Did Bankruptcy Reform Cause Mortgage Defaults to Rise?*

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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 discharged in bankruptcy. We argue that an unintended consequence of the reform was to cause mortgage default rates to rise.

We estimate a hazard model to test whether the 2005 bankruptcy reform caused mortgage defaults to rise, using a large dataset of individual mortgages. Our major result is that prime and subprime mortgage default rates rose by 23% and 14%, 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 their default rates rose even more. Overall, we calculate that bankruptcy reform caused the mortgage default rate to rise by one percentage point even before the start of the financial crisis, suggesting that the reform increased the severity of the crisis when it came.

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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 unsecured debts 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 that took effect in October 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 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 after the reform rose by 23% for homeowners with prime mortgages and 14% for those with subprime mortgages. 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 the mortgage default rate to rise by one percentage point, thus adding to the severity of the mortgage crisis when it came.

Bernstein (2008) and Morgan, Iverson and Botsch (2011) 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 mortgage defaults 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 their hypothesis by examining whether foreclosure rates for subprime mortgages

rose by more in states that have high or unlimited homestead exemptions, using aggregate state-year data. Their results for states with high homestead exemptions support the hypothesis, but—surprisingly—those for states with unlimited homestead exemptions do not. In contrast, we examine the relationship between bankruptcy reform and mortgage default using large samples of individual prime and subprime mortgages. Our data allow us to examine both how the reform affected default rates in general and how it affected default rates of homeowners who were particularly negatively affected by the reform .

Our paper also relates to the recent literature explaining mortgage default using data on individual mortgages, including Keys, Mukherjee, Seru and Vig (2010), 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 last section, we estimate the number of additional mortgage defaults that occurred as a result of bankruptcy reform.

Homeowners and Bankruptcy Before and After the 2005 Bankruptcy Reform[1]

US bankruptcy law provides two separate personal bankruptcy procedures—Chapter 7 and Chapter 13—and both are relevant for homeowners in financial distress. Prior to 2005, all debtors were allowed to choose between them. Under Chapter 7, most unsecured debts are discharged. Debtors are not obliged to use any of their future earnings to repay; they are only obliged to repay from assets above an asset exemption level. 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 some debtors

[1] See Elias (2006), White (2007), Eggum, Porter and Twomey (2008), Carroll and Li (2008), and White and Zhu (2010) for discussion of bankruptcy reform and how it affects homeowners.

with high assets and high income gain from filing for bankruptcy under Chapter 7. Under Chapter 13, debtors must have regular earnings and follow a court-supervised plan to repay some of their debt from future earnings over a 3 to 5-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 discharge of unsecured debt loosens their budget constraints and increases their ability to pay their mortgages.[2] In addition, filing under Chapter 7 stops mortgage lenders from foreclosing for a few months, so that homeowners who have fallen behind on their mortgage payments get additional time to repay the arrears. But the terms of residential mortgage contracts cannot be changed in Chapter 7. Thus filing under Chapter 7 helps homeowners save their homes only if they can repay their mortgage arrears within a few months.

Chapter 7 also helps homeowners who wish to give up their homes. They gain from filing because 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) are discharged in bankruptcy. Homeowners also gain from filing because bankruptcy delays foreclosure and homeowners get cost-free housing during the bankruptcy process.[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:

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

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 zero. If they give up their homes,

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

[3] In some states, homeowners can 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).

then H_7 equals the reduction in future housing costs when they shift from owning to renting, plus the value of having cost-free housing during the bankruptcy process and having deficiency judgments discharged. 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.[4] When non-exempt home equity is positive, homeowners in bankruptcy must give up their homes for sale by the bankruptcy trustee, since some of their home equity must be used to repay unsecured debt. Finally, C_7 is 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 3 to 5 years. They must also make all of their normal mortgage payments during the plan. Lenders cannot proceed with foreclosure as long as homeowners are making the required payments and, if 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 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

[4] Retirement accounts are generally exempt in bankruptcy; most other financial accounts are non-exempt. But homeowners can convert non-exempt financial assets into exempt 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.

[5] See Porter (2008) for discussion.

long as homeowners would not be required to repay any of their unsecured debt if they instead 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, H and C have the same meaning as before, but they generally have different values in Chapter 13 than Chapter 7. U_{13} exceeds U_7 for some filers, because additional types of debt can be discharged 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 only be discharged only in Chapter 13. I_{13} denotes the present value of future income that must be used to repay unsecured debt in Chapter 13; prior to bankruptcy reform, this was generally a token amount. Finally, C_{13} exceeds C_7 because bankruptcy lawyers charge more for Chapter 13 filings.

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.

Now consider how the 2005 bankruptcy reform changed homeowners' gains from defaulting and bankruptcy. The reform made several important changes in bankruptcy law. First, it raised the costs of filing—a study by the Government Accountability Office (2008) found that average total filing costs under Chapter 7 rose from $900 before the reform to $1,500 after and those under Chapter 13 rose from $3,700 before to $5,700 after. Costs rose because of higher filing fees, onerous new requirements on bankruptcy lawyers that caused them to raise legal fees, and new rules requiring filers to receive credit counseling before filing and to take a course in debt management during the bankruptcy process. Higher filing costs are predicted to reduce homeowners' probability

[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.

of filing for bankruptcy and to raise default rates for homeowners who previously would have filed for bankruptcy.

Second, the reform introduced a new "means test" that forces some homeowners with high incomes to file under Chapter 13 and to use future income to repay part of their unsecured debt. The means test affects homeowners differently depending on whether or not their home equity is exempt. Suppose first that home equity is entirely exempt. Homeowners 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 yearly income to the median family income level in the state, adjusted for family size. State median income levels in 2005 ranged 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 this level, then they must compute an individual income exemption, 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] The total equals their income exemption X_Y. Homeowners' non-exempt income equals their actual income minus the income exemption, or $Y - X_Y$. If $Y - X_Y$ exceeds $2,000 per year, then they 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 debt in bankruptcy. These high-income homeowners benefit less from filing after the reform, both because they must use more of their future income to repay and because they must pay the much higher costs of filing under Chapter 13 rather than Chapter 7. These homeowners are predicted to default on their mortgages more often. We refer to this test as the "income-only means test."

