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Mortgage Modification and Strategic Behavior: Evidence from a Legal Settlement with Countrywide[†]

By Christopher Mayer, Edward Morrison, Tomasz Piskorski, and Arpit Gupta*

We investigate whether homeowners respond strategically to news of mortgage modification programs. We exploit plausibly exogenous variation in modification policy induced by settlement of US state government lawsuits against Countrywide Financial Corporation, which agreed to offer modifications to seriously delinquent borrowers. Using a difference-in-differences framework, we find that Countrywide's monthly delinquency rate increased more than 0.54 percentage points—a 10 percent relative increase—immediately after the settlement's announcement. The estimated increase in default rates is largest among borrowers least likely to default otherwise. These results suggest that strategic behavior should be an important consideration in designing mortgage modification programs. (*JEL* D14, G21, K22, R31)

Debt relief programs have a long history and have attracted renewed interest during the recent financial crisis, which has seen millions of US homeowners lose their homes to foreclosure since 2007. The potential benefits and costs of these programs are well known. During a crisis, mortgage debt relief can prevent excessive foreclosures, which yield losses for both borrowers and lenders and may also generate

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negative externalities for surrounding communities.[1] Debt relief could also have macroeconomic benefits to the extent that high household leverage depresses aggregate consumption and employment, as Mian and Sufi (2012) show. On the other hand, debt relief can distort the incentives of homeowners, who may default on mortgages in order to qualify for relief even though they could continue making debt payments. Strategic behavior like this not only increases the cost of debt relief programs to the lenders, but may also raise the long-run price of credit, if borrowers and lenders anticipate future debt relief programs.

Despite the economic importance of debt relief programs, there is little empirical evidence on their effects. This paper presents evidence on their costs. We study a recent mortgage modification program with a simple eligibility criterion—borrowers in default qualified—and estimate the extent to which the program affected borrower incentives to default.

Our focus is motivated by a key trade-off in the design of debt relief programs. In principle, a cost-effective program should apply eligibility criteria that efficiently identify homeowners who are highly likely to default unless they receive relief. In practice, it is costly and difficult to identify these at-risk homeowners because homeowner default decisions can depend on hard-to-observe factors such as their financial ability to service debt, private valuation of their homes, and personal default costs.

One approach to the problem is to offer benefits only to homeowners who complete a rigorous audit that verifies that they are likely to default, or have defaulted, as a result of meaningful adverse conditions.[2] Such an audit, for example, would assess the home's value and the homeowner's current income and credit rating. Because this approach can be time-consuming and can induce screening costs, it may fail to extend benefits to homeowners before they enter foreclosure or decide to exit their homes, and could thereby lead to higher costs for borrowers, lenders, and surrounding communities. An alternative way to target modification benefits is to extend help only to homeowners who are delinquent.[3] While this approach is possibly quicker and less expensive in terms of screening costs, it could induce homeowners to default in order to obtain modification benefits. Such induced defaults can raise the costs of these programs for lenders because the borrowers may have continued repaying their loans without any concessions.

A key factor affecting this trade-off, at least from the perspective of lenders (or mortgage investors), is the extent to which simple delinquency requirements encourage borrowers to default on their loans. This has been an open empirical question

[1] Several papers explore the potential benefits of debt relief to both borrowers and lenders during adverse economic conditions, including Bolton and Rosenthal (2002); Kroszner (2003); and Piskorski and Tchistyi (2011). Because foreclosures may exert significant negative externalities (see, for example, Campbell, Giglio, and Pathak 2011 and Mian, Sufi, and Trebbi 2011), it may be socially optimal to modify mortgage contracts to a greater extent than lenders would select independently.

[2] An example of this approach is the Home Affordable Modification Program, introduced in March 2009, which contains multiple eligibility requirements, along with a trial period preceding any permanent modification (see Agarwal et al. 2012).

[3] For example, a number of recent modification programs have made benefits available to homeowners who failed to make at least two monthly mortgage payments (e.g., the Bank of America/Countrywide Modification Program). Other programs, like the IndyMac/FDIC Program, JP Chase Enhanced Program, Citi Homeownership Preservation Program, and GSE Streamlined Modification Program have also targeted seriously delinquent borrowers, though some include additional eligibility requirements. See Citigroup (2009).

as mortgage default can result in additional costs for the borrower. Seriously delinquent borrowers, for example, face higher costs of accessing credit in the future. Additionally, bounded rationality or moral considerations may further decrease the ability and willingness of borrowers to default on their loans to profit from debt relief polices (see, for example, Guiso, Sapienza, and Zingales 2013).

To investigate this question, we focus on a legal settlement with Countrywide Financial Corporation. In October 2008, Countrywide announced that it had settled suits filed by US state attorneys general. It agreed to extend offers of loan modifications, beginning December 2008, to all borrowers who had Countrywide-serviced subprime mortgages and were at least 60 days past due on payments. Three features of the Countrywide settlement—its unexpected public announcement in advance of its implementation, nationwide coverage, and the requirement that a borrower be delinquent in order to receive benefits—make it a potentially useful setting for assessing borrower behavior in response to the offer of mortgage modification featuring a simple delinquency requirement.

We examine strategic behavior after the Countrywide announcement using loan-level data matched to borrower credit histories. We say that a borrower exhibits "strategic behavior" if he or she defaults in response to public announcement of the settlement and would not have defaulted otherwise, at least in the near term. We focus on a particular measure of the default rate: the rate at which previously-current borrowers miss two payments in a row. These borrowers are said to "roll straight" from current to 60 days delinquent. We focus on this measure of default—the "rollover rate"—because the Countrywide program targeted borrowers who were at least 60 days delinquent. In a difference-in-difference framework, we estimate the change in this delinquency rate among Countrywide borrowers during the months immediately following the settlement announcement *relative to* the change during the same period among comparable borrowers who were unaffected by the settlement because their loans were not serviced by Countrywide.

We find that the settlement induced a 0.54 percentage point increase in the monthly rollover rate among Countrywide borrowers—a 10 percent increase relative to the pre-settlement rate (4.8 percent)—during the three months immediately after the settlement announcement. The effect of the settlement is even larger—a 16 to 18 percent increase relative to the pre-settlement rollover rate—when we subset on borrowers with (i) substantial available credit through credit cards and (ii) lower current combined loan-to-value (CLTV) ratios. These borrowers were arguably less likely to default in the near term because they had significant untapped liquidity through credit cards or some positive equity in their homes.

We confirm that these results are not driven by idiosyncratic features of Countrywide loans or borrowers. Although we observe an increase in relative default rates among Countrywide loans targeted by the settlement (subprime first lien mortgages), we do not observe an increase in relative default rates among loans not targeted by the settlement. Default rates on credit cards and second mortgages held by Countrywide borrowers did not increase relative to default rates among control group borrowers. Nor do we observe an increase in relative default rates among non-subprime fixed-rate mortgages (FRMs) held by Countrywide borrowers.

Together, these results inform ongoing discussions about the trade-off between quickly implemented programs with simple but possibly manipulable eligibility criteria and slowly implemented programs with more rigorous verification of homeowner distress. Further research is needed to determine whether the costs of strategic behavior are large relative to the potential benefits of a simple modification program that quickly extends benefits to a large number of homeowners.

Previous studies of incentives and strategic behavior in the context of the recent crisis have examined a number of questions, including the impact of bailouts and regulatory design on banks' incentives to take risk,[4] the likelihood that some lenders originated mortgages with greater risk due to their ability to sell the loans in the securitization market,[5] and the impact of securitization on servicer decisions to foreclose or renegotiate delinquent loans.[6] Little attention has been given so far to strategic behavior among homeowners.

Our analysis is also broadly connected to the household finance literature, surveyed by Campbell (2006) and Tufano (2009), especially the recent empirical literature examining household motives behind mortgage defaults. Most of this recent literature aims to assesses the relative importance of two key drivers of mortgage default: negative equity and illiquidity.[7] Guiso, Sapienza, and Zingales (2013) also explore how moral and social considerations affect the decision to default on a mortgage. To the best of our knowledge, our paper is the first to assess the effect of mortgage modification programs on incentives to default on a mortgage. Our paper is also related to the empirical literature examining the effects of various policies on household behavior, such as the impact of unemployment insurance on workers' incentives to work.[8] We contribute to this literature by examining the effects of mortgage modification policy on borrowers' incentives to repay their loans. Finally, our paper helps inform the empirical literature on contract renegotiation.[9]

The reminder of the paper proceeds as follows. In Section I we describe the Countrywide settlement and our hypotheses regarding its effects on homeowner behavior. Sections II and III describe our data and empirical methodology. We present our results in Section IV and discuss their implications for mortgage modification policies in Section V.

[4] See Farhi and Tirole (2012) and Poole (2009), for example, for the analysis of bailouts. See Agarwal et al. (forthcoming) who examine differences between federal and state regulators and their impact on banks' decisions.

[5] Mian and Sufi (2009); Keys, et al. (2010); Keys, Seru, and Vig (2012); Rajan, Seru, and Vig (2010); Berndt and Gupta (2009); and Purnanandam (2011) provide evidence suggesting that originators might have made riskier loans when they were able to securitize these loans.

[6] Piskorski, Seru, and Vig (2010) show that bank-held delinquent loans were foreclosed at a lower rate relative to comparable mortgages that were securitized. Agarwal et al. (2011) corroborate their findings and provide further evidence that bank-held loans were much more likely to be renegotiated than comparable securitized mortgages.

[7] See, among others, Foote, Gerardi, and Willen (2008); Cohen-Cole and Morse (2010); and Elul et al. (2010). See also Mian and Sufi (2011) who examine the role of the home equity-based borrowing channel in the recent crisis using a dataset consisting of individual credit files.

[8] See, for example, Meyer (1990) and Krueger and Meyer (2002).

[9] See, among others, recent research by Benmelech and Bergman (2008) and Roberts and Sufi (2009) in the context of corporate default, and Matvos (2013) for renegotiation in NFL football contracts.

I. Countrywide Settlement and Hypotheses

A. *The Settlement*

In June 2008, attorneys general in California and Illinois sued Countrywide, alleging deceptive lending practices. The California complaint, for example, alleged that Countrywide had "implemented [a] deceptive scheme through misleading marketing practices designed to sell risky and costly loans to homeowners, the terms and dangers of which they did not understand."[10] Over the next three months, similar suits were brought by attorneys general in over 30 other states.

On October 6, 2008, Countrywide entered a multi-state settlement, pursuant to which it agreed to extend offers of loan modification to all seriously delinquent or near-delinquent subprime first-mortgage loans[11] that it services throughout the nation.[12] It was irrelevant whether the loan was originated by Countrywide, whether it was securitized or held in Countrywide's portfolio,[13] whether it previously received a modification, or whether the borrower's home was encumbered by a second mortgage or junior lien.

