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Wenli Li
Federal Reserve Bank of Philadelphia

Michelle J. White
University of California, San Diego and NBER

Ning Zhu
University of California, Davis

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RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA
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Wenli Li
Federal Reserve Bank of Philadelphia

Michelle J. White
University of California, San Diego and NBER

and

Ning Zhu
University of California, Davis

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Abstract

This paper argues that the U.S. bankruptcy reform of 2005 played an important role in the mortgage crisis and the current recession. When debtors file for bankruptcy, credit card debt and other types of debt are discharged — thus loosening debtors' budget constraints. Homeowners in financial distress can therefore use bankruptcy to avoid losing their homes, since filing allows them to shift funds from paying other debts to paying their mortgages. But a major reform of U.S. bankruptcy law in 2005 raised the cost of filing and reduced the amount of debt that is discharged. We argue that an unintended consequence of the reform was to cause mortgage default rates to rise.

Using a large dataset of individual mortgages, we estimate a hazard model to test whether the 2005 bankruptcy reform caused mortgage default rates to rise. Our major result is that prime and subprime mortgage default rates rose by 14% and 16%, respectively, after bankruptcy reform. We also use difference-in-difference to examine the effects of three provisions of bankruptcy reform that particularly harmed homeowners with high incomes and/or high assets and find that the default rates of affected homeowners rose even more. Overall, we calculate that bankruptcy reform caused the number of mortgage defaults to increase by around 200,000 per year even before the start of the financial crisis, suggesting that the reform increased the severity of the crisis when it came.

Introduction

The financial crisis and the recession of 2008-09 were triggered by the bursting of the housing bubble and the subprime mortgage crisis that began in late 2006/early 2007. But we argue in this paper that U.S. personal bankruptcy law also played an important role. Because credit card debts and other types of unsecured debt are discharged in bankruptcy, filing for bankruptcy loosens homeowners' budget constraints and allows them to shift funds from paying other debts to paying their mortgages. Bankruptcy thus gives financially distressed homeowners a way to avoid losing their homes when their debts exceed their ability to pay. The availability of debt relief in bankruptcy was widely known; the costs of filing were low; and there was little stigma attached to filing. Even debtors with high incomes and high assets could take advantage of bankruptcy. But a major reform of U.S. bankruptcy law in 2005 raised the cost of filing and reduced the amount of debt discharged. It, therefore, caused bankruptcy filings to fall sharply. In this paper, we argue that an unintended consequence of bankruptcy reform was to increase the number of mortgage defaults by closing off a popular procedure that previously helped many financially distressed homeowners to pay their mortgages. The reform, therefore, contributed to the severity of the mortgage crisis by pushing up default rates even before the crisis began.

We use a large dataset of individual mortgages to test whether the 2005 bankruptcy reform caused mortgage defaults to rise. We find that mortgage defaults rose by around 15% after the reform went into effect and that the default rates of homeowners with high incomes or high assets — who were particularly negatively affected by bankruptcy reform — rose even more. We estimate that the 2005 bankruptcy reform caused about 200,000 additional mortgage defaults to occur each year, thus adding to the severity of the mortgage crisis when it came.

Bernstein (2008) and Morgan, Iverson and Botsch (2008) first suggested that the 2005 bankruptcy reform caused mortgage defaults to rise. Bernstein did not provide any empirical tests. Morgan et al. hypothesized that bankruptcy reform caused default rates to rise by more in states with high homestead exemptions because homeowners in these states gained the most from filing for bankruptcy prior to the reform. They tested this

hypothesis by examining whether foreclosure rates rose more in states with higher homestead exemptions. But the 2005 bankruptcy reform did not, in fact, change homestead exemptions in bankruptcy, except by imposing a cap of $125,000 on the exemption that affected very few homeowners. As a result, their test is not very precise and they, in fact, did not find very strong support for their hypothesis.[1] Also because Morgan et al. used aggregate state-quarter data covering a long period of time, they could not distinguish between the effects of bankruptcy reform versus the effect of the mortgage crisis on default rates. In contrast, we examine the relationship between bankruptcy reform and mortgage default using a large sample of individual mortgages and a short period of time that ends before the start of the mortgage crisis. Our data also allow us to examine how particular provisions of the reform affected default rates of high-income and high-asset homeowners.

Our paper also relates to the recent literature explaining mortgage default using data on individual mortgages, including Keys, Mukherjee, Seru and Vig (2008); Gerardi, Shapiro, and Willen (2007); Mayer, Pence, and Sherlund (2008); Demyanyk and van Hemert (2008); Rajan, Seru, and Vig (2009); Elul (2009); and Jiang, Nelson, and Vytlacil (2009). We add to this literature by showing that bankruptcy law is another important factor explaining mortgage default.

The paper proceeds as follows. We start by discussing how U.S. bankruptcy law treats mortgage debt and how the 2005 bankruptcy reform affected homeowners' incentives to default on their mortgages. We then describe our dataset, our empirical model, and the results. In the last section, we estimate how many additional mortgage defaults occurred as a result of the bankruptcy reform.

Homeowners and Bankruptcy Before and After the 2005 Bankruptcy Reform

U.S. bankruptcy law provides two separate personal bankruptcy procedures — Chapter 7 and Chapter 13 — and both are relevant to homeowners in financial distress.

[1] Morgan et al (2008) tested whether foreclosure rates rose by more after bankruptcy reform in states with higher or unlimited homestead exemptions, using a separate dataset for prime and subprime mortgage foreclosures. They found a positive and significant relationship only for subprime mortgages in states with higher, but not unlimited, homestead exemptions.

Prior to 2005, all debtors were allowed to choose between them. Under Chapter 7, most unsecured debts are discharged. Debtors are only obliged to use their assets above an asset exemption level to repay unsecured debt, while their future earnings are entirely exempt. States set the asset exemption levels and have different exemptions for different types of assets, but the homestead exemption for equity in an owner-occupied home is nearly always the largest. In states with high homestead exemptions, even debtors with high assets and high income may gain from filing for bankruptcy under Chapter 7. Under Chapter 13, debtors must have regular earnings and must follow a court-supervised plan to repay some of their debt from future earnings over a three to five-year period. They are also obliged to use their non-exempt assets — if any — to repay.

How does filing for bankruptcy help homeowners in financial distress? Consider Chapter 7 first. Chapter 7 helps homeowners save their homes because discharging unsecured debt increases their ability to pay their mortgages.[2] In addition, filing under Chapter 7 stops mortgage lenders from foreclosing for a few months, which gives homeowners who have fallen behind on their mortgage payments additional time to pay. But the terms of residential mortgage contracts cannot be changed in Chapter 7. Thus filing under Chapter 7 helps homeowners save their homes but only if they can repay their mortgage arrears within a few months.