[7] The pre-determined amounts for housing, transport costs and personal expenses are taken from Internal Revenue Service formulas for collecting from delinquent taxpayers. 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. See www.justice.gov/ust/eo/bapcpa/meanstesting.htm.

A different version of the means test is used for homeowners who have both non-exempt assets/home equity and non-exempt income. Prior to the reform, these homeowners were obliged to use their non-exempt home equity, $A - X_A$, to repay unsecured debt in bankruptcy. After the reform, their obligation to repay equals the maximum of their non-exempt assets, $A - X_A$, or their non-exempt income, $5(Y - X_Y)$, over 5 years. Thus homeowners gain less from filing for bankruptcy after the reform if their non-exempt income exceeds their non-exempt assets, both because their obligation to repay in bankruptcy rises by the amount $5(Y - X_Y) - (A - X_A)$ and because they must file under Chapter 13 rather than Chapter 7 and pay higher filing costs. 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] Affected homeowners are required to use home equity above the cap to repay in bankruptcy, which forces them to give up their homes if they file. The homestead exemption cap makes filing for bankruptcy less attractive for homeowners with high assets who live in states with high homestead exemptions. These homeowners are predicted to default more often after bankruptcy reform.

To illustrate these provisions, suppose a homeowner has unsecured debts totaling $100,000, income per year of $92,000, home equity of $25,000, and no other financial assets. Suppose she lives in Texas, which has an unlimited homestead exemption. Prior to bankruptcy reform, all of her unsecured debt was discharged in bankruptcy and she had no obligation to repay from either her home equity or her future income. Thus her gain from filing was $100,000 in discharged debt minus the costs of filing under Chapter 7. After bankruptcy reform, suppose the homeowner's income exemption X_Y equals the median income level in Texas, which was $49,000 for a three-person family in 2005. Her non-exempt income therefore is $92,000 - $49,000 = $43,000 per year, or $215,000 over

[8] The states with homestead exemptions greater than $125,000 during our period include Arkansas, Florida, Iowa, Kansas, Oklahoma, Texas, and the District of Columbia (all 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 (2007) and earlier editions.

five years. Since her home equity is still exempt, she is subject to the income-only means test, which obliges her to use all of her non-exempt income to repay debt. And since her non-exempt income exceeds her debts of $100,000, she receives no debt discharge in bankruptcy and no longer gains from filing.

Now suppose the same homeowner lives in New Jersey, which has no homestead exemption and a median family income level of $85,000. Everything else remains the same. Prior to bankruptcy reform, the homeowner would have been obliged to use her home equity of $25,000 to repay her debt in bankruptcy. Her gain from filing therefore would have been $100,000 - $25,000 = $75,000 in discharged debt minus the costs of filing under Chapter 7. After bankruptcy reform, her non-exempt assets are still $25,000, but now she has non-exempt income of $92,000 - $85,000 = $7,000 per year, or $35,000 over five years. Because she has both non-exempt income and non-exempt assets, she is subject to the income/asset means test. And since her non-exempt income is higher, she must repay $35,000 of debt in bankruptcy. Her gain from filing after the reform therefore falls, both because she must repay an additional $10,000 and because her filing costs increase from the pre-reform Chapter 7 level of $900 to the post-reform Chapter 13 level of $5,700, or by $4,800.

Finally, suppose the same homeowner again lives in Texas, but now has home equity of $200,000 and income of $45,000. Also suppose she has owned her home for less than 3 1/3 years at the time of filing. Her unsecured debt is still $100,000. Prior to the reform, her home equity would have been entirely exempt in bankruptcy, so that her gain from filing would have been $100,000 in discharged debt minus the cost of filing under Chapter 7 and she would have been allowed to keep her home. After the reform, she can still file under Chapter 7 because all of her income is exempt, but she must use $200,000 - $125,000 = $75,000 of her home equity to repay debt in bankruptcy. As a result, her post-reform gain from filing falls by $100,000 - $75,000 = $25,000 and she probably will have to give up her home in bankruptcy. Her costs of filing also rise from $900 to $1,500, or by $600.

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) 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 rise after bankruptcy reform, since the cap reduces their gain from filing and forces them to give up their homes if they file. 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.

In the next section, we test the predictions that 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.

Data and summary statistics

We use a large dataset of individual mortgages from LPS Applied Analytics, Inc. For each mortgage, we have detailed information from the mortgage application, plus updates each month on whether homeowners made their payments in full and whether they filed for bankruptcy. 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 periods. A complication is that Hurricanes Katrina and Rita struck in August and September of 2005 and caused many homeowners to delay paying their mortgages. Because their late payments were recorded as defaults just around the time that bankruptcy reform went into effect, we drop all mortgages in the affected counties.[9] We follow individual mortgages 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.[10] It should be noted that our samples consist of mortgages that originated near the peak of the housing bubble.

[9] See the Federal Emergency Management Agency website, www.fema.gov/news/disasters.fema?year=2005, for a list of affected counties. We are grateful to Paul Willen for pointing out the relevance of the hurricanes.

[10] LPS' coverage of subprime mortgages is less comprehensive than its coverage of prime mortgages, but coverage of subprime mortgages improved in January 2005 when mortgages originated by Countrywide Bank—one of the largest subprime lenders—were added. Mortgages originated by Countrywide prior to 2005 were also added to the

Figure 1 gives monthly average mortgage default rates for both samples in the months before and after bankruptcy reform. Following the literature, we define default to occur when mortgage payments become 60 days delinquent.[11] We drop mortgages from the dataset once they have defaulted, so that the number of defaults changes only because of changes in the number of new defaults. Default rates are shown both in their raw form and seasonally adjusted. Note that default rates for subprime mortgages are much higher than for prime mortgages—the seasonally adjusted default rates prior to bankruptcy reform were around 1% per month for subprime mortgages versus 0.16% per month for prime mortgages.