The settlement targeted subprime first mortgages serviced by Countrywide, including hybrid ARMs and Option ARMs. To qualify for modification, the mortgage and borrower had to satisfy four criteria: The loan must have been originated before 2008 and have been within Countrywide's servicing portfolio on June 30, 2008; the borrower's loan-to-value ratio (LTV) must be at least 75 percent; payments of principal or interest must be 60 or more days delinquent (or likely to become delinquent as a result of an interest rate reset or negative amortization trigger); and the borrower's post-modification mortgage payments must not exceed certain thresholds. The program was scheduled to last until June 30, 2012.

With respect to subprime hybrid ARMs, which are the primary focus of this paper, seriously delinquent borrowers would be considered for *unsolicited* restoration of the introductory interest rate for five years. Additionally, all seriously delinquent Hybrid ARM borrowers would be considered for some type of fully-amortizing loan modification. One type would reduce the interest rate for five years (to as low as 3.5 percent), after which the loan would be converted to an FRM at a low rate.

Countrywide agreed to be proactive in contacting borrowers eligible for modifications under the settlement. Although it made this commitment on October 6, 2008, it announced that it would not be ready to contact borrowers during the first few

[10] See State of California (2008a) and State of Illinois (2008).

[11] The settlement defined a subprime first mortgage as one that "is identified as such in connection with a securitization in which it is part of the pool of securitized assets or, in the case of a [Countrywide] Residential Mortgage Loan that is not included in a securitization, was classified as being 'subprime' on the systems of [Countrywide] and its subsidiaries on June 30, 2008. 'Subprime Mortgage Loans' do not include first-lien residential mortgage loans that are Federal Eligible." See Countrywide Financial Corporation (2008).

[12] A summary of the settlement is provided by a "Multistate Settlement Term Sheet" (see Countrywide Financial Corporation 2008). More detailed terms are provided by State of California (2008b), among other sources.

[13] Although securitization agreements often limit the servicer's authority to modify mortgages (see Mayer, Morrison, and Piskorski 2009 and Piskorski, Seru, and Vig 2010), Countrywide stated, "it currently has, or reasonably expects to obtain, discretion to pursue the foreclosure avoidance measures outlined in this agreement for the substantial majority of Qualifying Mortgages. Where [Countrywide] does not enjoy discretion to pursue these foreclosure avoidance measures, [Countrywide] will use its best effort to seek appropriate authorization from investors." See Countrywide Financial Corporation (2008).

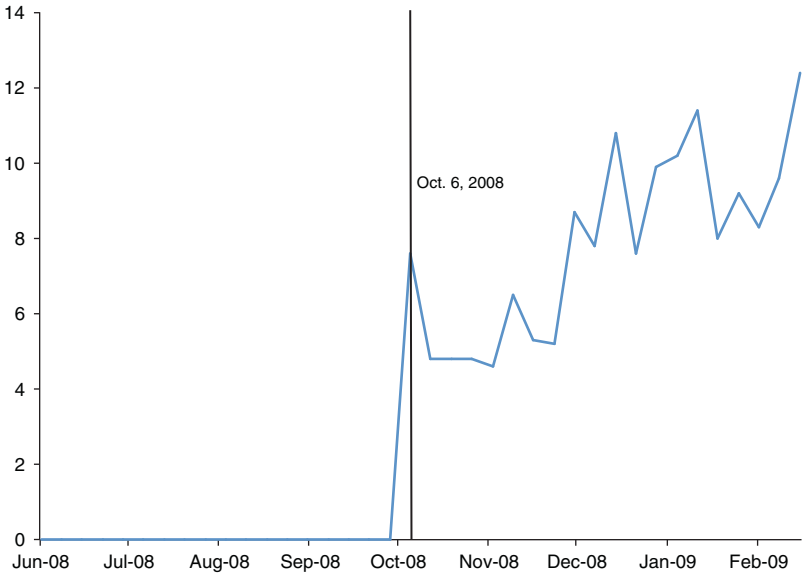

FIGURE 1. INTERNET SEARCHES FOR "COUNTRYWIDE MODIFICATION"

Notes: This figure plots an index of the weekly volume of Internet searches for the term "Countrywide Modification," as reported by Google Trends. Searches for this term spiked on October 6, 2008 the day the Countrywide settlement was announced and reported by newspapers around the country.

months of the program. Countrywide also agreed to temporarily suspend the foreclosure process for any borrower eligible for modification.

B. *Public Awareness of the Settlement*

The Countrywide settlement was widely reported in early October 2008, prior to its nationwide rollout in December 2008. Figure 1 documents the sudden interest in the settlement during this period: As reported by Google Trends, Internet searches for the term "Countrywide Modification" spiked in October, as newspapers around the country announced the settlement. Search activity dramatically increased just after this date.

Internet discussion forums also show that at least some Countrywide borrowers were aware that the settlement targeted borrowers who were at least 60 days delinquent. In one forum, borrowers report that they were in touch with Countrywide as early as October 2008 regarding their eligibility and were told that benefits were available to borrowers who were 60 days delinquent. Some forum participants also indicate that they responded to the settlement by missing mortgage payments in order to qualify for benefits.[14]

[14] The information reported in this paragraph is drawn from comments posted at http://loanworkout.org/2009/02/countrywide-idiots/. This site includes statements such as: "We started the process back in Oct of 2008. We have an ARM with a 8.75 percent rate currently. We have applied for a rate reductions but were told we would have to be delinquent on our account to qualify." "We received a loan modification agreement in December, but this was after we were told not to make a mortgage payment, because if we made a payment and we were current we would not qualify." "In order to get the help we were requesting, we had to go from having an excellent pay history

Countrywide was aware of the potential for strategic behavior. Its settlement included a provision stating that, if it "detects material levels of intentional nonperformance by borrowers that appears to be attributable to the introduction of the loan modification program, it reserves the right to require objective prequalification of borrowers for loan modifications under the program and to take other reasonable steps." It appears that this provision was not widely reported and may not have deterred some homeowners from strategically defaulting on their mortgages in order to qualify for modifications.

C. *Hypotheses*

We view the settlement as an opportunity to assess homeowner response to sudden announcement of a modification policy using simple but manipulable qualification criteria. Most of our analysis focuses on 2/28 ARMs, a type of loan primarily targeted by the settlement and very common among subprime borrowers (see Mayer, Pence, and Sherlund 2009). These mortgages offer an introductory "teaser" rate for the first two years, after which the rate resets to a possibly higher level for the remaining 28 years of the loan term.

Assuming the announcement was an exogenous shock—an assumption we justify in the next section—we propose the following differences-in-differences (DD) estimation strategy: Relative to the same type of mortgages held by comparable borrowers and serviced by other servicers, were Countrywide 2/28 ARMs more likely to "roll straight" from current to 60 days delinquent—i.e., abruptly stop payment for two months—during the period immediately after public announcement of the settlement? By abruptly stopping payment, homeowners could make themselves eligible for the benefits of the settlement.

We test for this DD effect beginning in October 2008, the month of the settlement announcement. There is, however, a potential confound beginning in early 2009. In February of that year the federal government announced plans to implement a widespread modification program, the Home Affordable Mortgage Plan (HAMP), which went online in March 2009. It is a potential confound because its effect on Countrywide borrowers, who may have already applied for or obtained modifications pursuant to the Countrywide settlement, may differ from its effect on non-Countrywide borrowers. Additionally, Countrywide borrowers may have suspended their response to the settlement because they expected the forthcoming federal program to be more generous.[15] To avoid this potential confound, we focus our analysis on the behavior of borrowers during the first few months after the settlement announcement (October 2008 to February 2009), paying particular attention to their behavior during the first quarter of the program (October 2008 to December 2009).

to completely tarnishing our record by missing two months of payments … so we skipped our payments for two months." "We would not even be behind if they did not advise us to enter into the loan modification and not send any payments in until it was approved or denied!"

[15] The HAMP guidelines do not have any specific requirement that a loan must to be delinquent to be eligible. In fact, the program provides additional financial incentives to servicers to modify loans that are currently making payments (but are at risk of default in the future). See Agarwal et al. (2012).

To be sure, the settlement announcement may have convinced some borrowers to default slightly earlier than they would have otherwise. These defaults are not strategic because the borrowers were already distressed and likely to default. To assess whether economic distress—rather than strategic behavior—is driving excess post-settlement defaults among Countrywide borrowers (relative to the control group), we examine the behavior of homeowners who were *least* likely to default when the settlement was announced: (i) homeowners with substantial available credit on their credit cards (equal to at least five times their monthly mortgage payment) and (ii) homeowners with relatively low current CLTV ratios. Because these homeowners had access to significant amounts of additional liquidity, or might have had positive home equity, they were less likely to default in the absence of a modification program, at least in the near future. If we observe a relative rise in rollover rates among these homeowners, we think it is suggestive of strategic behavior by those impacted by the settlement, rather than changes in other economic factors that might be coincident with announcement of the settlement.

As an additional test of strategic behavior, we examine the behavior of homeowners with respect to debts that were not targeted by the settlement, including second mortgages and credit cards. If strategic behavior—not economic distress—induced excess defaults on Countrywide subprime first mortgages, we do not expect to observe excess defaults (relative to the control group) with respect to nontargeted debts during the period immediately after the settlement announcement.

Finally, we consider the behavior of borrowers with FRMs. While hybrid ARMs are a risky mortgage product usually targeted at subprime borrowers, FRMs are a more conventional mortgage product that are often taken out by more creditworthy (non-subprime) borrowers who would not have qualified for modification under the settlement. Hence, we do not expect to observe a response among non-subprime FRMs. We can therefore assess whether the post-settlement increase in Countrywide's rollover rate (relative to the control group) reflects strategic behavior among targeted borrowers (those with hybrid ARMs) or just a generalized rise in default rates across all Countrywide borrowers, including nontargeted homeowners (those with non-subprime FRMs).

II. Data

We use a match between two databases: (i) loan-level mortgage data collected by BlackBox Logic and (ii) borrower-level credit report information collected by Equifax. BlackBox is a private company that provides a comprehensive, dynamic dataset with information about 21 million privately securitized subprime, Alt-A, and prime loans originated after 1999. These loans account for about 90 percent of all privately securitized mortgages from that period. The BlackBox data, which are obtained from mortgage servicers and securitization trustees, include static information taken at the time of origination, such as mortgage date and amount, FICO credit score, servicer name, interest rate, term, and interest rate type. The BlackBox data also include dynamic data on monthly payments, mortgage balances, and delinquency status.

Equifax is a credit reporting agency that provides monthly data on borrowers' current credit scores, payments and balances on mortgage and installment debt, and

balances and credit utilization for revolving debt (such as credit cards and HELOCs). Equifax reports the "Vantage" credit score, which is comparable to FICO and ranges from 501 to 990.