Chapter 7 also helps homeowners who give up their homes. They gain from having both unsecured debts and deficiency judgments (claims by lenders for the difference between the amount owed on the mortgage and the sale price of the home in foreclosure) discharged in bankruptcy. Homeowners also gain from filing because bankruptcy delays foreclosure, and they get cost-free housing during the bankruptcy procedure.[3] They also get more time to sell their homes privately and obtain the highest price.

Homeowners' gain from filing under Chapter 7 can be expressed as:

$$GainChapter7 = U_7 + H_7 - \max[A - X_A, 0] - C_7$$

[2] Berkowitz and Hynes (1999) first suggested that filing for bankruptcy helps homeowners keep their homes by reducing their unsecured debt.

[3] In some states, homeowners can even stay in their homes through foreclosure, which means that they become tenants and the lender (now the landlord) must go through an eviction procedure to force them to leave (Elias, 2008).

Here U_7 is the value of unsecured debt discharged in Chapter 7. Homeowners receive U_7 in bankruptcy regardless of whether they keep their homes or not. H_7 is the reduction in the present value of future housing costs when homeowners file under Chapter 7. If homeowners save their homes in Chapter 7, then H_7 is small or zero. If they give up their homes, then H_7 equals the reduction in the present value of future housing costs, including their gain from having cost-free housing during bankruptcy, from having deficiency judgments discharged, and from having lower housing costs when they shift from owning to renting. A is the value of homeowners' assets, which we assume are entirely in the form of home equity, and X_A denotes the state's asset (homestead) exemption. $\max[A - X_A, 0]$ is, therefore, the value of homeowners' non-exempt home equity. When non-exempt home equity is positive, homeowners in bankruptcy are forced to give up their homes for sale by the bankruptcy trustee, since part of the value of the home must be used to repay unsecured debt.[4] Finally, C_7 is the homeowners' cost of filing for bankruptcy under Chapter 7, including both time costs and out-of-pocket costs.

Now consider Chapter 13. Homeowners gain from filing under Chapter 13 if they owe large amounts on their mortgages but wish to save their homes. Under Chapter 13, they propose a repayment plan to repay their mortgage arrears in full, plus interest, over three to five years. They must also make all of their normal mortgage payments during the plan. Lenders cannot proceed with foreclosure as long as the homeowners are making the required payments; and, if the homeowners complete all of the payments specified in the plan, then the original mortgage contract is reinstated. Thus Chapter 13 gives homeowners more time to repay their mortgage arrears than Chapter 7. Also, second mortgages can be discharged in Chapter 13 if they are completely underwater, and

[4] Financial assets other than home equity are not generally exempt in bankruptcy, since states' exemptions for these assets are small. But homeowners can convert financial assets into home equity by paying down their mortgages before they file for bankruptcy. The additional home equity is exempt as long as total home equity is less than the state's homestead exemption.

bankruptcy trustees sometimes challenge fees and penalties that mortgage lenders add to overdue payments. [5]

Prior to 2005, homeowners proposed their own Chapter 13 plans and were allowed to choose the length of the plan period and the amount of unsecured debt to be repaid. They frequently proposed plans that repaid their mortgage arrears in full, but paid only a token amount to unsecured creditors. Bankruptcy judges generally accepted these plans as long as homeowners would not be required to repay any of their unsecured debt if they filed under Chapter 7. [6]

Homeowners who do not plan to save their homes also gain from filing under Chapter 13. More types of debt can be discharged in Chapter 13 than in Chapter 7; and homeowners can delay foreclosure and live cost-free in their homes for longer in Chapter 13, particularly if they propose and then withdraw several repayment plans.

Homeowners' gain from filing under Chapter 13 can be expressed as:

$$GainChapter13 = U_{13} + H_{13} - I_{13} - \max[A - X_A, 0] - C_{13}.$$

Here U and H have the same meaning as before, but they may take different values in Chapter 13 than Chapter 7. U_{13} exceeds U_7 for many filers because more types of debt are dischargeable in Chapter 13. H_{13} also exceeds H_7 for many filers because homeowners receive cost-free housing for longer in Chapter 13 than Chapter 7 and because second mortgages can be discharged only in Chapter 13. I_{13} denotes the present value of future income that is used to repay unsecured debt in Chapter 13; prior to 2005, this was generally only a token amount. Finally, homeowners' cost of filing under Chapter 13 is higher than their cost of filing under Chapter 7, or $C_{13} > C_7$.

Thus prior to 2005, homeowners in financial distress gained from filing for bankruptcy, regardless of whether they planned to save their homes or give them up. Homeowners who wished to save their homes were likely to default because of financial

[5] Having a second mortgage discharged in Chapter 13 requires that a valuation hearing be held, which raises bankruptcy costs. See Porter (2008) for a discussion of how lenders often add high fees to mortgages in default.

[6] The "best interests of creditors" test, § 1129(a)(7) of the U.S. Bankruptcy Code, requires that unsecured creditors receive no less in Chapter 13 than they would receive in Chapter 7.

distress and then to file for bankruptcy in order to save their homes; while those who planned to give up their homes gained from doing either.

Now consider how the 2005 bankruptcy reform changed homeowners' gains from defaulting and filing for bankruptcy. The reform made several important changes in bankruptcy law. First, it raised homeowners' costs of filing. According to a study by the U.S. Government Accountability Office (2008), filing costs rose by more than 50%. Costs also rose because of new requirements that filers must undergo credit counseling before filing, take a course in debt management during the bankruptcy process, and provide extensive documentation of their income and assets. Higher filing costs are predicted to reduce homeowners' probability of filing for bankruptcy and to raise default rates for homeowners who previously would have used bankruptcy to help pay their mortgages.

Second, the reform introduced a new "means test" that forces some high-income homeowners to file under Chapter 13 and to repay some of their unsecured debt from future income. Suppose first that homeowners have no non-exempt home equity. They first compute their average family income during the six months prior to filing and convert it to a yearly income figure, denoted *Y*. Then they compare their income to the median family income level in the state, adjusted for family size. State median income levels vary widely, from $46,000 for a family of three in Mississippi to $85,000 for a family of the same size in New Jersey and Connecticut. If *Y* is less than the state median income level, then homeowners are allowed to file under Chapter 7. But if *Y* exceeds the state median level, then homeowners must compute individualized income exemptions, denoted X_Y. They start with pre-determined allowances for housing costs, transport costs, and personal expenses. Then they add their mortgage and car loan payments in excess of the pre-determined housing and transport allowances. Then they add a list of other allowed expenses.[7] Their income exemption X_Y equals the total. Homeowners'

[7] The pre-determined amounts for housing, transport costs, and personal expenses are taken from Internal Revenue Service formulas for collecting from delinquent taxpayers. See www.justice.gov/ust/eo/bapcpa/20090315/meanstesting.htm. Other allowed expenses include the costs of caring for elderly or disabled relatives, some children's education expenses, tax payments, mandatory payroll deductions, costs of home security, and telecommunication costs.

non-exempt income equals income minus the income exemption, or $Y - X_Y$. If $Y - X_Y$ exceeds $2,000 per year, then homeowners must file under Chapter 13 if they file for bankruptcy at all and they must use all of their non-exempt income for five years, or $5(Y - X_Y)$, to repay their debt. Since the homeowners' obligation to repay debt from future income was a token amount prior to bankruptcy reform, those with high incomes now benefit less from filing for bankruptcy. These homeowners are predicted to default on their mortgages more often. We refer to this test as the "income-only means test."