Seasonal adjustment is important in our context, because mortgage default rates vary seasonally and tend to be lowest in the spring and highest in the fall. Because bankruptcy reform went into effect in October 2005, we want to avoid concluding that reform caused default rates to rise simply because they normally rise in the fall. For both samples, non-seasonally adjusted default rates rose in the months prior to bankruptcy reform, jumped at the time of bankruptcy reform, and then dropped in the months after the reform. The seasonally adjusted figures, in contrast, are fairly flat in the months before and after bankruptcy reform, and jump around the time of the reform, although with some fluctuations. These figures thus suggest a relationship between bankruptcy reform and default rates. (See below for discussion of our seasonal adjustment procedure.)

The time pattern of default rates is also affected by whether homeowners filed for bankruptcy before the reform went into effect and whether they defaulted first versus filed for bankruptcy first. Figure 2 shows national bankruptcy filing rates around the time of bankruptcy reform, as well as filing rates in our samples of prime and subprime mortgages. All three filing rates spiked before bankruptcy reform went into effect in

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database at the same time, as long as they were still in effect in January 2005. We do not include mortgages that originated prior to January 2004 because LPS' coverage of subprime mortgages is less comprehensive in earlier years. We use lenders' classifications of 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.

[11] Papers that use this definition in models of mortgage default and renegotiation include Demyanyk and van Hemet (2011), Jiang et al (2010), Keys et al (2010) and Adelino et al (2009).

October 2005. Homeowners' default rates are likely to respond differently to bankruptcy reform depending on whether or not they filed for bankruptcy before the reform went into effect. In particular, the default rates of pre-reform filers are likely to fall after bankruptcy reform, because their financial gain from filing helps them to avoid defaulting on their mortgages during the next few months. In contrast, the default rates of homeowners who did not file for bankruptcy before the reform are predicted to rise after the reform. This is because if there had been no bankruptcy reform, these homeowners might have filed for bankruptcy after October 2005 in order to avoid defaulting. But because the reform reduced their gain from filing, they are less likely to file for bankruptcy and more likely to default. Alternately, if there had been no bankruptcy reform, these homeowners might have defaulted on their mortgages post-reform and then filed for bankruptcy in order to save their homes. But after the reform, they are likely to default earlier since they no longer expect to save their homes.

Whether overall default rates are predicted to rise or versus fall after bankruptcy reform thus depends on the number of defaults by homeowners who filed for bankruptcy before the reform relative to the number of defaults by homeowners who did not file before the reform. Figure 1 suggests that the latter group in fact predominates. More specifically, table 2 gives the number of defaults per month before versus after bankruptcy reform by homeowners in each group. The pre-reform time period covers three months before bankruptcy reform went into effect and the post- reform time period covers three months after. For both the prime and subprime samples, the number of defaults per month by pre-reform bankruptcy filers dropped after the reform went into effect, while the number of defaults by non-filers increased after the reform went into effect. But for both samples, the number of defaults by non-bankruptcy filers is much larger than the number of defaults by filers. Thus the overall time pattern of default is dominated by homeowners who did not file for bankruptcy before the reform and their default rates rose substantially following the reform.[12]

[12] In the regressions discussed below, we keep homeowners who filed for bankruptcy before the reform in the sample. Doing so biases our estimates of the effect of bankruptcy reform on mortgage default rates downward. There is also a third group of homeowners who filed for bankruptcy after the reform. They are excluded from table 2

Now turn to sample periods. We use short sample periods before versus after the date of bankruptcy reform. This is both because other aspects of the economic environment remain fairly constant and because short sample periods end before the mortgage crisis began, thus allowing us to separate the effects of bankruptcy reform from the effects of the mortgage crisis on default rates. Our base case model uses a sample period of three months before to three months after bankruptcy reform. Because bankruptcy reform went into effect on October 17, 2005, our sample period is actually 3½ months before to 3½ months after reform (July 2005 through January 2006). We also estimate our model for a shorter period of two months before to two months after bankruptcy reform (August 2005 through December 2005) and a longer sample period of six months before to six months after bankruptcy reform (April 2005 through April 2006).[13] All of these periods end before housing prices peaked in June 2006, according to the Case/Shiller home price index.[14]

Because the LPS dataset does not include any homeowner demographic characteristics, we merge it with data from the Home Mortgage Disclosure Act (HMDA) to get homeowners' income, sex, and race at the time of the mortgage application, and whether they had a co-applicant for the mortgage.[15] Our final samples for the three months before to three months after period consist of 353,225 prime mortgages and

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because their default rates are very low both before and after the reform. But they are included in the sample used for the regressions.

[13] We assign individual mortgages payments due in October 2005 to the pre- versus post-bankruptcy reform period depending on whether the payment due date is before versus after October 17, 2005.

[14] This is based on the non-seasonally adjusted version of the Case/Shiller index, available at www.standardandpoors.com. Housing prices in Boston peaked much earlier (in July 05), but remained near their peak levels over the following year.

[15] HMDA data cover nearly all mortgage originations. Mortgages were matched based on the zipcode 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. The sex variable in HMDA is for the main mortgage applicant.

310,187 subprime mortgages, with approximately 2.1 million monthly observations for each.[16] Sample sizes for the other time periods are proportionately smaller or larger.

Now turn to how we calculate dummy variables to represent the three groups of homeowners that 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 do not have all of the information needed to calculate individual income exemptions according to the procedure specified by bankruptcy law. Instead, we use the state median income level as a proxy for the income exemption 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 update home value at the time of mortgage origination by multiplying it by the average change in housing values in the homeowner's metropolitan area since the date of mortgage origination.[17] We know the mortgage principal amount each month, so home equity each month equals current home value minus the current mortgage principal. Non-exempt home equity then equals the maximum of home equity minus the state's homestead exemption, or zero.[18]

We use $MT1$ to denote the income-only means test; it equals one if homeowners are negatively-affected by the test. $MT1 = 1$ if homeowners have non-exempt income, but no non-exempt home equity, or if $Y - X_Y > 0$ and $A - X_A \leq 0$. $MT2$ denotes the income/asset means test; it equals one if homeowners are harmed by the test. $MT2 = 1$ if non-exempt income over 5 years exceeds non-exempt assets/home equity, or if

[16] We start with a 10% random sample of prime mortgages and all subprime mortgages that originated in 2004 or 2005. With the loss of observations from the HMDA match and dropping mortgages in hurricane-affected counties, our final samples are approximately 5% of prime mortgages and 50% of subprime mortgages in the LPS dataset.