The match between BlackBox and Equifax data was performed by 1010Data, a provider of data warehousing and processing, using a proprietary match algorithm. We impose four restrictions on the merged BlackBox-Equifax data in order to create a "base sample." First, we restrict the data to the types of loans that might have been eligible for the Countrywide settlement, namely first-lien mortgages on residential properties that were the owners' primary residences. First-liens were identified as loans with the following characteristics in the BlackBox dataset: (i) a lien type of "first" and (ii) a current or origination mortgage balance that was within 5 percent of the current or origination balance reported for the largest two first mortgages in the Equifax dataset. Second, we retain only loans that were originated during 2005, 2006, and the first half of 2007 because we have access to Equifax data covering these originations. Third, we exclude mortgages with an origination LTV less than seventy. Borrowers with lower LTVs are unlikely to have been subprime borrowers at the time of origination. Finally, we exclude mortgages serviced by Citibank, IndyMac, and J.P. Morgan, all of which implemented modification programs around the time that the settlement was announced. We are interested in comparing the behavior of Countrywide borrowers to that of similar borrowers who were not offered modification benefits around the time of the announcement. After imposing these restrictions, we obtain a base sample that includes more than 500,000 2/28 ARMs and more than 700,000 FRMs.

Although 1010Data was able to link nearly all BlackBox mortgages to Equifax credit reports, we took steps to reduce the likelihood of poor-quality linkages by creating a "matched sample" on which we perform all analysis involving Equifax covariates. We exclude from the matched sample any observation for which the borrower zip code reported in Equifax does not match the property zip code in the BlackBox dataset. This exclusion omits mismatched loans at the level of zip code and provides additional verification that owner-occupants held the loans in our sample.[16] Due to these restrictions, the matched sample is smaller than the base sample and includes more than 300,000 2/28 ARMs and more than 450,000 FRMs.

Because the Equifax data include information about current balances on other junior mortgages held by the borrower, we are able to compute an initial combined loan-to-value (CLTV) ratio for each property. We can then estimate current CLTV at any point of time using zip-level home price indices provided by Zillow.[17]

In the analysis below, we report results both for the full base sample as well as the smaller matched sample. Variables provided by Equifax are used as covariates only in the matched sample.

[16] We have conducted an extensive comparison of merge quality between the datasets in the matched sample, checking fields such as dynamic payment history, origination balance, and origination dates. We find that these fields match very closely across the two databases, providing additional verification of merge quality.

[17] For both the base and matched samples, we use the MAPLE/Geocorr2k engine provided by the Missouri Census to link property zip code to metropolitan statistical areas. We compute the current CLTV of a loan as a ratio of combined outstanding loan balances to the current estimated house value (a house price at loan origination indexed by cumulative change of zip code house price index).

III. Methodology

We estimate a probit specification of the following form:

$$(1)\quad \Pr(Y_{it} = 1 \mid Current_{it-2}) \;=\; \Phi(CW_{it}\beta + Oct\text{-}Dec_{it}\mu + CW_{it}\,Oct\text{-}Dec_{it}\delta + \mathbf{x}'_{it}\gamma).$$

The dependent variable is the probability that a mortgage becomes 60 days past due in month t ($Y_{it} = 1$), conditional upon being current 60 days (two months) earlier ($Current_{it-2}$). We call this the "rollover rate": the rate at which borrowers "roll straight" from current to 60 days delinquent. It is our primary dependent variable for three reasons: (i) the settlement targeted borrowers who were at least 60 days delinquent; (ii) evidence of strategic behavior is more compelling if we observe an abrupt increase in defaults among borrowers who were current on payments prior to the settlement announcement; and (iii) by conditioning on loans that were previously current, we study transition rates among a relatively homogeneous group of loans. We confirm, however, that our results are similar when we consider a standard hazard model (see Section IVE).

In the above specification, CW_{it} is a dummy variable that equals 1 if the loan is serviced by Countrywide. $Oct\text{-}Dec_{it}$ is another dummy, equaling 1 if month t occurs during the period October through December 2008. October 2008 is the first month during which we could observe a borrower response to announcement of the settlement on October 6, 2008.[18] $\mathbf{x}_{it}$ is a vector of loan and borrower characteristics that includes variables such as initial Vantage score and the change in Vantage score from origination to the current period, initial and current CLTV, origination quarter, initial and current interest rate, loan balance, controls for date of reset, dummies for each quarter before and after the settlement announcement, interactions between these time dummies and the Countrywide indicator (CW_{it}), and a constant term. Standard errors are clustered by mortgage, but we confirm that we obtain comparable results when they are clustered by location (MSA) of the property backing the loan.[19]

In baseline models, we estimate the above specification on monthly data from July 2007 through February 2009. July 2007 roughly marks the start of the subprime crisis and the end of both subprime originations and the opportunity to refinance such mortgages. Thus, all mortgages in our study have been originated by July 2007.[20] This allows us to focus on a simple transition of mortgages from current status to default.[21] We end our analysis period in February 2009 to avoid the potential confound arising from HAMP, but our core results do not change when we extend our analysis to include periods after February 2009 (see Section IVE).

The key coefficient of interest is δ, which measures the difference-in-differences—the estimated change in the difference between Countrywide and control group

[18] Our data record the payment status of the borrower as of the end of a given month. For example, a borrower who is 30 days delinquent in September will be recorded as being 60 days delinquent in October if no new payments were received by the end of October.

[19] See Tables A.3 and A.4 in the online Appendix.

[20] The majority of mortgages enter our data during 2006 and the first half of 2007.

[21] A competing hazard model would be needed for data prior to July 2007. Such a model would be more complex to implement because distressed borrowers could use the refinancing option as an alternative to default. Moreover, the model might need to account for a possible structural shift in parameter values after the collapse of the subprime refinancing market in 2007.

Table 1—Summary Statistics for 2/28 ARMs

	Countrywide		Control group	
Number of loans	43,418		203,960	
	Mean	SD	Mean	SD
Panel A. BlackBox variables				
Initial CLTV	92	8.8	90	8.9
Initial interest rate	8.18	1.28	8.07	1.24
Current interest rate	8.63	1.35	8.56	1.37
Origination FICO	618	54	617	56.3
Origination balance	196	114	206	133
Low/no doc	0.42	0.49	0.6	0.49
Refi	0.055	0.23	0.1	0.3
Cash out refi	0.39	0.49	0.37	0.48
Panel B. Equifax variables				
Current CLTV	121	28	119	28
Current Vantage	667	82	666	84
2nd lien balance	47.9	31.4	52.4	38.4
Has junior lien	0.44	0.5	0.38	0.48
Credit utilization	0.47	0.37	0.47	0.37

Notes: This table presents summary statistics for 2/28 adjustable rate mortgages (ARMs) serviced by Countrywide and the control group in the matched sample as of September 2008. The summary statistics include characteristics of these loans at origination and as of September 2008, the month before public announcement of the settlement on October 6, 2008. CLTV and interest rates are reported in percentage terms; loan balances are in thousands of dollars.

rollover rates during the quarter immediately after the settlement announcement (Oct–Dec 2008) relative to the first quarter in our analysis period (Jul–Sep 2007). We omit the first quarter of our sample because our empirical model includes interactions between the Countrywide dummy and time dummies for each quarter (or two-month period) prior to and after the settlement. The coefficients for these interactions trace out the time path of differences between Countrywide and control group delinquency rates. By choosing the first quarter as the omitted category, we make it easier to detect differential trends in pre-settlement delinquency rates. This is important because our identification assumption is that, in the absence of the settlement, observationally similar Countrywide and control group mortgages would display similar default patterns (up to a constant difference) during the period of study.

A. *Comparability of Countrywide and Control Group Loans*

Table 1 presents summary statistics for the stock of 2/28 ARMs at loan origination and in September 2008, the month before public announcement of the settlement. Measured at means, Countrywide and control group loans are comparable: origination and current CLTV differ by at most 2 percentage points, origination and current interest rates differ by at most 11 basis points, and origination FICO and current Vantage differ by at most 1 point. Origination balances differ by about $10,000, less than 10 percent of the standard deviation. Available utilization on credit cards is measured as a fraction of the total credit limit available on all credit cards that have been used by the borrower. Table 1 shows similar levels of credit card utilization across the two groups of loans.

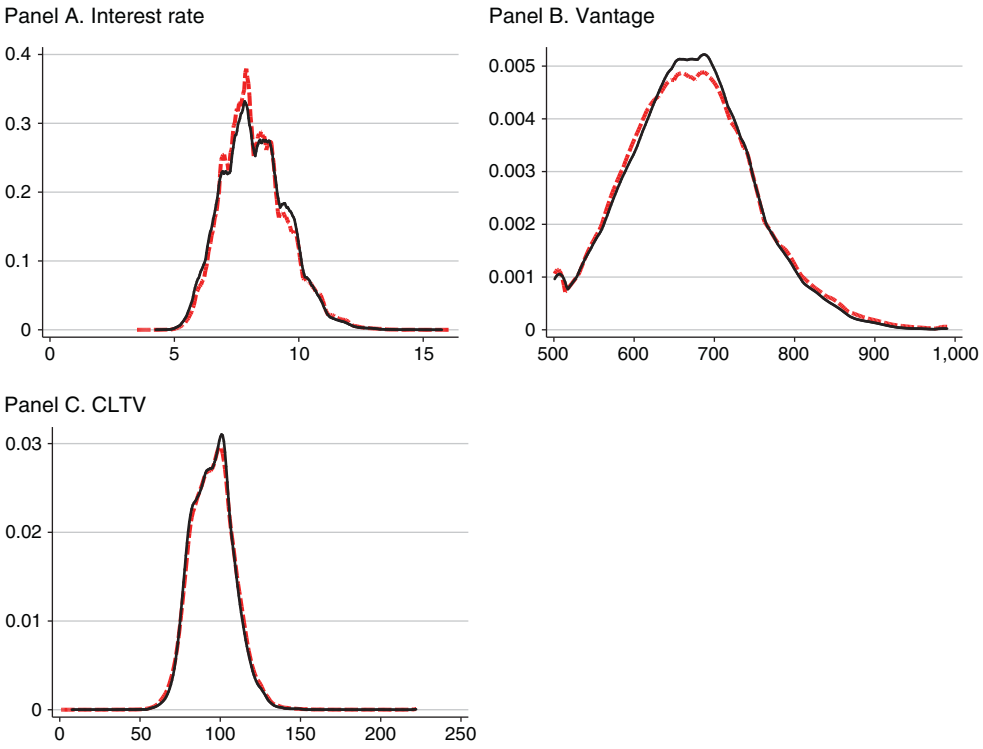

FIGURE 2. COMPARABILITY OF COUNTRYWIDE AND CONTROL GROUP: KERNEL DENSITY OF OBSERVABLES, JULY 2007

Notes: This figure shows the kernel density plots as of July 2007 for mortgage interest rate (panel A), Vantage credit score (panel B), and CLTV (panel C) for 2/28 ARMs in the matched sample. The solid line shows the Countrywide loans while the dashed line shows the corresponding values for mortgages in the control group.