Third, bankruptcy reform also harmed some homeowners who have both non-exempt income and non-exempt assets/home equity. Prior to the reform, these homeowners were obliged to use their non-exempt home equity, $A - X_A$, plus a token amount of future income to repay unsecured debt in Chapter 13 bankruptcy. But after the reform, their obligation to repay became the maximum of their non-exempt assets, $A - X_A$, or their non-exempt income over 5 years, $5(Y - X_Y)$. Thus, homeowners gain less from filing after bankruptcy reform if $5(Y - X_Y)$ exceeds $A - X_A$. We refer to this test as the "income/asset means test."

Finally, the reform imposed a new cap of $125,000 on the homestead exemption that applies to homeowners who live in states with homestead/asset exemptions exceeding $125,000 and have owned their homes for less than 3 1/3 years.[8] Homeowners affected by the cap found bankruptcy much less attractive after the reform, since they are now forced to give up their homes in bankruptcy. The adoption of the homestead exemption cap is, therefore, predicted to increase mortgage default by these homeowners.

Our predictions are, therefore, as follows: (1) The mortgage default rate is predicted to rise for all homeowners following the 2005 bankruptcy reform because the cost of filing for bankruptcy rose. (2) The default rates of homeowners who fail the income-only means test or the income/asset means test are predicted to rise after bankruptcy reform, since both groups gain less from filing after the reform. (3) The default rate of homeowners who are subject to the new cap on the homestead exemption is predicted to

[8] The cap only affects homeowners living in Arkansas, Florida, Iowa, Kansas, Oklahoma, Texas, and the District of Columbia (which have unlimited homestead exemptions); Arizona ($150,000); Massachusetts ($500,000); Minnesota ($200,000); and Nevada ($200,000, raised to $350,000 in 2006). See Elias (2008) and earlier editions.

rise after bankruptcy reform, since the cap forces them to give up their homes in bankruptcy. Table 1 shows the three groups of homeowners who were particularly negatively affected by bankruptcy reform as a function of whether they have non-exempt assets and/or non-exempt income. [9]

In the next section, we test the predictions that the default rates of homeowners in general rose after bankruptcy reform and that default rates of homeowners in the three negatively affected groups rose even more after bankruptcy reform.[10]

Data and Summary Statistics

We use individual mortgage data from LPS Applied Analytics, Inc., which include detailed information from the time of mortgage origination, plus updates each month on whether homeowners made their payments in full or whether they filed for bankruptcy. Both prime and subprime mortgages are covered. Our sample consists of first-lien, 30-year mortgages used for home purchase or refinance that originated between January 2004 and December 2005 and were in effect during at least part of our sample period. Thus, our sample consists of mortgages that originated near the peak of the housing bubble. We follow them until they are repaid in full, go into default, or until the sample period ends. Following the literature, we construct separate samples of prime and subprime mortgages.[11] Each sample contains 300,000 to 400,000 separate mortgages.[12]

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[9] See Elias (2006), White (2007), Eggum, Porter and Twomey (2008), Carroll and Li (2008), and White and Zhu (2010) for further discussion of the 2005 bankruptcy reform and its effect on homeowners.

[10] We ignore other changes made under the 2005 bankruptcy reform because they cannot be tested with our data. Morgan et al. (2008) examine how bankruptcy reform affected car loans.

[11] We did not include mortgages originated earlier because the LPS dataset is smaller and much less representative before 2004. We use lenders' classifications concerning whether individual mortgages are prime versus subprime. The prime mortgage category includes alt-A mortgages, which are considered to be intermediate between prime and subprime. Alt-A borrowers generally do not provide full documentation of income and assets.

[12] We start with a 10% random sample of prime mortgages and all of the subprime mortgages in the LPS dataset that originated in 2004 or 2005. With the loss of observations resulting from the Home Mortgage Disclosure Act (HMDA) match (see below), our final samples of prime and subprime mortgages are approximately 5% and

Figure 1 gives monthly average mortgage default rates for our prime and subprime samples before and after bankruptcy reform, where we define mortgage default to occur when payments are 60 days delinquent or more. Default rates for prime mortgages in our sample were around 0.15% per month in the months before bankruptcy reform, or about 1.8% per year. Default rates for subprime mortgages were much higher — around 1% per month or 11.4% per year in the same period. Average default rates for both groups climbed for several months before bankruptcy reform took effect, jumped at the time of bankruptcy reform, and then fell for the next several months. We attribute the climb in default rates before the reform and the fall in default rates after the reform to the fact that many homeowners rushed to file for bankruptcy before the reform went into effect and — for reasons discussed above — they often file for bankruptcy and default around the same time.[13] After these adjustments, the post-reform default rates for both groups remained higher than the pre-reform rates.[14]

In order to focus on the effects of bankruptcy reform on default rates, we use short time periods before versus after the reform occurred. Short sample periods around the date of the reform have two advantages: first, other aspects of the economic environment remain fairly constant and, second, they end before the mortgage crisis began, thus allowing us to distinguish between the effects of bankruptcy reform versus the mortgage crisis. We run the model on sample periods of two months before to after bankruptcy reform (August – December 2005) and three months before to after bankruptcy reform (July 2005 – January 2006), and, as a robustness check, we also run the model on the sample period of six months before to after bankruptcy reform (April 2005 – April

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50% of the mortgages in the LPS dataset, respectively. We use all subprime mortgages because the LPS dataset under-represents this category.

[13] See Li and White (2009) for evidence that homeowners often default and file for bankruptcy around the same time. Mann (2007) estimates that the adoption of bankruptcy reform caused 500,000 additional bankruptcy filings to occur before October 2005.

[14] One factor that affects mortgage default rates is mortgage age, where the mortgages in our samples are disproportionately young and therefore have higher default rates. However, we did not find that the time pattern of default rates reported in figure 1 changed appreciably if we corrected for the age of mortgages in our sample. See Demyanyk and van Hemert (2009) and Jiang et al. (2009) for discussion of how default rates vary with mortgage age in other samples of subprime mortgages.