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

[18] Asset/home equity exemption levels by state are taken from Elias (2006) and median state income levels for 2005 are taken from the U.S. Trustee Program at the Department of Justice (www.justice.gov/ust/eo/bapcpa/meanstesting.htm).

$5(Y - X_Y) > A - X_A > 0$. HC denotes the homestead exemption cap and equals one for homeowners harmed by the cap. HC = 1 if homeowners live in states with homestead exemptions greater than $125,000 and have assets/home equity in excess of the cap, or if $X_A > \$125{,}000$ and $X_A - A > 0$. We apply the homestead exemption cap only to homeowners whose mortgages were for purchase, since we assume that those whose mortgages were for refinance have owned their homes for more than 3 1/3 years.

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

Specification

We estimate Cox proportional hazard models of prime and subprime 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 baseline hazard depends on the age of the mortgage, in months. Figure 3 gives the baseline hazard rates for our prime and subprime mortgage samples. For both samples, default rates rise steeply after the first few months and peak at around 12-19 months. Other researchers have found similar age profiles for subprime mortgages.[19]

The key variables of interest in our models are the bankruptcy reform dummy, *BR*, and the interactions of *BR* with *MT*1, *MT*2 and *HC*. The coefficient of the bankruptcy reform dummy measures the change in default rates after bankruptcy reform; if the reform had not occurred, default rates would have been expected to remain constant after controlling for the explanatory variables and mortgage age. The three interaction terms measure difference-in-differences, or whether default rates increased by more after bankruptcy reform for homeowners in each of the three negatively-affected groups than for other homeowners. If bankruptcy reform had not occurred, default rates would not have been expected to change differently for homeowners in the three groups than for other homeowners. All of these variables are predicted to have positive signs.

[19] See Demyanyk and van Hemet (2009), Jiang et al (2009), and Keys et al (2010).

Ai and Norton (2003) have pointed out that, while the coefficients of interaction terms equal 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 evaluating using the full estimated model, including all of the results for the control variables. We compute corrected difference-in-differences using this procedure.[20]

Our choice of control variables is guided by availability and by the recent literature on mortgage default. Our demographic variables are those from HMDA, discussed above. We also include dummy variables representing ranges of FICO scores (the highest category is omitted) and ranges of loan-to-value ratios and debt-to-income ratios (the lowest categories for each are omitted).[21] We include dummy variables for whether the mortgage is a jumbo, whether it is fixed-rate (versus adjustable rate or hybrid), whether it is for refinance (versus purchase), whether it was securitized (versus held in the lender's portfolio) and whether 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).[22] We also include dummy variables for whether the homeowner provided full documentation of income and assets when applying for the mortgage, partial documentation, "other" documentation, or whether

[20] We use Stata 11 margins and nlcom commands for these calculations. 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* both equal 1 and the control variables are assumed to take their mean values. We divide by the default rate when *HC* = 0 in order to take out the baseline hazard. 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.

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

[22] Correspondents are mortgage brokers that originate mortgages only for a single lender; while independent mortgage brokers sell to multiple lenders. Correspondents' interests are considered to be more closely aligned with the interests of banks than those of independent mortgage brokers. See Jiang et al (2010) for discussion of the role of mortgage brokers and Keys et al (2010) and Rajan et al (2009) for discussion of the effect of securitization on default rates.

documentation information is missing (the omitted category is no documentation).[23] House characteristics include whether the house is single-family (versus multi-family) and whether it is a vacation home or an investment property (versus a primary residence). We also include a measure of homeowners' benefit from refinancing their mortgages at the currently-available mortgage interest rate—it increases in size when interest rates on new mortgages are lower.[24] Finally we include measures of regional economic conditions: 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 zipcode—all lags are one month. [25]

We also include our seasonality measure, which takes a different value each month.[26] We do not include time dummies, because in our short samples they would be collinear with the bankruptcy reform dummy. But we include state fixed effects. We cluster observations by mortgage (results do not change in any substantive way if we cluster by zipcode).

Table 3 gives summary statistics for our prime and subprime mortgage samples over the time period three months before to three months after bankruptcy reform.[27] The income-only means test harms 27% of prime mortgage-holders versus 45% of subprime mortgage-holders. Since the test applies only to homeowners whose home equity is entirely exempt, it is more likely to affect subprime mortgage-holders since they have less home equity. The opposite is true for the income/asset means test, which harms 31%

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[23] "Other" means that documentation is not categorized as full, partial or no documentation.

[24] The measure is $\{r_0[1-(1+r_t)^{t-M}]\}/\{ r_t[1-(1+r_0)^{t-M}]\}$, 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).

[25] 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.

[26] The seasonality measure is calculated using the SAS X11 procedure, developed by Statistics Canada. To calculate it, we first construct monthly average default rates for our sample, using the longer sample period of March 2005 through October 2008. The X11 procedure estimates trends using an iterative moving average (ARIMA) procedure and then removes the trends by subtraction. Then it uses the same procedure to estimate irregular components (including bankruptcy reform) and remove them. See support.sas.com/documentation/cdl/en/etsug/60372/HTML/default/x11_toc.htm.

[27] The mean default rates given in table 3 are not seasonally adjusted.

of prime mortgage-holders versus 11% of subprime mortgage-holders. This test requires that homeowners have non-exempt home equity in addition to their non-exempt income, so that it is more likely to harm prime mortgage-holders. Finally the homestead exemption cap, which requires very high home equity, applies to 5% of prime mortgage-holders, but only 1% of those with subprime mortgages.