Figures 2 and 3 show kernel density plots, comparing the distributions of loan terms for Countrywide and control group loans at two points in time—at the beginning of our sample (July 2007) and during the month before the settlement announcement (September 2008). The distribution of loan characteristics is virtually identical for the two groups in July 2007, but in September 2008 we see a difference in the tails: Countrywide mortgages include a slightly greater proportion of higher-risk loans as manifested by their high CLTVs and interest rates.

We explore our identifying assumption further for 2/28 ARMs by tracking the evolution by month of current interest rates, Vantage scores, and CLTV among 2/28 ARMs (see Figure A.1 in the online Appendix). Measured at means, Countrywide and control group loans display current interest rates, Vantage scores, and CLTVs that generally track each other closely prior to the settlement announcement.[22] However, some differences emerge in the last few months before the announcement. Most notably, a difference in current CLTV begins to emerge in the last few

[22] We also verify that default rates among Countrywide and control group loans follow similar trends prior to our estimation period (July 2007 through February 2009). Between mid-2006 and mid-2007 about 7.2 percent of Countrywide and 7.6 percent of control group loans had entered default (Figure A.2 in the online Appendix).

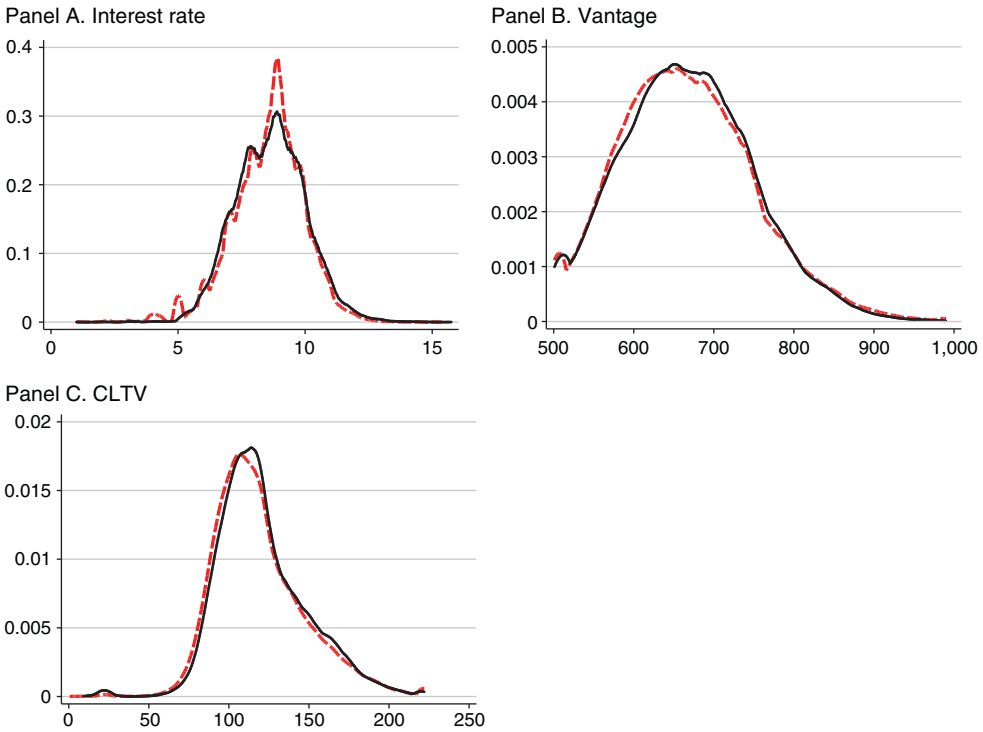

FIGURE 3. COMPARABILITY OF COUNTRYWIDE AND CONTROL GROUP: KERNEL DENSITY OF OBSERVABLES, SEPTEMBER 2008

Notes: This figure shows the kernel density plots as of September 2008 for mortgage interest rate (panel A), Vantage credit score (panel B), and CLTV (panel C) for 2/28 ARMs in the matched sample. The solid line shows the Countrywide loans while the dashed line shows the corresponding values for mortgages in the control group.

months before the announcement. This is consistent with Figure 3, which shows that Countrywide loans include a greater proportion of loans with extreme-valued CLTVs just before the settlement announcement.

We obtain similar inferences for non-subprime FRMs (see Table A1 in the online Appendix). We define a loan as non-subprime if the borrower's origination FICO was more than 620.[23] Non-subprime FRMs are comparable across most dimensions, including origination and current CLTV, origination FICO and current Vantage, origination balance, and credit card utilization. Some differences exist with respect to interest rates, with average interest rate being 30 basis points lower for Countrywide loans.

Overall, this analysis shows that the mean characteristics of Countrywide and control group were comparable prior to the settlement, but that Countrywide loans have a relatively larger share of risky tail loans. This reflects the fact that Countrywide loans include a greater proportion of mortgages that were originated in areas where house prices declined most steeply during the crisis and that were often extended to

[23] Subprime status is difficult to define because there is no single agreed-upon definition. In order to be conservative, we define an FRM as non-subprime if the borrower's origination FICO was greater than 620, a common threshold for subprime status. Most lenders define a borrower as subprime if the borrower's FICO credit score is below 620 on a scale that ranges from 300 to 850. This is also how the Office of the Comptroller of the Currency defines subprime status in their mortgage metrics reports (see Keys et al. 2010).

high-risk borrowers, as reflected by their higher interest rates. Because some variation in default rates between Countrywide and control group loans could be due to differences in the mix of mortgages originated, we include a wide range of controls for loan, borrower, and regional characteristics in the regressions reported below. We also test whether our results vary when we subset on a relatively homogeneous subset of loans that excludes high-risk mortgages.[24]

IV. Results

A. *Evolution of Default Rates*

Figure 4 plots the average monthly rollover rate for Countrywide and control group loans during the five quarters preceding the settlement announcement, the quarter just after the announcement (Oct–Dec 2008), and the Jan–Feb 2009 period. Panel A examines all loans. Panel B subsets on low utilization borrowers, defined as those who had sufficiently large liquidity available to them through credit cards that they could charge the equivalent of five or more months of mortgage payments when they become delinquent on their mortgages. Panel C subsets on borrowers whose mortgages had a CLTV less then 100 percent at the time of their delinquency. These low credit utilization and low CLTV borrowers were arguably less likely to default in the near term because they had significant untapped liquidity through their credit cards or some positive equity in their homes.

Panel A of Figure 4 shows a significant increase in the rollover rate of Countrywide loans relative to the control group during the Oct–Dec 2008 period, the first quarter during which we could observe an effect of the settlement announcement. However, we also observe an increase in the rollover rate of Countrywide loans relative to the control group during the quarter immediately preceding the settlement announcement. This pre-settlement increase is somewhat less evident when we subset on low utilization borrowers in panel B. When we consider low CLTV borrowers in panel C, we observe a substantial post-settlement increase in Countrywide's rollover rate relative to the control group, but no visible pre-settlement difference.

The patterns in Figure 4 suggest that the differential pre-settlement increase in Countrywide's default rate is driven by high-risk loans, which are more concentrated in the Countrywide group (as Figure 3 showed). We explore this possibility by subsetting on Countrywide and control group loans with CLTVs, interest rates, and credit scores that were within one standard deviation of the corresponding Countrywide means during each month of the pre-settlement period. By trimming our sample in this way, we subset on relatively homogeneous loans and exclude high-risk loans with extreme characteristics. We observe no differential pre-settlement default patterns in this sample, but continue to find that Countrywide's rollover rate increased

[24] It might be thought that unobservable differences are potentially important because Countrywide was sued while other mortgage lenders and servicers were not. However, evidence presented by Lacko and Pappalardo (2007) suggests that Countrywide's lending practices may not have differed substantially from those of other institutions. It appears that Countrywide was sued by state attorneys general because it was the largest originator and servicer of subprime mortgages and was still solvent at the time of the lawsuits (earlier in 2008, it had been acquired by Bank of America). Other originators, such as New Century and IndyMac, had already collapsed and either filed for bankruptcy or been placed into receivership by the federal government.

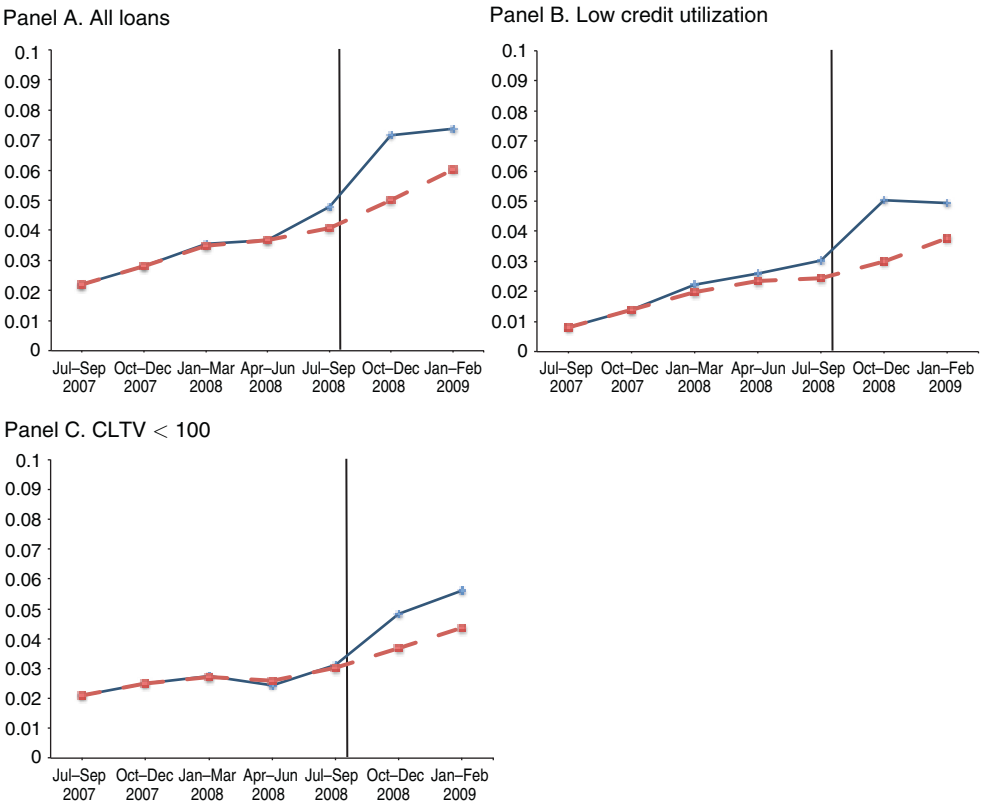

FIGURE 4. EVOLUTION OF DEFAULT RATES FOR 2/28 ARMS: COUNTRYWIDE AND CONTROL GROUP

Notes: This figure plots the average monthly rollover rate (the 60-day delinquency rate among borrowers who were current two months before) during each of the five quarters preceding the settlement announcement, the quarter just after the announcement (Oct–Dec 2008), and the Jan–Feb 2009 period. Panel A plots the rate for all the loans, panel B subsets on borrowers with low credit utilization, and panel C subsets on borrowers whose mortgages had a CLTV less than 100 percent at the time of delinquency. The solid line shows the rollover rate for Countrywide loans while the dashed line shows the corresponding rate for mortgages in the control group.

substantially relative to the control group immediately after the settlement announcement (see Figure A.3 in the online Appendix). We also observe that Countrywide's mean rollover rate reverts to the control group rate in early 2009.