2006).[15] All of these periods end before housing prices peaked in June 2006, according to the Case/Schiller home price index.[16] Sample sizes for the three-month-before-to-three-months-after sample are 2.2 million and 1.5 million monthly observations for prime and subprime mortgages, respectively, and are proportionately smaller or larger for the other time periods.

Because the LPS dataset does not include any demographic characteristics, we merged it with data from the Home Mortgage Disclosure Act (HMDA) to get homeowners' income, sex, race, and marital status at the time of mortgage origination.[17]

Now turn to how we calculate dummy variables to represent the three groups of homeowners who were particularly negatively affected by bankruptcy reform. We first calculate homeowners' non-exempt income ($\max[Y - X_Y, 0]$) and non-exempt assets/home equity ($\max[A - X_A, 0]$). We have data on family income at the time of mortgage origination, but we do not have all the information needed to calculate individual income exemptions X_Y according to the procedure specified by bankruptcy law. Instead, we use the state median income level as a proxy for X_Y, so that non-exempt income equals the maximum of homeowners' family income minus the state median income level or zero. To calculate non-exempt home equity, we first calculate the current value of the home by updating home value at the time of mortgage origination using the average monthly change in housing values in the homeowner's metropolitan

[15] All sample periods include October 2005, since bankruptcy reform went into effect in the middle of October. We assign individual mortgages payments that are due in October 2005 to the pre- versus post-bankruptcy reform period, depending on whether the payment was due before or after bankruptcy reform went into effect.

[16] Available at www.standardandpoors.com.

[17] HMDA data cover nearly all mortgage originations. Mortgages were matched based on the zip code of the property, the date when the mortgage originated (within 5 days), the origination amount (within $500), the purpose of the loan (purchase, refinance or other), the type of loan (conventional, VA guaranteed, FHA guaranteed or other), occupancy type (owner-occupied or non-owner-occupied), and lien status (first-lien or other). The match rate was 48%. We calculated summary statistics for all the variables that are included in this study and found no significant differences between the means of the matched observations and the original LPS dataset. This suggests that the matched observations are a random subset of the original LPS dataset.
See www.ffiec.gov/hmda/history.htm for information on HMDA data.

area since the date of the mortgage origination. [18] We know the mortgage principal each month, so home equity each month equals the current value of the house minus the current mortgage principal. Non-exempt home equity then equals the maximum of home equity minus the homestead exemption or zero.

Define $MT1$ to denote homeowners who are harmed by the income-only means test: $MT1$ equals one if homeowners have non-exempt income, but no non-exempt home equity, or if $I - X_I > 0$ and $A - X_A \leq 0$. Also define $MT2$ to denote homeowners who are harmed by the income/asset means test: $MT2$ equals one if homeowners' non-exempt income over five years exceeds their non-exempt assets/home equity, or if $5(Y - X_Y) > A - X_A > 0$. Finally, define *HC* to denote homeowners who were harmed by the homestead exemption cap: *HC* equals one if homeowners live in states with homestead exemptions greater than $125,000 and if some of their assets/home equity become non-exempt because they exceed the new cap of $125,000, or if $X_A > \$125{,}000$ and $A > \$125{,}000$. We apply this test only to homeowners whose mortgages were for purchase, under the assumption that those whose mortgages were for refinance have owned their homes for more than 40 months.

Finally, *BR* equals one in months when the 2005 bankruptcy reform was in effect.

Specification

We estimate Cox proportional hazard models of mortgage default, where the baseline hazard depends on the age of the mortgage in months (see Kiefer, 1988). We use the proportional hazard model because we wish to explain time to default and because hazard models take account of both left- and right-censoring. Since our sample periods are short, many of our mortgages originate before the sample period starts and/or continue after the sample period ends, so that both types of censoring are important.

The key variables of interest are the bankruptcy reform dummy, *BR*, and the interactions of *BR* with *MT*1, *MT*2, and *HC*. The coefficient of the bankruptcy reform

[18] If the homeowner lives in a non-metropolitan area, we update the value of the house using the average change in housing values in the non-metropolitan areas of the state. Our estimates of home equity are biased upward, since we ignore second mortgages for which we have no data.

dummy measures the change in default rates after bankruptcy reform went into effect, and the three interaction terms measure difference-in-differences, or whether default rates changed by more after bankruptcy reform for homeowners in each of the three groups that were particularly negatively affected. All changes in response to bankruptcy reform are predicted to be positive.

Ai and Norton (2003) have pointed out that, while the coefficients of interaction terms are equal to difference-in-differences in linear models, this result does not carry over to non-linear models. Instead difference-in-differences in non-linear models must be evaluated using the full estimated model, including all of the results for the control variables. We compute corrected difference-in-differences using this procedure.[19]

Our choice of control variables is guided by availability and by the recent literature on mortgage default (see references above). Demographic variables are whether the homeowner is married, is African American, or is female. We include dummy variables representing ranges of FICO scores (the highest category is omitted), ranges of loan-to-value ratios, and ranges of debt-to-income ratios (the lowest categories for each are omitted).[20] We also include dummy variables for whether the loan is a jumbo, whether it is fixed-rate (versus adjustable rate or hybrid), whether it is for refinance (versus purchase), whether homeowners provided full documentation of income and assets when applying for the mortgage or provided partial documentation or whether documentation information is missing (the omitted category is no documentation), whether the property is a single-family residence, and whether it is a vacation home or an investment property (the omitted category is primary residences). Additional dummy variables include whether the mortgage was securitized (versus held in the lender's portfolio) and whether

[19] For example, the difference-in-difference for the interaction of bankruptcy reform with the homestead exemption cap is
$[\hat{D}(HC=1, BR=1) - \hat{D}(HC=0, BR=1)] / \hat{D}(HC=0, BR=1)$ -
$[\hat{D}(HC=1, BR=0) - \hat{D}(HC=0, BR=0)] / \hat{D}(HC=0, BR=0)$, where $\hat{D}(HC=1, BR=1)$ denotes the predicted probability of default when *HC* and *BR* are both equal to 1 and the control variables are assumed to take their mean values. Other difference-in-difference terms are calculated using the same procedure. We also compute corrected values for the coefficients of *BR*, *MT*1, *MT*2, and *HC*. The only papers we have found that use a hazard model and compute difference-in-differences correctly are Chen (2008), which uses a much smaller dataset, and Elul et al. (2010). We use Stata 11 for these calculations.