Results

Table 4 gives the results of estimating the hazard model using our base case sample period of three months before to three months after bankruptcy reform. Only the results for the control variables are shown. All results are given as proportional increases or decreases in default rates relative to one—for example the coefficient of 1.13 for the jumbo mortgage dummy in the subprime sample indicates that homeowners with jumbo mortgages are 13% more likely to default than those with smaller mortgages, while the coefficient of 0.78 on the fixed rate mortgage dummy in the prime sample indicates that homeowners with fixed rate prime mortgages are 22% less likely to default than those with variable rate prime mortgages. Tests of statistical significance are for whether the results differ significantly from one (rather than zero).

Our results for the subprime mortgage sample are similar to those found by previous researchers, but there has been much less research on default by prime mortgage-holders. One interesting result is that default rates for prime mortgages are more responsive to changes in FICO scores, but default rates for subprime mortgages are more responsive to changes in loan-to-value ratios. All of the results for variables representing mortgage sources are less than one, so that both prime and subprime mortgages originated by independent mortgage brokers—the omitted category—are the most likely to default.[28] Our results show that prime mortgages that were securitized are significantly more likely to default, but—surprisingly— subprime mortgages that were securitized are significantly less likely to default. The documentation variables are insignificant for prime mortgages, suggesting that higher levels of documentation are not associated with reduced likelihood

[28] This is similar to the results of Jiang et al (2010) for subprime mortgages, using different data.

of default.[29] Also homeowners with both types of mortgages are more likely to default if they live in zipcodes with higher lagged average default rates, implying that defaults may respond to persistent local shocks.

Table 5 gives the results for the key variables, using the same sample. Because the interaction terms are correlated with the bankruptcy reform dummy 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 23% for prime mortgages and 14% for subprime mortgages. Both results are highly significant ($p < .001$). In columns (2) – (4), we separately enter each of the three dummy variables *MT*1, *MT*2 and *HC* and their interactions with bankruptcy reform and, in column (5), we enter all of them together. In both samples, 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 negatively related to default rates.

Now turn to the difference-in-differences. Using the results in column (5) for prime mortgages, default rates rose following bankruptcy reform by 26% for homeowners subject to the income-only means test, 11% for homeowners subject to the income-asset means test, and 30% for homeowners subject to the homestead exemption cap—all relative to the changes in default rates of homeowners not subject to these provisions. The first two results are statistically significant at the 1% and 10% levels, respectively. The result for the homestead exemption cap is just short of significance in column (5), but is significant in column (4) when it is entered by itself ($p = .036$). For subprime mortgage-holders, default rates rose following bankruptcy reform by 5% for homeowners subject to the income-only means test and by 28% for homeowners subject to the homestead exemption cap, relative to homeowners not subject to these provisions. Both results are significant at the 5% level. However, homeowners subject to the income/asset means test are 11% *less* likely to default after bankruptcy reform and the result is

[29] In contrast, both Jiang et al (2010) and Sherlund (2008) found that subprime mortgages lacking full documentation were more likely to default.

significant.[30] Overall, our results suggest substantial support for the hypothesis that bankruptcy reform caused mortgage default rates to rise overall and to rise by even more for homeowners subject to the three provisions.

Table 6 shows the results when we rerun the model on the shorter sample period of two months before to two months after bankruptcy reform and the longer sample period of six months before to six months after bankruptcy reform. Results are given only for the bankruptcy reform dummy and the three interaction terms. The figures in the middle column of table 6 repeat those in table 5, column (5), for the three months before to three months after sample period. In both samples, the bankruptcy reform dummy remains positive and highly significant in all three time periods and the interaction terms also remain similar in size and significance. The difference-in-difference results for the homestead exemption cap increase in size in the shortest time period for both the prime and subprime samples, reflecting the fact that there was a spike in defaults by homeowners subject to the cap just after bankruptcy reform went into effect.

As robustness checks, we ran placebo tests assuming that bankruptcy reform went into effect at fictitious dates. Our fictitious dates are June 2005 (four months early), February 2006 (four months late), and October 2006 (one year late), where October 2006 is of interest because the effect of seasonality should be nearly the same. The specification otherwise remains the same as in table 4, column (5). The results are given in table 7. For the prime mortgage sample, all of the results become either negative or positive but insignificant. For the subprime sample, however, two results are positive and significant: the bankruptcy reform dummy and the income-asset means test interaction—both for the fictitious date of February 2006. The positive result for the bankruptcy reform dummy reflects the fact that subprime mortgage default rates in our sample were rising during the period March – May 2006 as the mortgage crisis approached, even after seasonal adjustment.

[30] Default rates of homeowners with subprime mortgages who are subject to the income/asset means test increased over the entire sample period, but the rate of increase was higher before bankruptcy reform than after. Once we correct for seasonality, the effect of bankruptcy reform is therefore negative.

We also reran our base case model, but dropping mortgages of homeowners who filed for bankruptcy before the reform went into effect. Dropping these mortgages from the sample is predicted to increase the coefficient of the bankruptcy reform dummy, because—as discussed above—default rates of homeowners who filed for bankruptcy before the reform fell rather than rose after the reform went into effect. The results are shown in table 8. The coefficient of the bankruptcy reform dummy increases from 23% to 26% for the prime mortgage sample and from 14% to 20% for the subprime mortgage sample. Both results remain significant at the 1% level.[31]

Finally, we ran a version of Morgan et al's (2011) model, using our data and our specification. Morgan et al argue that bankruptcy reform caused mortgage default rates to rise by more in states with higher homestead exemptions, because prior to the reform, homeowners in these states gained the most from filing for bankruptcy. To test their model, we drop our *HC*, *MT*1 and *MT*2 variables and substitute the dollar value of the state's homestead exemption (normalized by the appraised value of the house), plus a dummy variable that equals one for mortgages in states with unlimited homestead exemptions. Both variables are entered by themselves and also interacted with the bankruptcy reform dummy. The sample period is three months before to three months after bankruptcy reform. The specification is otherwise the same as in tables 3 and 4.[32]

The results are shown in table 9. The bankruptcy reform dummy remains statistically significant and approximately the same size as in table 5. The interaction of the bankruptcy reform dummy with the homestead exemption variable is insignificant in both samples, but the interaction of the bankruptcy reform dummy with the unlimited homestead exemption dummy is positive and highly significant in both. In states with unlimited homestead exemptions, prime and subprime mortgage default rates increased by 19% and 27%, respectively, after bankruptcy reform.