This evidence suggests that the settlement induced an increase in Countrywide's default rate and that the increase is concentrated in the first quarter immediately following the settlement announcement. Moreover, it indicates that differential patterns in pre-settlement mean default rates are driven by high-risk loans that are more heavily concentrated in the Countrywide group. These patterns largely disappear, while the effect of the settlement persists, when we account for these high-risk tail loans.

B. *Baseline Model of Settlement Effects*

Table 2 implements equation (1) for 2/28 ARMs. Column 1 estimates the model using the full base sample, but includes minimal controls—time dummies, a Countrywide dummy, and interactions between the Countrywide and time dummies.

TABLE 2—DEFAULT SPECIFICATION FOR 2/28 ARMS

	Base sample (1)	Base sample (2)	Matched sample (3)	Matched sample (4)
Countrywide × Oct–Dec 2007	−0.0012**	−0.0005	0.0002	0.0004
	(0.0005)	(0.0005)	(0.0006)	(0.0005)
Countrywide × Jan–Mar 2008	−0.0003	−0.0008	−0.0002	0.0002
	(0.0005)	(0.0005)	(0.0006)	(0.0005)
Countrywide × Apr–Jun 2008	−0.0004	−0.0022***	−0.0018***	−0.0014**
	(0.0005)	(0.0005)	(0.0006)	(0.0006)
Countrywide × Jul–Sep 2008	0.0056***	−0.0003	0.0001	0.0006
	(0.0006)	(0.0005)	(0.0006)	(0.0006)
Countrywide × Oct–Dec 2008	0.0160***	0.0052***	0.0048***	0.0054***
	(0.0007)	(0.0006)	(0.0007)	(0.0006)
Countrywide × Jan–Feb 2009	0.0092***	0.0001	−0.0005	0.0005
	(0.0008)	(0.0007)	(0.0007)	(0.0007)
Countrywide	−0.0002	0.0016***	0.0017***	0.0018***
	(0.0004)	(0.0003)	(0.0004)	(0.0004)
Origination quarter	No	Yes	Yes	Yes
BlackBox control	No	Yes	Yes	Yes
MSA control	No	Yes	Yes	Yes
Reset control	No	Yes	Yes	Yes
Equifax control	No	No	No	Yes
Number of cases	9,448,457	9,448,457	6,261,055	6,261,055
Avg. delinquency 2008:III	0.049	0.049	0.048	0.048
Average share Countrywide	0.15	0.15	0.18	0.18
Countrywide × (2008:IV–2008:III)	0.0104	0.0055	0.0047	0.0048
Wald Test (*p*-value)	0.0000	0.0000	0.0000	0.0000

Notes: This table reports estimates of probit specification (1) using data on Hybrid 2/28 ARMs. The dependent variable takes the value of one when a loan becomes 60 days past due in a given month, conditional upon being current 60 days earlier, and is equal to zero otherwise. Column 1 estimates the model using the base sample and includes only time dummies, a Countrywide dummy that equals one if the loan is serviced by Countrywide, and interactions between the Countrywide and time dummies. The excluded category is July–September 2007, the first quarter of our analysis period. Column 2 adds indicators for the quarter of origination and additional controls from the BlackBox data, including a wide range of loan and borrower-level characteristics, such as origination LTV, origination FICO and CLTV (when available), and their interactions with time dummies, initial interest rate, current interest rate, reset controls capturing the timing of reset, and MSA fixed effects for the location of the property backing the loan. Columns 3 and 4 use the matched sample instead of the base sample. Column 3 includes the same controls as in column 2; column 4 includes additional Equifax controls, such as current CLTV, credit card utilization, and current credit scores (Vantage) and their change over time. Coefficients reported are marginal effects from a probit regression; standard errors are in parentheses; standard errors are clustered at the loan ID.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

The time dummies identify the quarters before and after the settlement announcement. The excluded category is Jul–Sept 2007, the first quarter of our analysis period. The final time dummy—Jan–Feb 2009—includes only two months because we stop our analysis in February 2009, the month before HAMP was announced. These Countrywide × Time interactions allow us to assess variation in the relative default rates of Countrywide and control group loans before and after the settlement announcement.

The coefficients are marginal effects and can be compared to the mean monthly rollover rate among Countrywide loans during the Jul–Sep 2008 period, as reported

at the bottom of the table ("Avg. delinquency").[25] In order to facilitate a direct assessment of the change in rollover rates between the quarters before (Jul–Sep 2008) and after (Oct–Dec 2008) the announcement, the bottom of the table also reports the magnitude and statistical significance of the difference between the estimated interactions, Countrywide × Jul–Sep 2008 and Countrywide × Oct–Dec 2008.

Column 2 adds additional controls from the BlackBox database. These controls include a wide range of loan- and borrower-level characteristics, such as origination FICO, initial LTV and CLTV (when available), current LTV, initial interest rate, and any change in rate over time. Column 2 also includes MSA fixed effects,[26] dummies that identify loans that had reset within the preceding three or six months, and interactions between these reset variables and the Countrywide dummy. These variables account for heterogeneity across loans and systematic differences between Countrywide and the control group, including the possibility that Countrywide mortgages experienced higher default rates at rate resets or during other time periods. Columns 3 and 4 analyze the matched sample: column 3 includes the same controls as in column 2; column 4 includes the set of Equifax controls, including information about second liens, credit card utilization, and current credit scores. Column 4 also uses current and origination CLTV.

Across all columns in Table 2, the Countrywide × Oct–Dec 2008 interaction is positive, statistically significant, and economically meaningful. Controlling for borrower and loan characteristics, the estimates imply a 0.48 to 0.54 percentage point absolute increase in the monthly rollover rate of Countrywide loans, relative to the control group, during the quarter following the settlement announcement. This represents a 10 to 11 percent increase in Countrywide's rollover rate relative to the average rate among Countrywide loans during the quarter immediately prior to the announcement (4.8 percent, as reported at the bottom of the table).[27] Because the magnitude of the effect does not vary meaningfully across columns 2 through 4, we conclude that restricting our attention to the matched sample with a full set of controls does not bias our inference.

As the unconditional mean default rates reported in Figure 4, the estimates in Table 2 point to a potential pre-settlement increase in Countrywide's rollover rate relative to the control group. In column 1, the coefficient for Countrywide × Jul–Sep 2008 is substantial and statistically significant. When we add controls that account for heterogeneity in borrower and loan characteristics, the magnitude of this coefficient becomes much smaller and its significance disappears. The controls that substantially reduce this coefficient are those that account for the current interest rate and its reset date, the current CLTV of the loan, and the borrower's current credit score (See Table A.2 in the online Appendix). This confirms what we saw in the univariate statistics: there are some differences in the composition

[25] The estimated treatment effect in nonlinear difference-in-differences probit models such as ours is given by the incremental effect of the coefficient of the interaction term (see Kremer and Snyder 2010; Puhani 2012).

[26] In unreported regressions, we obtained virtually identical results when we included both State dummies and State × Time interactions.

[27] These estimates compare the quarter immediately after the announcement (the fourth quarter of 2008) to the first quarter of our analysis period (the third quarter of 2007). At the bottom of the table, we present estimates comparing the quarter immediately after to the quarter immediately before (third quarter of 2008). The results are similar: Estimates range from 0.48 to 0.55 percentage points, again representing a 10 to 11 percent increase relative to the rollover rate during the third quarter of 2008.

of Countrywide and control group loans, especially with respect to high-risk loans. When we include a full battery of controls in column 4, all pre-settlement Countrywide × Time interactions are insignificant and small in magnitude except for the Countrywide × Apr–Jun 2008 interaction, which is marginally significant, negative, and small in magnitude.

Table 2 also shows that the settlement effect is concentrated in the first quarter following its announcement. There is no apparent effect during Jan–Feb 2009. This pattern may reflect the way information about the Countrywide settlement was transmitted to borrowers. It was announced through media channels in early October 2008 (Countrywide subsequently sent letters to borrowers beginning in December 2008). If only a subset of Countrywide borrowers received news of the settlement, and responded quickly, we might not observe an effect in early 2009. In Section V we discuss the economic importance of our estimates and their implications.

Overall, this evidence is consistent with our analysis of mean rollover rates from the previous section: we find a substantial increase in the relative default rate of Countrywide loans immediately after the settlement. Although we also observe a pre-settlement relative increase in the Countrywide default rate, this effect disappears when we control for loan characteristics.

C. *Settlement Effects by Credit Card Utilization and CLTV*

The baseline results displayed in Table 2 report a marked post-settlement increase in the rollover rate of Countrywide loans relative to the control group. This could reflect strategic behavior, or it could reflect an increase in defaults by economically distressed borrowers who were already highly likely to default in the near term. We address this concern by identifying subsets of borrowers who were unlikely to default in the absence of the settlement.

We stratify our sample by levels of credit card utilization and CLTV (both measured monthly). With respect to utilization, we identify three groups: borrowers with access to credit equal to more than five months of mortgage payments ("> 5 Months"), those with available credit equal to one to five months of payments ("1–5 Months"), and those with available credit equal to no more the one payment ("0–1 Months"). We hypothesize that borrowers with high levels of available credit (e.g., "> 5 Months") are likely to be less liquidity constrained and therefore less vulnerable to economic shocks than borrowers with lower levels of available credit.[28]

We similarly separate borrowers into three groups based on current CLTV: borrowers with CLTV less than 100 ("above water"), those with CLTV between 100 and 120, and those with CLTV greater than 120 ("underwater"). Again, we hypothesize that borrowers with CLTV under 100 are less likely to default because they have positive home equity. Finally, we identify a group of borrowers who had high available credit ("> 5 Months"), but were underwater on their homes ("CLTV > 100"). These homeowners are often thought to be the most likely to engage in strategic behavior.

[28] In unreported regressions we verify that our results are robust to different definitions of credit utilization. We reran our regressions separately on borrowers with zero to one month, one to two months, two to four months, four to six months, and six to twelve months of available credit. Consistent with Table 3, we find that the post-settlement relative increase in rollover rates among Countrywide loans is larger among borrowers with greater available credit.