[20] Debt-to-income ratios include second mortgages and non-mortgage debt.

it was originated by the lender that services it, acquired wholesale, or acquired from a correspondent (the omitted category is mortgages originated by independent mortgage brokers).[21] We also include a measure of homeowners' benefit from refinancing their mortgages at the currently available mortgage interest rate — this variable increases in size when interest rates on new mortgages are lower.[22] We also include the lagged unemployment rate in the metropolitan area, the lagged real income growth rate in the state, and the lagged average mortgage default rate in the homeowner's zip code — all lags are one month.[23] Finally, we include state fixed effects. We do not include time dummies because our sample periods are short and because time dummies would be collinear with the bankruptcy reform dummy. We cluster observations by mortgage (the results do not change in any substantive way when we cluster by zip code).

Table 2 gives summary statistics for our prime and subprime mortgage samples over the period three months before to three months after bankruptcy reform. The adoption of the income-only means test harms 27% of prime mortgage-holders versus 44% of subprime mortgage-holders. The latter are more likely to be harmed since subprime mortgage-holders generally have less home equity and the test applies only to homeowners whose home equity is entirely exempt. The opposite is true for the adoption of the income/asset means test, which harms 31% of prime mortgage-holders versus 12% of subprime mortgage-holders. This test is more likely to harm prime mortgage-holders because they have more home equity. The homestead exemption cap,

[21] Correspondents are mortgage brokers that originate mortgages only for a single lender; while independent mortgage brokers sell to multiple lenders. Correspondents' interests are more closely aligned with the interests of banks than with those of independent mortgage brokers. See Jiang et al. (2009) for a discussion of the role of mortgage brokers. Keys et al. (2008) and Rajan et al. (2009) both argue that lenders scrutinize soft information concerning borrowers less carefully when they expect to sell the mortgages to securitizers and this, in turn, suggests that homeowners with securitized mortgages will be more likely to default.

[22] The measure equals $\{r_0[1-(1+r_t)^{t-M}]\}/\{ r_t[1-(1+r_0)^{t-M}]\}$, where r_0 is the interest rate on the homeowner's existing mortgage, r_t is the interest rate currently available on new mortgages, and M is the term of the mortgage. See Richard and Roll (1989).

[23] Unemployment rates by metropolitan area are taken from the Bureau of Labor Statistics; income data by state are from the Bureau of Economic Analysis; housing price data by metropolitan area are from the Federal Housing Finance Agency; bankruptcy exemption levels by state are from Elias (2006 and earlier editions); and median state income levels are from the U.S. Trustee Program at the Department of Justice.

which requires very high home equity, applies to 5% and 1% of prime and subprime mortgage-holders, respectively.

Results

Table 3 gives the results of estimating the hazard model using the sample period three months before to three months after bankruptcy reform. Only the bankruptcy reform dummy *BR* and the control variables are entered. Results are given as proportional increases or decreases in default rates relative to one — for example the coefficient of 1.11 for the jumbo mortgage dummy in the subprime sample indicates that homeowners with jumbo mortgages are 11% more likely to default than those with smaller mortgages, while the coefficient of 0.82 on the fixed rate mortgage dummy in the prime sample indicates that homeowners with fixed rate mortgages are 18% less likely to default than those with variable rate mortgages. Tests of statistical significance are for whether the results differ significantly from one.

Results for the controls are reasonable and generally similar to those in the literature: Homeowners are more likely to default when they have lower FICO scores, higher debt-to-income ratios, and higher loan-to-value ratios. All of the results for variables representing mortgage sources are less than one, so that mortgages originated by independent mortgage brokers — the omitted category — are the most likely to default.[24] Prime mortgages that were securitized are more likely to default, but — surprisingly — subprime mortgages that were securitized are less likely to default. The documentation variables are generally insignificant, suggesting that higher levels of documentation are not associated with the reduced likelihood of default.[25] Homeowners are more likely to default if they live in zip codes with higher lagged average default rates — thus, defaults lead to more defaults in the local area. Homeowners also default more often if they live in metropolitan areas with higher lagged unemployment rates or in states with lower lagged real income growth rates.

[24] This is similar to the results of Jiang et al (2009), who use different data.
[25] This differs from the results of Jiang et al (2009) and Sherlund (2008), both of which found that mortgages lacking full documentation were more likely to default.

Table 4 gives the results for the key variables, using the three month before to after sample. The result for the bankruptcy reform dummy *BR* in column (1) of table 4 is the same as that given in table 3. Because the interaction terms are correlated with *BR* and with each other, we show the results when they enter both individually and together. The adoption of bankruptcy reform led to a substantial increase in mortgage default rates in both samples — using the figures in column (5), the increases are 14% for prime mortgages and 16% for subprime mortgages and both are highly significant ($p < .001$). The coefficients of *MT*1, *MT*2, and *HC* are either less than one or greater than one but insignificant. Since all of these variables are correlated with higher levels of income and assets, we expect them to be associated with lower default rates.

Now turn to the difference-in-differences. Using the results in column (5) for prime mortgages, the effect on the default rate of being harmed by the income-only means test rose by 20% after bankruptcy reform; the effect on the default rate of being harmed by the income/asset means test rose by 5.5% after bankruptcy reform; and the effect on the default rate of being harmed by the homestead exemption cap rose by 36%, although only the first and last results are statistically significant. For subprime mortgage holders, the effect on the default rate of being harmed by the homestead exemption cap rose by 43% after bankruptcy reform ($p = .002$); but the income-only means test is not statistically significant, and the income/asset means test has the wrong sign and is marginally significant. The fact that the difference-in-difference results for the two means tests for subprime mortgage holders are not in line with our predictions is additional evidence that these homeowners exaggerated their incomes when applying for mortgages and, therefore, were less likely to be affected by the means tests than prime mortgage holders. The large increase in default rates after bankruptcy reform by mortgage-holders of both types who are subject to the cap on the homestead exemption suggests that homeowners often are financially stretched even when they have very high home equity.

Table 5 shows the results when we rerun the model on the shorter sample period of two months before to after bankruptcy reform and the longer period of six months before to after bankruptcy reform. The results shown include all three interaction terms. The table also shows the results reported in table 4, column (5) for the three months before to after the sample period. In the prime sample, the results remain quite stable as we

shorten and lengthen the sample period. The increase in default rates after bankruptcy reform ranges from 10% to 15% over the three sample periods, while the difference-in-difference results for the three tests remain similar in magnitude and generally have the same levels of significance. For the subprime samples, the results also remain similar, except that the income-only means test becomes positive and significant in the six months before to after the sample period, and the homestead exemption cap becomes smaller and insignificant in the same sample period.