The large and significant results for the unlimited homestead exemption interaction are probably due to the fact that the unlimited homestead exemption dummy is correlated

[31] The results in table 8 drop homeowners who filed for bankruptcy in September and October 2005, but they remain virtually unchanged if we also drop homeowners who filed for bankruptcy in July and August 2005.

[32] Morgan et al's (2011) dependent variable is foreclosure rates, but we use mortgage default rates.

with the homestead exemption cap and the income-only means test. The homestead exemption cap is more likely to be binding for homeowners living in states with unlimited homestead exemptions, because these states—plus a few others—have home equity exemptions greater than $125,000. Also the income-only means test harms homeowners if they have non-exempt income but no non-exempt home equity. Because home equity is always exempt when the homestead exemption is unlimited, homeowners in unlimited-exemption states are more likely to be harmed by this test. The proportion of all homeowners with prime and subprime mortgages who were harmed by the adoption of either the homestead exemption cap or the income-only means test is .28 and .46, respectively. But for homeowners in states with unlimited homestead exemptions, these figures rise to .55 and .62, respectively. Thus the interaction of the bankruptcy reform dummy and the unlimited homestead exemption dummy is probably significant because it captures the combined effect on default rates of the homestead exemption cap and the income-only means test.

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 to even larger increases in default rates by homeowners who were harmed by the two means tests and the homestead exemption 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 default rate of homeowners with prime and subprime mortgages rose by 23% and 14%, respectively, after bankruptcy reform. Default rates rose even more after bankruptcy reform for homeowners who were subject to one of the new means tests or to the cap on the homestead exemption, compared to the increases for homeowners not harmed by these provisions. These results suggest that bankruptcy reform squeezed homeowners' budgets by raising the cost of filing for bankruptcy and reducing the amount of debt discharged. It therefore increased mortgage default by

closing off a popular procedure that previously helped financially distressed homeowners save their homes.

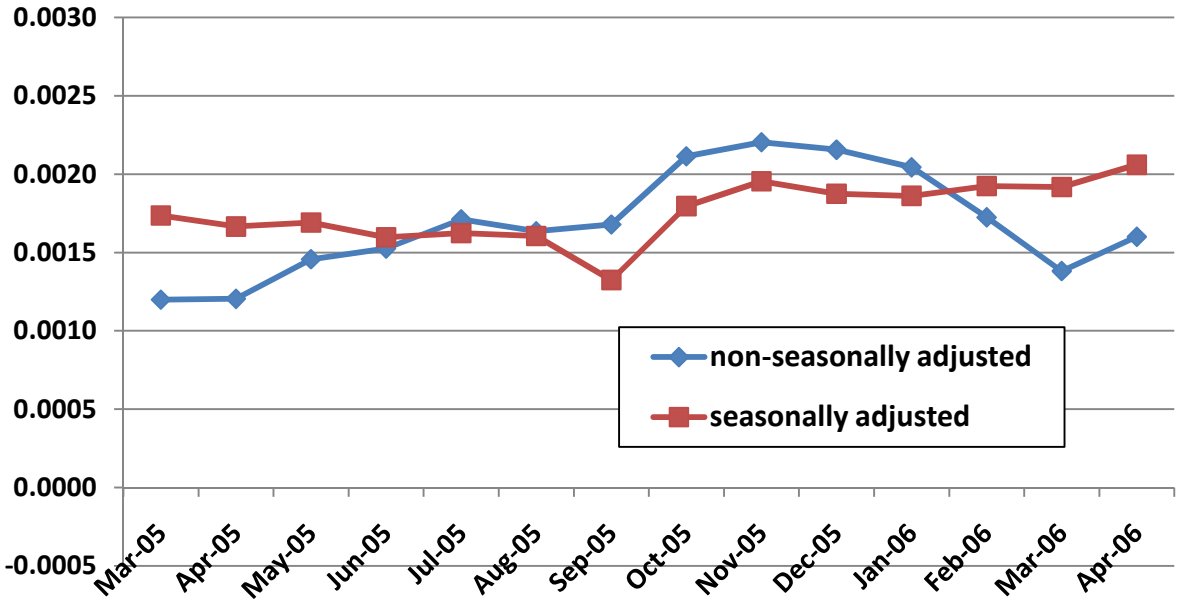
We can use the results to predict the number of additional mortgage defaults that occurred because of the 2005 bankruptcy reform. Consider first the effect of the increase in the cost of filing for bankruptcy. Default rates in our sample are approximately 2.3% and 15% per year for prime and subprime mortgages, respectively. The total number of mortgage originations in the U.S. in 2004-05 was 22 million, of which approximately 81% were prime and 19% were subprime.[33] Using these mortgages as a base, we calculate that the adoption of bankruptcy reform led to an increase of 180,000 per year in the number of mortgage defaults. (See table 10.) In addition, the adoption of the two means tests and the homestead exemption cap caused an additional 54,000 defaults per year. Thus even before the mortgage crisis began, the 2005 bankruptcy reform was responsible for around 180,000 + 54,000 = 224,000 additional mortgage defaults per year, or 1% of all mortgages that originated in 2004-05. The adoption of bankruptcy reform probably also caused default rates of mortgages that originated before 2004 to rise, but the rate of increase was probably smaller because these mortgages were both older at the time of bankruptcy reform and less risky.

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

[33] This breakdown is based on Mayer and Pence (2008), who give a range of figures based on different definitions of subprime mortgages. We use the average of their high versus low figures.