Table 3—Default Specification for 2/28 ARMs by Current Credit Utilization and CLTV

	> 5 months (1)	1–5 months (2)	0–1 months (3)	CLTV < 100 (4)	100 ≤ CLTV < 120 (5)	120 ≤ CLTV (6)	> 5 months and CLTV > 100 (7)
Countrywide × Oct–Dec 2007	−0.0004	0.0008	−0.0001	0.0011	−0.0011	−0.0059	−0.0026
	(0.0008)	(0.0009)	(0.0005)	(0.0006)	(0.0008)	(0.0035)	(0.0016)
Countrywide × Jan–Mar 2008	0.0012	0.0008	−0.0001	0.0013	−0.0008	−0.0054	−0.0006
	(0.0009)	(0.0009)	(0.0005)	(0.0006)	(0.0008)	(0.0034)	(0.0016)
Countrywide × Apr–Jun 2008	0.0003	−0.0014	−0.0014	−0.0009	−0.0032***	−0.0055	−0.0024
	(0.0007)	(0.0009)	(0.0010)	(0.0007)	(0.0008)	(0.0033)	(0.0015)
Countrywide × Jul–Sep 2008	0.0011	0.0018	0.0015	0.0009	−0.0011	0.0007	−0.0011
	(0.0008)	(0.0010)	(0.0011)	(0.0008)	(0.0009)	(0.0031)	(0.0015)
Countrywide × Oct–Dec 2008	0.0054***	0.0052***	0.0063***	0.0050***	0.0038***	0.0076	0.0049**
	(0.0011)	(0.0012)	(0.0013)	(0.0011)	(0.0012)	(0.0039)	(0.0021)
Countrywide × Jan–Feb 2009	0.0002	0.0009	0.0015	0.0049***	−0.0004	−0.0029	−0.0028
	(0.0009)	(0.0012)	(0.0014)	(0.0014)	(0.0011)	(0.0035)	(0.0017)
Countrywide	−0.0001	0.0011	0.0025***	0.0005	0.0040***	0.0078**	0.0025
	(0.0005)	(0.0007)	(0.0008)	(0.0004)	(0.0007)	(0.0035)	(0.0016)
Origination quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BlackBox control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reset control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Equifax control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,210,922	1,639,789	1,748,890	1,994,158	1,715,891	1,067,641	611,797
Avg. share Countrywide	0.18	0.19	0.18	0.16	0.18	0.19	0.20
Avg. Countrywide 2008:III delinquency	0.030	0.041	0.052	0.031	0.039	0.078	0.040
Countrywide × (2008:IV–2008:III)	0.0043	0.0034	0.0048	0.0041	0.0049	0.0069	0.006
Wald Test (p-value)	0.0000	0.0019	0.0001	0.0010	0.0000	0.0001	0.0000

Notes: This table reports estimates of probit specification (1) for Hybrid 2/28 ARMs, but stratifies the Matched Sample by borrowers current credit utilization and CLTV. The models are estimated using the full set of BlackBox and Equifax controls used in column 4 of Table 2. The dependent variable takes the value of one if the loan becomes 60 days past due in a given month, conditional upon being current 60 days earlier, and is equal to zero otherwise. The excluded category is July–September 2007, the first quarter of our analysis period. Columns 1 through 3 separate borrowers by available credit card utilization, 4 through 6 separate them by CLTV, and 7 subsets on underwater borrowers with high available credit utilization. Coefficients reported are marginal effects from a probit regression; standard errors are in parentheses; standard errors are clustered at the loan ID.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

Table 3 reruns our main specification with the full set of controls (column 4 in Table 2) for each group of borrowers. Columns 1 through 3 separate borrowers by credit card utilization, 4 through 6 separate them by CLTV, and 7 subsets on underwater borrowers with high available utilization. As the bottom of the table shows ("Avg. Countrywide 2008:III delinquency") pre-settlement rollover rates are substantially lower among borrowers with lower CLTVs and higher levels of available credit. These patterns are consistent with our hypothesis that, prior to the settlement, borrowers with substantial available credit and positive home equity were substantially less likely to default than more credit-constrained or "underwater" borrowers.

Across columns 1 through 7, we observe a substantial post-settlement increase in Countrywide's relative rollover rate. Stratifying borrowers by credit card utilization, columns 1 through 3 show that the relative effect of the settlement was largest among borrowers with the most available credit. Among borrowers with "$>$ 5 Months" of available credit, Countrywide's monthly rollover rate increased by 0.54 percentage points. This represents an 18 percent increase relative to the pre-settlement rate. Among borrowers in the "1–5 Months" and "0–1 Months" categories, the estimates represent 13 and 12 percent relative increases, respectively.[29]

We observe similar patterns when we stratify loans by CLTV in columns 4 through 6. Countrywide's relative rollover rate increased by 0.50 percentage points among "above-water" borrowers with CLTV $<$ 100, a 16 percent increase compared to the pre-settlement rollover rate. We also observe a relative increase in defaults during January–February 2009 among borrowers with CLTV $<$ 100.[30] The estimates for underwater borrowers—0.38 and 0.76 percentage point effects—represent 10 percent increases relative to the pre-settlement default rate (and the effect is only marginally significant for borrowers with CLTV $>$ 120).[31] Column 7 of Table 3 provides evidence that the settlement induced an increase in Countrywide's relative rollover rate among underwater borrowers with substantial available credit. The 0.49 percentage point effect translates into a 12 percent increase compared to the pre-settlement delinquency rate among Countrywide loans.[32]

Overall, these results support our hypothesis that the settlement induced defaults among borrowers who were unlikely to default otherwise, at least in the near future. Equally important, as we look across the columns in Table 3, we do not find significant evidence of differential pre-settlement default patterns. This is consistent with our previous findings, which indicate that these patterns are driven by Countrywide high-risk loans and that, once we control for these loans or consider a more homogenous sample of mortgages, these patterns are no longer evident.

D. *Effects of the Settlement on Nontargeted Debts*

The settlement targeted subprime first lien mortgages. We do not expect to observe an increase in defaults among nontargeted debts—such as second lien mortgages and credit card debt—in response to the settlement. Similarly, we do not expect the settlement announcement to affect default behavior of borrowers who were not eligible for benefits, such as borrowers with non-subprime mortgages. Although the

[29] The magnitude of the post-settlement increase is slightly smaller when we compute the estimated change between the quarters immediately before and after the settlement. As reported at the bottom of Table 3, the absolute increase is 0.43 percentage points among borrowers with "$>$ 5 Months" of available credit, a 14 percent increase relative to the pre-settlement mean. Among borrowers in the other categories, the increase is smaller—an 8 percent increase among borrowers in the "1–5 Months" category and a 9 percent increase among borrowers in the "0–1 Months" category.

[30] Borrowers with lower CLTV levels may have taken more time to respond, possibly as their perceived cost of strategic behavior was higher.

[31] When we compute the difference between the estimated coefficients for Countrywide $\times$ Oct–Dec 2008 and Countrywide $\times$ Jul–Sep 2008 (the quarters before and after the settlement), we obtain comparable results, as shown at the bottom of Table 3. Among above-water borrowers, we observe a 13 percent increase in Countrywide's relative rollover rate compared to the pre-settlement mean. Borrowers with CLTV above 120 exhibit an increase of only 9 percent.

[32] The effect is even larger—15 percent compared to the pre-settlement mean—when we compare the estimated coefficients for Countrywide $\times$ Oct–Dec 2008 and Countrywide $\times$ Jul–Sep 2008, as the bottom of Table 3 shows.

settlement offered relief to subprime fixed-rate mortgage (FRM) borrowers, the vast majority of securitized FRMs in our data are non-subprime loans offered to borrowers with relatively high credit ratings. Because these non-subprime FRMs were not targeted by the settlement, they provide a useful placebo test.

Table 4 tests these hypotheses. Columns 1 and 2 reestimate our main specification, but change the dependent variable to measure the probability of being 60 days past due on a second lien (column 1) or missing a payment on credit card debt (column 2), conditional upon being current two months earlier. Borrowers are included in these regressions only if they have a second lien or credit card. Across both columns, we observe no effect of the settlement on the relative delinquency rate of Countrywide borrowers, consistent with the hypothesis that the settlement did not induce defaults on nontargeted debts.[33]

Columns 3 and 4 rerun these regressions on subsets of borrowers with high available credit (> 5 Months) and borrowers with above-water mortgages (CLTV < 100). Although these borrowers had the lowest default rates on first mortgages prior to the settlement announcement, as Table 3 showed, their rollover rates exhibited the strongest response to the announcement. Yet we find no evidence that the settlement increased delinquency rates on nontargeted debts among these borrowers, relative to control group. To the contrary, column 4 shows that credit card delinquency rates *decreased* among low utilization Countrywide borrowers, relative to the control group, after the settlement announcement. This pattern suggests that some borrowers may have strategically defaulted on first mortgages and then used the additional available cash flow to service credit card debts. With respect to second liens, we observe a similar pattern, though the effects are not significant except in Jan–Feb 2009. These results suggest that the settlement may have induced behavior that effectively reverses the priorities of first and second liens: Countrywide borrowers continued making payments on lower-priority second liens loans while defaulting on more senior loans.[34]

Finally, column 7 estimates our main specification using data on non-subprime fixed-rate mortgages (FRMs). Again, we observe no increase in rollover rates among Countrywide borrowers, relative to the control group, during the months following the settlement announcement. Indeed, relative rollover rates appear to have declined among these Countrywide borrowers during those months.[35]

[33] This evidence also suggests that the delinquency induced by the Countrywide program did not shift the "moral compass" of borrowers by encouraging them to default on other types of debt.

[34] We also estimated a version of our main specification in which the dependent variable equals 1 if the borrower becomes 60 days delinquent, conditional upon being current 2 months earlier, while remaining current on credit cards for at least 6 months following the month in which he or she becomes 60 days delinquent. This dependent variable measures a type of default behavior—defaulting on first mortgages while remaining current on other debts—that others have described as "strategic behavior." We observe a substantial increase in this type of default among Countrywide borrowers, relative to the control group during the quarter following the settlement announcement. The effect is larger when we subset on borrowers with more available credit or those with above-water mortgages.

[35] We have also investigated the program response among Countrywide subprime FRMs that were targeted by the settlement. For that purpose, we define an FRM loan as subprime if the borrower's origination FICO was less than 620. We find some evidence that Countrywide subprime FRMs experienced a relative increase in delinquency rates after the announcement, but our estimates are imprecise because we have only about 10,000 Countrywide subprime FRMs in our data (compared to more than 130,000 non-subprime FRMs).