As robustness checks, we ran placebo tests assuming that bankruptcy reform went into effect both earlier and later than the actual date. We assumed that hypothetical dates of bankruptcy reform were July 2005 and January 2006; and, for each of these dates, we ran our model using a sample period of two months before to two months after the hypothetical dates. The specification remains the same, but in table 6 we show only the results for the bankruptcy reform dummy and the three difference-in-differences. For the prime mortgage samples, all of the results either change from increases to decreases or else they remain increases but are insignificant. For the subprime mortgage sample, the same pattern holds, but the default rate increases by 22% when bankruptcy reform is assumed to occur in July 2005 and the result is significant. This result reflects the fact that default rates steadily increased during the months of May to September 2005 because debtors were rushing to file for bankruptcy before the reform went into effect and some also defaulted at the same time.

Overall, the results support our hypotheses that bankruptcy reform led to a general increase in mortgage default rates because filing for bankruptcy became more costly and led to even larger increases in mortgage default rates by prime mortgage holders who were harmed by the adoption of the means tests and the homestead exemption cap and by subprime mortgage holders who were harmed by the adoption of the cap.

Conclusion and Policy Implications

Our main result is that the 2005 bankruptcy reform caused mortgage default rates to rise. Using the results for the sample period three months before to three months after bankruptcy reform, we find that the default rate of homeowners with prime and subprime

mortgages rose by 14% and 16%, respectively, after bankruptcy reform. Default rates of homeowners with prime mortgages rose even more after bankruptcy reform if they were subject to the new means tests or the new cap on the homestead exemption, compared with the increases for homeowners not harmed by these provisions. But default rates of homeowners with subprime mortgages responded only to the cap on the homestead exemption, suggesting these homeowners were likely to exaggerate their incomes when applying for mortgages. The results suggest that bankruptcy reform squeezed homeowners' budgets by raising the cost of filing for bankruptcy and reducing the amount of debt discharged in bankruptcy. It, therefore, increased mortgage default by closing off a popular procedure that previously helped financially distressed homeowners save their homes.

We can use the results to predict the number of additional mortgage defaults that occurred as a result of the 2005 bankruptcy reform. Consider first the general effect of the increase in the cost of filing for bankruptcy. There were 22 million mortgage originations during the period 2004-05, of which approximately 81% were prime and 19% were subprime.[26] Default rates in our sample are approximately 2.5% and 11% per year for prime and subprime mortgages, respectively. Using the mortgages originated in 2004-05 as a base, we calculate that the adoption of bankruptcy reform increased the number of mortgage defaults per year by 159,000 (See table 7). In addition, the adoption of the two means tests and the homestead exemption cap caused defaults to rise by an additional 36,000 per year.[27] Thus, even before the mortgage crisis began, the 2005 bankruptcy reform was responsible for around 159,000 + 36,000 = 196,000 additional mortgage defaults per year by homeowners whose mortgages originated in 2004-05. The figures would be higher if the calculations were applied to other mortgage cohorts.

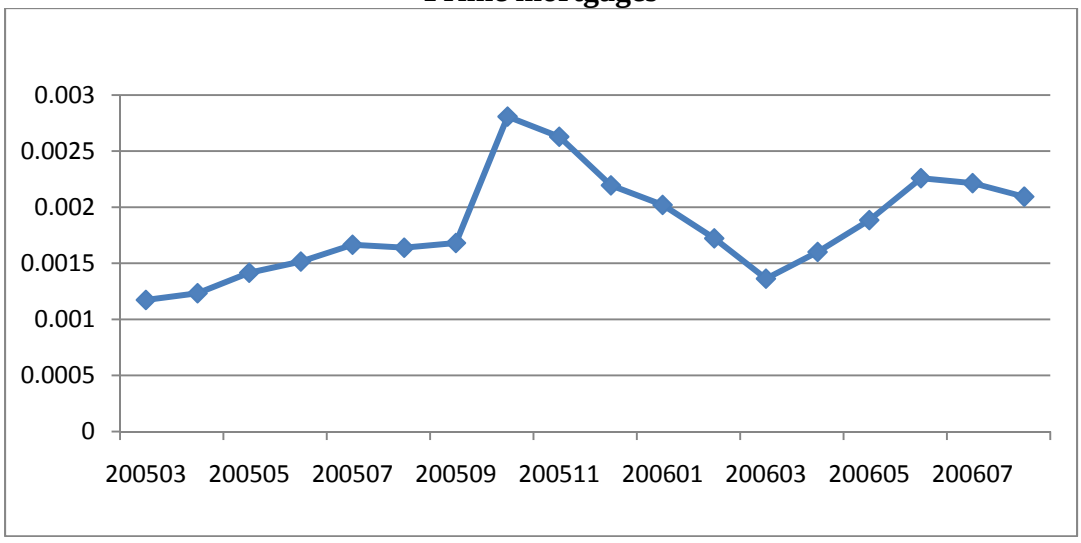
The Bush and Obama administrations have both tried a number of programs to deal with the housing crisis by encouraging mortgage lenders to renegotiate mortgages rather than foreclose when homeowners default. None of these programs have worked very well. Our results suggest that a simple change such as rolling back the cost of filing for

[26] See Mayer and Pence (2008). They give a range of figure, based on different definitions of subprime mortgages. We use the average of their high versus low figures.
[27] We do not compute increases in default by subprime mortgage holders due to the means tests, since these interactions were not consistently significant. See table 7.

bankruptcy to pre-2005 levels would help in dealing with the housing crisis by reducing the number of mortgage defaults.

Figure 1:
Average Mortgage Default Rates
Before and After the October 2005 Bankruptcy Reform

Prime mortgages



Subprime mortgages

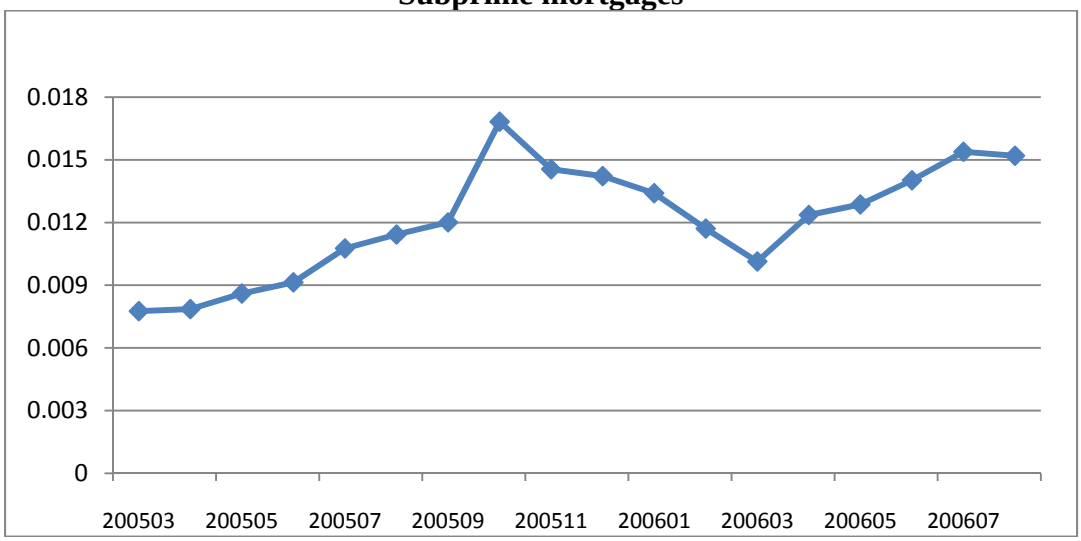


Table 1:

Effect of the 2005 Bankruptcy Reform on Homeowners' Obligation to Repay in Bankruptcy

	All home equity exempt	**Some home equity non-exempt**
All income exempt	No change	Must repay more if homestead exemption cap is binding ($HC = 1$); otherwise no change
Some income non-exempt	Must repay more if non-exempt home equity exceeds $2,000 per year ($MT1 = 1$); otherwise no change	Must repay more if non-exempt income over 5 years > non-exempt home equity ($MT2 = 1$); otherwise no change

Note: Prior to the 2005 bankruptcy reform, all income was exempt.

Table 2: Summary Statistics

Three Months Before to Three Months After Bankruptcy Reform

	Prime Mortgages	**Subprime Mortgages**
Default rate per month	0.0020 (.045)	0.0132 (.114)
Income-only means test (*MT*1)	0.266 (.442)	0.435 (.496)
Income/asset means test (*MT*2)	0.314 (.464)	0.121 (.326)
Homestead exemption cap (*HC*)	0.0472 (.212)	0.0136 (.116)
Average income*	$102,000 (91,000)	$72,800 (59,000)
If FICO score 650 to 750*	0.521 (.500)	0.231 (.421)
If FICO score 550 to 650*	0.138 (.345)	0.625 (.484)
If FICO score 350 to 550*	0.0073 (.085)	0.124 (.330)
Debt payment-to-income ratio > 0.5*	0.083 (.276)	0.044 (.205)
Debt payment-to-income ratio (0.4, 0.5)*	0.119 (.324)	0.191 (.394)
Debt payment-to-income ratio missing*	0.344 (.475)	0.526 (.499)
Loan-to-value ratio > 1.0*	0.017 (.131)	0.00025 (.016)
Loan-to-value ratio (0.8,1.0)*	0.219 (.413)	0.385 (.486)
If full documentation*	0.368 (.482)	0.563 (.496)
If partial documentation*	0.077 (.266)	0.023 (.149)
If documentation information missing*	0.159 (.365)	0.107 (.309)
If single-family house*	0.747 (.434)	0.808 (.393)
If fixed rate mortgage*	0.609 (.488)	0.246 (.431)
If jumbo mortgage*	0.147 (.354)	0.087 (.281)
If vacation home*	0.040 (.196)	0.010 (.101)
If investment property*	0.051 (.220)	0.050 (.218)
If occupancy type missing*	0.194 (.395)	0.050 (.219)
If loan was to re-finance*	0.351 (.477)	0.523 (.499)
If mortgage was securitized	0.242 (.429)	0.822 (.382)
If loan was originated by the lender	0.515 (.500)	0.434 (.495)
If loan was acquired wholesale, but not from a mortgage broker	0.194 (.396)	0.172 (.377)
If loan was acquired from a correspondent lender	0.221 (.415)	0.102 (.303)
Homeowner's gain from refinancing	1.07 (.239)	0.839 (.145)
Lagged cumulative delinquency rate (zip code)	0.091 (.321)	0.341 (.726)
Lagged unemployment rate (MSA)	0.046 (.013)	0.047 (.013)
Lagged real income growth rate (state)	0.0019 (.024)	0.0020 (.033)

Notes: Standard errors are in parentheses. The sample period is July 2005 through January 2006. Variables marked with asterisks are observed only at origination, while other variables are updated each month.

Table 3:
Cox Proportional Hazard Models Explaining Mortgage Default
Three Months Before to Three Months After Bankruptcy Reform

	Prime Mortgages	**Subprime Mortgages**
Bankruptcy reform dummy (*BR*)	1.14 (.039)***	1.17 (.019)***
If FICO score 650 to 750	3.29 (.215)***	1.85 (.209)***
If FICO score 550 to 650	10.9 (.742)***	4.05 (.451)***
If FICO score 350 to 550	28.7 (2.52)***	6.63 (.749)***
If FICO score is missing	1.07 (.053)	0.844 (.019)***
Debt payment-to-income ratio > 0.5	1.07 (.069)	1.10 (.040)**
Debt payment-to-income ratio (0.4 to 0.5)	1.21 (.057)***	1.17 (.025)***
Loan-to-value ratio > 1.0	1.51 (.128)***	4.43 (.618)***
Loan-to-value ratio (0.8 to 1.0)	1.85 (.069)***	0.956 (.015)***
If full documentation	0.917 (.058)	1.07 (.066)
If partial documentation	1.14 (.085)*	1.31 (.097)***
If documentation information missing	0.864 (.069)*	1.12 (.077)
If single-family house	1.04 (.040)	1.14 (.022)***
If fixed rate mortgage	0.815 (.031)***	0.710 (.014)***
If jumbo mortgage	0.987 (.066)	1.11 (.034)***
If vacation home	1.12 (.080)	1.02 (.067)
If investment property	0.944 (.064)	0.964 (.031)
If occupancy type missing	1.24 (.054)***	1.12 (.059)**
If loan was to re-finance	0.926 (.035)**	0.837 (.012)***
If mortgage was securitized	1.17 (.053)***	0.824 (.020)***
If loan was originated by the lender	0.691 (.041)***	0.685 (.016)***
If loan was acquired wholesale, but not from a mortgage broker	0.877 (.055)**	0.802 (.022)***
If loan was acquired from a correspondent lender	0.836 (.051)***	0.702 (.022)***
Homeowner's gain from refinancing	0.371 (.089)***	0.171 (.012)***
Lagged average mortgage default rate (zip code)	1.08 (.028)***	1.09 (.007)***
Lagged unemployment rate (MSA)	0.987 (.013)	1.04 (.006)***
Lagged real income growth rate (state)	0.0003 (.000)***	0.005 (.002)***
State dummies?	Y	Y

Notes: ***, **, and * indicate whether the coefficient is significantly different from one at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses. The sample period is July 2005 through January 2006. Following the terms of our agreement with LPS Applied Analytics, results for the demographic variables are not reported.