Figure 1:
Monthly Average Default Rates With and Without Seasonal Adjustment

Prime Mortgages



Subprime Mortgages

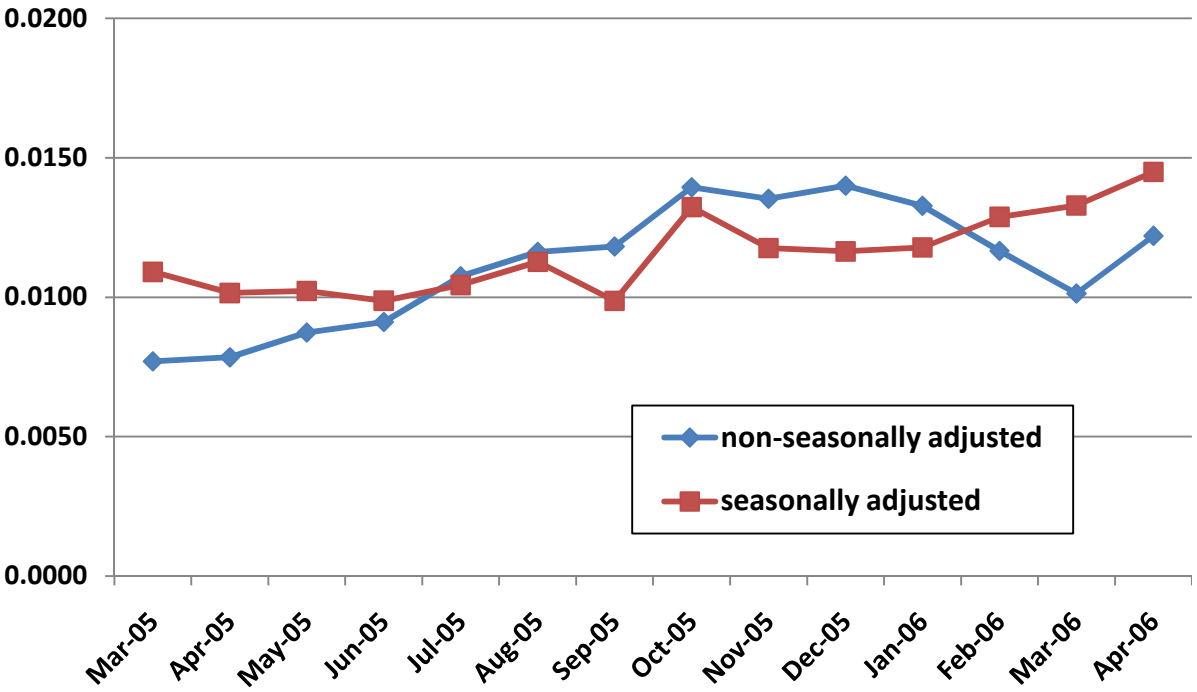
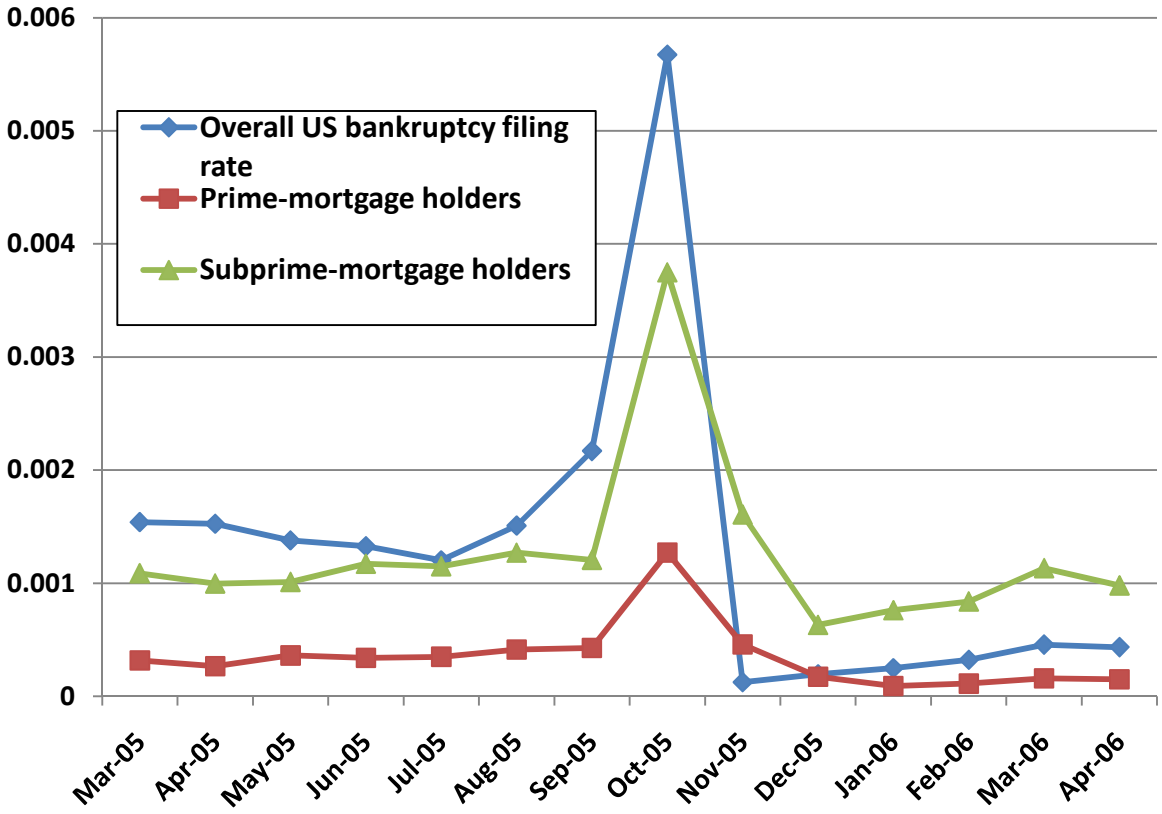