TABLE 4—DEFAULT SPECIFICATIONS FOR OTHER DEBT TYPES

			5+ months utilization		CLTV < 100		
	2nd lien (1)	Credit card (2)	2nd lien (3)	Credit card (4)	2nd lien (5)	Credit card (6)	Non-subprime FRM (7)
Countrywide × Oct–Dec 2007	0.0002	−0.0016	−0.0011	−0.0026	0.0001	−0.0009	0.0000
	(0.0008)	(0.0012)	(0.0012)	(0.0017)	(0.0006)	(0.0020)	(0.0000)
Countrywide × Jan–Mar 2008	0.0012	0.0009	−0.0009	−0.0030	0.0011	0.0039	0.0003***
	(0.0009)	(0.0014)	(0.0011)	(0.0018)	(0.0011)	(0.0025)	(0.0000)
Countrywide × Apr–Jun 2008	−0.0000	0.0004	−0.0018	−0.0022	−0.0002	0.0013	0.0003***
	(0.0000)	(0.0015)	(0.0010)	(0.0020)	(0.0010)	(0.0030)	(0.0001)
Countrywide × Jul–Sep 2008	0.0004	−0.0001	−0.0016	−0.0016	0.0013	−0.0000	0.0000
	(0.0008)	(0.0007)	(0.0011)	(0.0020)	(0.0014)	(0.0000)	(0.0000)
Countrywide × Oct–Dec 2008	0.0004	−0.0018	−0.0018	−0.0047**	−0.0002	0.0011	−0.0002***
	(0.0009)	(0.0016)	(0.0011)	(0.0021)	(0.0012)	(0.0037)	(0.0000)
Countrywide × Jan–Feb 2009	−0.0003	−0.0016	−0.0031***	−0.0033	0.0017	0.0071	−0.0002***
	(0.0081)	(0.0019)	(0.0010)	(0.0026)	(0.0019)	(0.0051)	(0.0000)
Countrywide	0.0018**	−0.0014	0.0033**	0.0033	0.0001	−0.0026	0.0004***
	(0.0008)	(0.0012)	(0.0014)	(0.0017)	(0.0005)	(0.0018)	(0.0000)
Origination quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BlackBox control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reset control	Yes	Yes	Yes	Yes	Yes	Yes	No
Equifax control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,906,151	3,230,307	525,191	903,902	265,800	870,999	8,920,874
Avg. share Countrywide	0.20	0.18	0.21	0.18	0.18	0.16	0.30
Avg. Countrywide 2008:III delinquency	0.028	0.073	0.021	0.045	0.010	0.082	0.0090
Countrywide × (2008:IV–2008:III)	0.0000	−0.0017	−0.0002	−0.0031	−0.0015	0.0011	−0.0002
Wald Test (p-value)	0.94	0.28	0.83	0.12	0.31	0.77	0.0000

Notes: This table reports estimates from models similar to probit specification (1), but with the dependent variable measuring delinquency on loans that were not targeted by the settlement. The models are estimated using the matched sample and the full set of BlackBox and Equifax controls used in column 4 of Table 2. In column 1 below, the dependent variable equals one if the borrower becomes 60 days past due on a second lien, conditional upon being current two months earlier, and equals zero otherwise. In column 2, the dependent variable equals one if the borrower becomes delinquent on credit card debt, conditional upon being current two months earlier, and equals zero otherwise. Columns 3–6 show the corresponding results after subsetting on borrowers with low credit utilization (columns 3 and 4) and CLTV < 100 (columns 5 and 6). Column 7 uses data on borrowers with fixed-rate mortgages (FRMs). The dependent variable equals one if the borrower becomes 60 days past due on a FRM, conditional upon being current two months earlier, and equals zero otherwise. Across all columns, the excluded category is July–September 2007, the first quarter of our analysis period. Coefficients reported are marginal effects from a probit regression; standard errors are in parentheses; standard errors are clustered at the loan ID.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

E. *Additional Robustness Checks*

Extending the Analysis Period.—In the foregoing analysis, we analyze default rates until February 2009, but do not consider data from subsequent months in order to avoid the potential confound created by the HAMP program. The downside of this approach is that it leaves open the possibility that the settlement merely accelerated defaults that would have happened later in time. If that were true, the relative increase in Countrywide's rollover rate in fourth quarter 2008 should be offset by relative decreases in subsequent quarters. We explore this possibility by extending

our analysis through December 2009. We observe a relative increase in the estimated Countrywide's rollover rate immediately after the settlement announcement, as reflected in the Countrywide × Oct–Dec 2008 interaction, but none of the subsequent Countrywide × Quarter interactions is negative and significant (see Figure A.4 in the online Appendix). This is inconsistent with the hypothesis that the settlement merely accelerated defaults that would have occurred anyway in the near term. Instead, these results indicate that the settlement induced a net increase in the stock of delinquent Countrywide loans and that this increase did not quickly reverse itself over time.

Alternative Modeling Strategies.—Our empirical strategy models the probability that a loan becomes 60 days delinquent in month t, conditional upon being current in month $t-2$. Because of this restriction, we are not estimating a standard hazard model. As we discussed above, we chose this specification because we believe that evidence of strategic behavior is more compelling if we observe a relative increase in Countrywide borrowers who abruptly defaulted on their loans but were current on their payments before they received news of the settlement. This specification also subsets on a relatively homogeneous group of borrowers, all of whom were current two months before the month of interest.

We confirmed, however, that a standard hazard model yields comparable results. Following Grogger and Bronars (2001) and DeCicca, Kenkel, and Mathios (2002), we estimated a version of our baseline specification—column 4 of Table 2—in which the dependent variable equals 1 when a loan becomes 60 days delinquent (without conditioning on being previously current). Once a loan becomes 60 days delinquent, it drops out of our sample. We account for possible duration dependence by including dummies for origination quarter and current quarter (which were already included in our baseline specification) and by including controls for loan age and loan age squared. This specification is a discrete-time hazard model. Estimating this specification, we find that Countrywide loans exhibit a relative increase in the hazard of being 60 days delinquent immediately after the settlement announcement. The magnitudes are similar to those reported in Table 2 (see Figure A.5 in the online Appendix).[36]

Alternative Control Groups.—Our empirical strategy treats all non-Countrywide loans as a control group. It is possible that our analysis is confounded by differential changes in default trends among particular loan servicers within the control group. To address this possibility, we reran our main specification—column 4 of Table 2—but included dummies that identify loans serviced by the top five non-Countrywide servicers and interacted these dummies with pre- and post-settlement time dummies. The remaining loans were left in the control group. Although we continue to find a strong effect of the settlement among Countrywide loans, we observe no impact among loans serviced by the top five non-Countrywide Servicers, supporting our empirical design. As an additional placebo test, we reran our specification, but dropped Countrywide loans and replaced the Countrywide indicator with an indicator for loans serviced by Wells Fargo, the second largest servicer in our

[36] We obtain similar results when we reestimate this specification using a complementary log-log regression, which is equivalent to a discrete-time proportional hazard model.

dataset. We find no meaningful post-settlement increase in the relative default rate among Wells Fargo loans.

Alternative Approaches to Time-Varying Effects.—Our estimates in Table 2 report an average settlement effect across all loan vintages. The settlement, however, could have impacted some loan vintages differently than others. For example, it may have been most beneficial to borrowers experiencing interest rate resets before or around the time the settlement was announced. To explore this possibility, we reran our main specification from Table 2 for each quarterly origination cohort. Despite a relatively small sample size for each cohort, we observe a statistically significant post-settlement relative increase in the Countrywide default rate both in cohorts that were resetting around the time of the settlement (2006:II and 2006:III) and in cohorts that reset more than a year before the settlement announcement (2005:I, 2005:II, and 2006:I). The effects range from more than 10 percent to more than 20 percent compared to the pre-settlement delinquency rate among Countrywide loans.

Additionally, our empirical specifications use quarterly time effects. This allows us to estimate the settlement effect with greater power, avoiding some of the issues associated with noisy variation in monthly default rates. We verified, however, that our results are robust to the way we model time effects. For example, we reestimated our main specification, but replaced the quarterly dummies with monthly dummies, which were interacted with the Countrywide indicator. Consistent with our prior results, we observe a substantial increase in Countrywide's rollover rate during November and December 2008 (see Figure A.6 in the online Appendix).

V. Conclusion

We investigate whether homeowners respond strategically to news of mortgage modification programs by defaulting on their mortgages. We analyze a program that used a simple eligibility criterion: A borrower becomes eligible upon default. We find that this program induced an increase in defaults. The borrowers whose estimated default rates increased the most were those who appear to have been the least likely to default otherwise.

"Back-of-the-envelope" calculations suggest that the estimated effects of strategic behavior could be economically meaningful. Over 45 million first-lien mortgages were outstanding and current in early 2007, when housing prices began to fall.[37] Suppose lenders considered at that time whether to implement a national mortgage modification program with simple eligibility criteria similar to the Countrywide settlement. The estimates in Table 2 imply that the Countrywide settlement resulted in a 0.54 percentage point absolute increase in the monthly delinquency rate during the quarter immediately after its announcement. This means that 1.62 percent of current loans became delinquent during this quarter as a result of the settlement announcement. Applying that estimate (1.62 percent) to the stock of outstanding, current

[37] Based on LPS and BlackBox databases.

loans (45 million), a national program would immediately induce over 700,000 additional strategic defaults.[38]

If the typical loan modification offered debt relief equivalent to about 30 percent of a borrower's outstanding loan balance (with an average balance of about $200,000), strategic defaults would impose losses of over $43 billion on mortgage lenders and investors (in terms of foregone payments from borrowers).[39] If programs with simple eligibility criteria have longer-run impacts on strategic default rates—which we cannot assess due to the limits of our empirical setting—the losses would be larger. On the other hand, we note that such long-term costs could also be lower if some of the strategic defaulters would have defaulted anyway at some point in the future. Likewise, because the Countrywide settlement compensated borrowers who allegedly suffered deception, the borrowers may have felt entitled to take advantage of the program in a way that wouldn't occur in a program with different origin.

With these caveats in mind, we can use our rough cost estimate to explore the potential trade-off facing mortgage lenders (and investors). Simple modification programs can result in strategic behavior leading to unnecessary modifications. On the other hand, if lenders try to avoid these losses by implementing slower programs with more complex eligibility criteria, they may fail to prevent foreclosures that also reduce payoffs to lenders (and homeowners). To illustrate this trade-off, assume that a foreclosure results in losses to lenders equal to about 50 percent of the borrower's outstanding loan balance.[40] Assume as well that foreclosures can be prevented by offering homeowners debt relief equivalent to about 30 percent of their balances. Unnecessary foreclosures, then, expose lenders to losses equal to 20 percent of the borrower's outstanding balance. Unnecessary modifications, by contrast, expose them to losses equal to 30 percent of the borrower's outstanding balance. A simple calculation indicates that lenders would be indifferent between a quick program generating over 700,000 unnecessary modifications and a slow program generating over one million unnecessary foreclosures. Both programs generate the same costs to lenders. This example suggests that concerns about strategic defaults may help explain the relatively slow pace of mortgage modifications during the recent crisis.[41]

Could lenders alleviate costs of strategic behavior by using our proxies—high available credit utilization and low current CLTV—to identify borrowers who are more likely to be acting strategically in response to a mortgage modification program? There are a number of challenges in applying these proxies to design more cost-effective modification programs. First, available utilization is manipulable: Borrowers can strategically increase their credit utilization in order to qualify for

[38] A similar increase in strategic defaults is implied by our estimates in Table 3, which subsets on less-risky borrowers with relatively high remaining credit card utilization and lower CLTV ratios. This implies that our back-of-the envelope calculations are unlikely to be biased by the relatively low average creditworthiness of Countrywide borrowers.