Table 4:
Results of Cox Proportional Hazard Models Explaining Mortgage Default Three Months Before to Three Months After Bankruptcy Reform

Prime Mortgages

	(1)	(2)	(3)	(4)	(5)
Bankruptcy reform (*BR*)	1.14*** (.039)	1.14*** (.039)	1.14*** (.039)	1.14*** (.039)	1.14*** (.039)
Income-only means test (*MT*1)		0.941 (.032)			0.871*** (.033)
Income/asset means test (*MT*2)			0.848*** (.032)		0.804*** (.033)
Homestead exemption cap (*HC*)				1.05 (.098)	1.07 (.102)
Bankruptcy reform*income-only means test (*BR*MT*1)		1.22*** (.062)			1.20*** (.061)
Bankruptcy reform *income/asset means test (*BR*MT*2)			0.983 (.068)		1.055* (.060)
Bankruptcy reform *homestead exemption cap (*BR*HC*)				1.45*** (.191)	1.36* (.198)

Subprime Mortgages

	(1)	(2)	(3)	(4)	(5)
Bankruptcy reform (*BR*)	1.17*** (.019)	1.17*** (.019)	1.17*** (.019)	1.17*** (.019)	1.16*** (.019)
Income-only means test (*MT*1)		0.918*** (.015)			0.916*** (.015)
Income/asset means test (*MT*2)			1.03 (.026)		0.993 (.027)
Homestead exemption cap (*HC*)				0.933 (.070)	0.952 (.071)
Bankruptcy reform*income-only means test (*BR*MT*1)		1.02 (.026)			1.01 (.027)
Bankruptcy reform* income/asset means test (*BR*MT*2)			0.909 (.047)		0.918* (.048)
Bankruptcy reform* homestead exemption cap (*BR*HC*)				1.42*** (.136)	1.43*** (.140)

Notes: ***, **, and * indicate whether the coefficient is significantly different from one at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses. The sample period is from July 2005 through January 2006. All equations include the control variables shown in table 3, plus state dummies.

Table 5:
Results of Cox Proportional Hazard Models Explaining Mortgage Default Using Varying Sample Periods

Prime Mortgages

	+-2 months	+-3 months	+-6 months
Bankruptcy reform (*BR*)	1.10***	1.14***	1.11***
	(.019)	(.039)	(.031)
Income-only means test (*MT*1)	0.911	0.871***	0.877***
	(.039)	(.033)	(.026)
Income/asset means test (*MT*2)	0.818***	0.804***	0.822***
	(.038)	(.033)	(.027)
Homestead exemption cap (*HC*)	1.10	1.07	0.985
	(.121)	(.102)	(.078)
Bankruptcy reform*income-only means test (*BR*MT*1)	1.29***	1.20***	1.13***
	(.076)	(.061)	(.049)
Bankruptcy reform* income/asset means test (*BR*MT*2)	1.05	1.05	1.14***
	(.071)	(.060)	(.050)
Bankruptcy reform * homestead exemption cap (*BR*HC*)	1.50**	1.36*	1.17
	(.237)	(.198)	(.153)

Subprime Mortgages

	+2 months	+- 3 months	+- 6 months
Bankruptcy reform (*BR*)	1.09***	1.16***	1.14***
	(.019)	(.019)	(.016)
Income-only means test (*MT*1)	0.927***	0.916***	0.918***
	(.018)	(.015)	(.012)
Income/asset means test (*MT*2)	1.00	0.993	1.06**
	(.030)	(.027)	(.023)
Homestead exemption cap (*HC*)	0.947	0.952	0.90
	(.082)	(.071)	(.061)
Bankruptcy reform*income-only means test (*BR*MT*1)	1.02	1.01	1.06***
	(.032)	(.027)	(.021)
Bankruptcy reform* income/asset means test (*BR*MT*2)	0.85***	0.92**	0.945
	(.054)	(.048)	(.043)
Bankruptcy reform*homestead exemption cap (*BR*HC*)	1.68***	1.43***	1.17
	(.168)	(.140)	(.120)

Notes: ***, **, and * indicate whether the coefficient is significantly different from one at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses. All equations include the control variables shown in table 3. "+-2 months" indicates the sample period two months before to two months after bankruptcy reform. Other sample periods are analogously defined.

Table 6:
Results of Placebo Tests Using Hypothetical Dates for Bankruptcy Reform

Prime Mortgages

	+-2 months July 05	**+-2 months Jan 06**
Bankruptcy reform (*BR*)	1.09 (.056)	0.658*** (.024)
Bankruptcy reform*income-only means test (*BR*MT*1)	0.793* (.089)	0.620*** (.081)
Bankruptcy reform* income/asset means test (*BR*MT*2)	1.07 (.085)	1.05 (.079)
Bankruptcy reform* homestead exemption cap (*BR*HC*)	1.43 (.301)	0.733 (.203)

Subprime Mortgages

	+-2 months July 05	**+-2 months Jan 06**
Bankruptcy reform (*BR*)	1.22*** (.041)	0.933*** (.039)
Bankruptcy reform*income-only means test (*BR*MT*1)	1.00 (.038)	1.09** (.031)
Bankruptcy reform* income/asset means test (*BR*MT*2)	0.956 (.114)	0.918 (.070)
Bankruptcy reform *homestead exemption cap (*BR*HC*)	0.916 (.571)	0.436*** (.161)

Notes: ***, **, and * indicate whether coefficients are significantly different from one at the 0.1%, 1%, and 5% levels, respectively. Standard errors are in parentheses. All equations include the control variables shown in the table 3, plus *MT*1, *MT*2, and *HC*. "+-2 months July 05" indicates that the hypothetical date of bankruptcy reform is July 2005 and the sample period is May - September 2005.

Table 7:
Number of Additional Mortgage Defaults
Resulting from the 2005 Bankruptcy Reform

	Bankruptcy Reform	Income-only Means Test	Income/ Asset Means Test	Homestead Exemption Cap
Total mortgages originated 2004-05	22,000,000	22,000,000	22,000,000	22,000,000
Prime mortgages:				
Proportion of all mortgages originated in 2004-05	.81	.81	.81	.81
Proportion affected by the change	1.00	.266	.314	.047
Default rate/year	.0249	.0214	.0148	.0256
Increase in default rate after bankruptcy reform	.145	.20	.055	.36
Subprime mortgages:				
Proportion of all mortgages originated in 2004-05	.19			.19
Proportion affected by the change	1.00			.014
Default rate/year	.145			.153
Increase in default rate after bankruptcy reform	.16			.43
Number of additional mortgage defaults/year	159,000	20,000	4,500	11,500

Note: The figure in the bottom row, left column, equals 22,000,000(.81*1.0*.0249*.145 + .19*1.0*.145*.16). The other figures are calculated in the same way. We do not calculate increases in the number of mortgage defaults by subprime mortgage holders subject to the two means tests, since these results were not consistently significant. Mortgage default rates per month are converted to default rates per year using the conversion factor $\sum_{t=0}^{11}(1-m)^t$, where m is the monthly default rate.

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