underline{\alpha}', \bar{\alpha})$, we show that the payoff from action $w$ exceeds the payoff from action $nw$ at the top two terminal nodes and the payoff from $nw$ exceeds the payoff from $w$ at the bottom terminal node:

1. $M - P - \alpha W > 0$ by assumption
2. $M - P - \alpha W > 0 \Rightarrow M - P - \alpha(W + \varepsilon) > -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon + I_2$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon + I_2$$
$$\Leftrightarrow \alpha \leq \frac{\rho(M - P) - I_2}{W}$$

which is false because in this case $\alpha \in [\underline{\alpha}', \bar{\alpha})$ and $\underline{\alpha}' = \frac{\rho(M-P)-I_2}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ choose action $nw|A = M - P$ and $w$ otherwise, the homeowner will choose action $a$ because his payoff from doing so, $P + I_1 + I_2$ strictly exceeds his payoff from $na$, $P - F$. By backwards induction, knowing that the lender will choose $a$, the homeowner will choose $s$ at the initial node because $W > \varepsilon \Rightarrow M - P - \alpha\varepsilon + I_2 > M - P - \alpha W$.
For homeowners of type $\alpha \in [\bar{\alpha}, 1]$, we show that the payoff from action $nw$ exceeds the payoff from action $w$ at each terminal node in Figure 2, working from top to bottom.

1. $M - P - \alpha W < 0$ by assumption
2. $M - P - \alpha W < 0 \Rightarrow M - P - \alpha(W + \varepsilon) < -\alpha\varepsilon$
3. Given that the lender is offering $A = M - P$, the homeowners payoff from choosing action $nw$ is $M - P - \alpha\varepsilon + I_2$ and from $w$ is $M - P - \alpha W - \alpha\varepsilon + \rho(M - P)$. The homeowner will choose $w$ if and only if

$$M - P - \alpha W - \alpha\varepsilon + \rho(M - P) > M - P - \alpha\varepsilon + I_2$$
$$\text{that is} \Leftrightarrow \alpha \leq \frac{\rho(M - P) - I_2}{W}$$

which is false because in this case $\alpha \in [\bar{\alpha}, 1]$ and $\bar{\alpha} = \frac{(M-P)}{W} > \frac{\rho(M-P)-I_2}{W}$.

Knowing that homeowners with $\alpha \in [0, \underline{\alpha})$ always choose action $nw$, the homeowner will compare his payoff from $a$, which is $P + I_1 + I_2$, to his payoff from choosing action $na$ which is $M$. The lender will choose $a$ if and only if

$$\begin{aligned} P + I_1 + I_2 &\geq M, \\ \text{that is} \Leftrightarrow I_1 + I_2 &\geq M - P, \end{aligned}$$

which is false by assumption. Thus the lender will choose $na$ in this case. By backwards induction, knowing that the lender will choose $na$, the homeowner will choose $ns$ at the initial node because $0 > -\alpha\varepsilon$. $\square$

# References


Adelino, M., K. Gerardi, and P. S. Willen (2009): "Why Don't Lenders Renegotiate More Home Mortgages? Redefaults, Self-Cures, and Securitization," *Federal Reserve Bank of Boston Public Policy Discussion Papers*, 09(4), 1–41.

Campbell, J. Y., and J. F. Cocco (2011): "A Model of Mortgage Default," Working Paper 17516, National Bureau of Economic Research.

Foote, C. L., K. Gerardi, and P. S. Willen (2008): "Negative equity and foreclosure: Theory and evidence," *Journal of Urban Economics*, 64(2), 234 – 245.

Hedlund, A. (2011): "The Cyclical Behavior of Housing, Illiquidity and Foreclosures," University of Pennsylvania.

Making Home Affordable (2010): "Handbook for Servicers of Non-GSE Mortgages Version 2.0," .

——— (n.d.): Accessed February 15, 2012.

RealtyTrac (2011): "Record 2.9 Million U.S. Properties Receive Foreclosure Filings in 2010 Despite 30-Month Low in December," accessed February 15, 2012.

Vandell, K. D. (1995): "How Ruthless is Mortgage Default? A Review and Synthesis of the Evidence," *Journal of Housing Research*, 6(2), 245–264.

Wang, K., L. Young, and Y. Zhou (2002): "Nondiscriminating Foreclosure and Voluntary Liquidating Costs," *Review of Financial Studies*, 15(3), 959–985.