[39] We assume a loan modification equal to 30 percent of a borrower's outstanding loan balance because home prices fell over 30 percent after mid-2007, according to the Case-Shiller ten-city composite index (Sinai 2013). A modification of the magnitude we contemplate here would allow most homeowners to become above-water on their mortgages.

[40] This loss arises from (i) the house price decline that has already occurred and (ii) the deadweight costs of the foreclosure process.

[41] There are other factors that could adversely affect mortgage renegotiation such as institutional frictions implied by the high rate of securitization of loans at risk of foreclosure (see Piskorski, Seru, and Vig 2010 and Agrawal et al. 2011) or limited ability of servicers to handle distressed loans (Agrawal et al. 2012).

benefits. Second, although CLTV is less manipulable than utilization, it is harder to verify and often measured with noise, particularly for homes that haven't experienced recent transactions. As a result, a policy that makes benefits available only to borrowers with high estimated CLTVs could prevent some eligible borrowers from obtaining relief.[42]

The above rough calculations show that the costs associated with strategic default—even if relatively small compared to the amount of mortgage debt outstanding—may be large enough to induce lenders to favor slower, more cautious debt relief programs, which fail to prevent many foreclosures. Such foreclosures, however, can yield negative externalities for surrounding communities, as illustrated by Campbell, Giglio, and Pathak (2011) and Mian, Sufi, and Trebbi (2011). Additionally, debt-relief programs may mitigate the distorting effects of high household debt levels on aggregate demand, investment decisions, and employment (Mian and Sufi 2012).

Our analysis does not necessarily imply that it would be socially optimal to incentivize or require lenders to implement generous modification programs. These programs could generate other costs or undesirable redistributional effects that we have not studied here. Our results instead highlight a trade-off that merits further investigation: Mortgage modification policies that use simple but potentially manipulable eligibility criteria (i) do appear to generate economically meaningful strategic behavior, but (ii) may also offer benefits more quickly and to a larger group of homeowners at risk of default. More work must be done to assess the overall costs and benefits of such modification policies both in the near term and in the long run.

REFERENCES

Agarwal, Sumit, Gene Amromin, Itzhak Ben-David, Souphala Chomsisengphet, and Douglas D. Evanoff. 2011. "The Role of Securitization in Mortgage Renegotiation." *Journal of Financial Economics* 102 (3): 559–78.

Agarwal, Sumit, Gene Amromin, Itzhak Ben-David, Souphala Chomsisengphet, Tomasz Piskorski, and Amit Seru. 2012. "Policy Intervention in Debt Renegotiation: Evidence from Home Affordable Modification Program." National Bureau of Economic Research Working Paper 18311.

Agarwal, Sumit, David O. Lucca, Amit Seru, and Francesco Trebbi. Forthcoming. "Inconsistent Regulators: Evidence from Banking." *Quarterly Journal of Economics*.

Benmelech, Efraim, and Nittai K. Bergman. 2008. "Liquidation Values and the Credibility of Financial Contract Renegotiation: Evidence from U.S. Airlines." *Quarterly Journal of Economics* 123 (4): 1635–77.

Berndt, Antje, and Anurag Gupta. 2009. "Moral Hazard and Adverse Selection in the Originate-to-Distribute Model of Bank Credit." *Journal of Monetary Economics* 56 (5): 725–43.

Bolton, Patrick, and Howard Rosenthal. 2002. "Political Intervention in Debt Contracts." *Journal of Political Economy* 110 (5): 1103–34.

Campbell, John Y. 2006. "Household Finance." *Journal of Finance* 61 (4): 1553–1604.

Campbell, John Y., Stefano Giglio, and Parag Pathak. 2011. "Forced Sales and House Prices." *American Economic Review* 101 (5): 2108–31.

Citigroup. 2009. "A Brief (And Complete) History of Loan Modifications." Unpublished.

Cohen-Cole, Ethan, and Jonathan Morse. 2010. "Your House or Your Credit Card, Which Would You Choose? Personal Delinquency Tradeoffs and Precautionary Liquidity Motives." Unpublished.

[42] The difficulty in measuring CLTV may help explain why recent modification programs have been fairly generous along this dimension. Many programs, for example, require a CLTV greater than 75 percent. A criterion like this effectively ensures that the vast majority of underwater borrowers will be considered for benefits (see Citigroup 2009).

Countrywide Financial Corporation. 2008. "Multistate Settlement Term Sheet." Unpublished.
DeCicca, Philip, Donald Kenkel, and Alan Mathios. 2002. "Putting Out the Fires: Will Higher Taxes Reduce the Onset of Youth Smoking?" *Journal of Political Economy* 110 (1): 144–69.
Elul, Ronel, Nicholas S. Souleles, Souphala Chomsisengphet, Dennis Glennon, Robert Hunt. 2010. "What 'Triggers' Mortgage Defaults." *American Economic Review* 100 (2): 490–94.
Farhi, Emmanuel, and Jean Tirole. 2012. "Collective Moral Hazard, Maturity Mismatch and Systemic Bailouts." *American Economic Review* 102 (1): 60–93.
Foote, Christopher L., Kristopher S. Gerardi, and Paul S. Willen. 2008. "Negative Equity and Foreclosure: Theory and Evidence." *Journal of Urban Economics* 64 (2): 234–45.
Grogger, Jeffrey, and Stephen G. Bronars. 2001. "The Effect of Welfare Payments on the Marriage and Fertility Behavior of Unwed Mothers: Results from a Twins Experiment." *Journal of Political Economy* 109 (3): 529–45.
Guiso, Luigi, Paola Sapienza, and Luigi Zingales. 2013. "The Determinants of Attitudes towards Strategic Default on Mortgages." *The Journal of Finance* 68 (4): 1473–1515.
Keys, Benjamin, Tanmoy Mukherjee, Amit Seru, and Vikrant Vig. 2010. "Did Securitization Lead to Lax Screening? Evidence From Subprime Loans." *Quarterly Journal of Economics* 125 (1): 307–62.
Keys, Benjamin, Amit Seru, and Vikrant Vig. 2012. "Lender Screening and the Role of Securitization: Evidence from Prime and Subprime Mortgage Markets." *Review of Financial Studies* 25 (7): 2071–2108.
Kremer, Michael, and Christopher M. Snyder. 2010. "When are Drugs More Lucrative than Vaccines?" Unpublished.
Kroszner, Randall. 2003. "Is It Better to Forgive than to Receive? An Empirical Analysis of the Impact of Debt Repudiation." Unpublished.
Krueger, Alan B., and Bruce D. Meyer. 2002. "Labor Supply Effects of Social Insurance." In *Handbook of Public Economics*. Vol. 4, edited by A. J. Auerbach and M. Feldstein, 2327–92. Amsterdam: Elsevier Science B.V.
Lacko, James M., and Janis K. Pappalardo. 2007. "Improving Consumer Mortgage Disclosures: An Empirical Assessment of Current and Prototype Disclosure Forms." Federal Trade Commission Bureau of Economics Staff Report.
Matvos, Gregor. 2013. "Renegotiation Design: Evidence from NFL Roster Bonuses." Unpublished.
Mayer, Christopher J., Edward R. Morrison, and Tomasz Piskorski. 2009. "A New Proposal for Loan Modifications." *Yale Journal on Regulation* 26 (2): 417–29.
Mayer, Christopher, Edward Morrison, Tomasz Piskorski, and Arpit Gupta. 2014. "Mortgage Modification and Strategic Behavior: Evidence from a Legal Settlement with Countrywide: Dataset." *American Economic Review*. http://dx.doi.org/10.1257/aer.104.9.2830.
Mayer, Christopher, Karen Pence, and Shane M. Sherlund. 2009. "Symposium: Early Stages of the Credit Crunch: The Rise in Mortgage Defaults." *Journal of Economic Perspectives* 23 (1): 27–50.
Meyer, Bruce. 1990. "Unemployment Insurance and Unemployment Spells." *Econometrica* 58 (4): 757–82.
Mian, Atif R., and Amir Sufi. 2009. "The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis." *Quarterly Journal of Economics* 124 (4): 1449–96.
Mian, Atif R., and Amir Sufi. 2011. "House Prices, Home Equity-Based Borrowing, and the US Household Leverage Crisis." *American Economic Review* 101 (5): 2132–56.
Mian, Atif R., and Amir Sufi. 2012. "What Explains High Unemployment? The Aggregate Demand Channel." National Bureau of Economic Research Working Paper 17830.
Mian, Atif R., Amir Sufi, and Francesco Trebbi. 2011. "Foreclosures, House Prices, and the Real Economy." National Bureau of Economic Research Working Paper 16685.
Piskorski, Tomasz, Amit Seru, and Vikrant Vig. 2010. "Securitization and Distressed Loan Renegotiation: Evidence from the Subprime Mortgage Crisis." *Journal of Financial Economics* 97 (3): 369–97.
Piskorski, Tomasz, and Alexei Tchistyi. 2011. "Stochastic House Appreciation and Optimal Mortgage Lending." *Review of Financial Studies* 24 (5): 1407–46.
Poole, William. 2009. "Moral Hazard: The Long-Lasting Legacy of Bailouts." *Financial Analysts Journal* 65 (6): 17–23.
Puhani, Patrick A. 2012. "The Treatment Effect, the Cross Difference, and the Interaction Terms in Nonlinear 'Difference-in-Differences' Models." *Economics Letters* 115 (1): 85–7.
Purnanandam, Amiyatosh K. 2011. "Originate-to-Distribute Model and the Subprime Mortgage Crisis." *Review of Financial Studies* 24 (6): 1881–1915.
Rajan, Uday, Amit Seru, and Vikrant Vig. 2010. "The Failure of Models that Predict Failure: Distance, Incentives and Defaults." Unpublished.

Roberts, Michael R., and Amir Sufi. 2009. "Renegotiation of Financial Contracts: Evidence from Private Credit Agreements." *Journal of Financial Economics* 93 (2): 159–84.

Sinai, Todd. 2013. "House Price Moments in Boom-Bust Cycles." In *Housing and the Financial Crisis*, edited by Edward L. Glaeser and Todd Sinai, 19–68. Chicago: University of Chicago Press.

State of California. 2008a. "Complaint for Restitution, Injunctive Relief, Other Equitable Relief, and Civil Penalties." *California v. Countrywide Financial Corporation*, Case No. LC083076. Superior Court of the State of California for the County of Los Angeles (June 24, 2008).

State of California. 2008b. "Stipulated Judgment and Injunction." *California v. Countrywide Financial Corporation*, Case No. LC083076. Superior Court of the State of California for the County of Los Angeles (October 20, 2008).

State of Illinois. 2008. "Complaint for Injunctive and Other Relief." *Illinois v. Countrywide Financial Corporation* (June 25, 2008).

Tufano, Peter. 2009. "Consumer Finance." *Annual Review of Financial Economics* 1: 227–47.

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