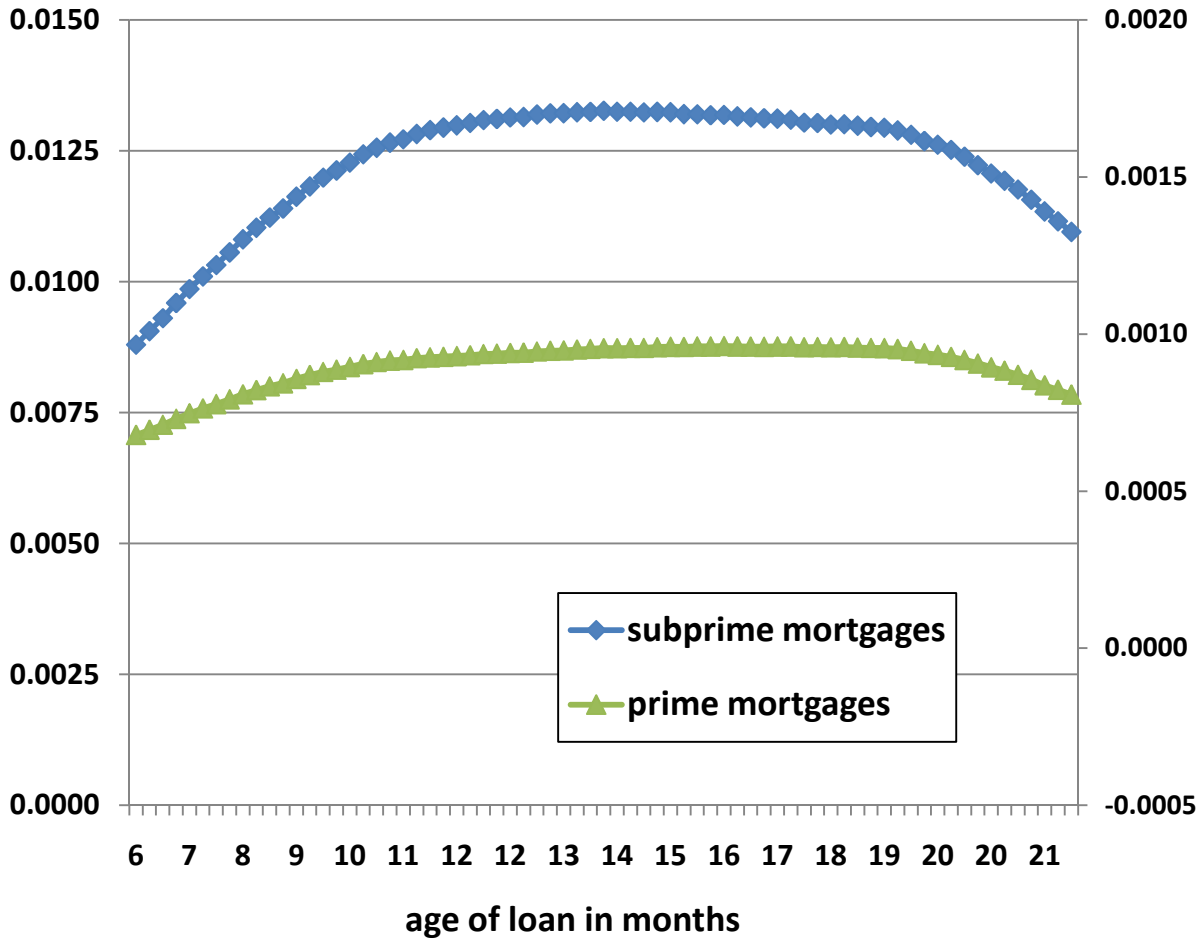
Figure 2:

Monthly Bankruptcy Filing Rates for All U.S. Households and for Homeowners with Prime and Subprime Mortgages, March 2005 – April 2006



Note: The overall U.S. bankruptcy filing rate is relative to all U.S. households. The bankruptcy filing rates for prime and subprime mortgage-holders are computed from our data and are for homeowners only. Data on number of U.S. bankruptcy filings is taken from www.abiworld.org/AM/AMTemplate.cfm?Section=Home&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=61641.

Figure 3:
Baseline Default Hazard As a Function of Mortgage Age



Notes: The scale for prime mortgage default rates is on the left and the scale for subprime mortgage default rates is on the right.

Table 1:
Changes in Homeowners' Obligation to Repay in Bankruptcy
Due to the 2005 Bankruptcy Reform

	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 income 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:
Number of Defaults per Month by Homeowners
Depending on Whether They Filed for Bankruptcy Prior to Bankruptcy Reform

	Prime mortgages		Subprime mortgages	
	Before bankruptcy reform	After bankruptcy reform	Before bankruptcy reform	After bankruptcy reform
Defaults per month by pre-reform bankruptcy filers	31	14	108	37
Defaults per month by non-bankruptcy filers	522	738	2,565	3,267

Notes: The pre-reform period covers July-October 16, 2005 and the post-reform period covers October 17, 2005 – January 2006. All bankruptcy filings in October 2005 are attributed to the pre-reform period. Defaults in October 2005 are attributed to the pre- or post-reform period depending on the due date of the mortgage payment. The same time periods are also used for our base case regressions, reported in tables 4-5.

Table 3: Summary Statistics
Three Months Before to Three Months After Bankruptcy Reform

	Prime Mortgages	Subprime Mortgages
Default rate per month	.002 (.044)	.013 (.114)
Income-only means test (*MT*1)	.265 (.442)	.451 (.498)
Income/asset means test (*MT*2)	.314 (.464)	.108 (.310)
Homestead exemption cap (*HC*)	.049 (.215)	.010 (.101)
Average income*	$101,526 (89,780)	$73,037 (59,328)
If FICO score 650 to 750*	.522 (.500)	.233 (.148)
If FICO score 550 to 650*	.138 (.345)	.623 (.485)
If FICO score 350 to 550*	.007 (.084)	.124 (.329)
Debt payment-to-income ratio > 0.5*	.084 (.277)	.044 (.206)
Debt payment-to-income ratio (0.4, 0.5)*	.119 (.323)	.191 (.393)
Debt payment-to-income ratio missing*	.344 (.475)	.528 (.499)
Loan-to-value ratio > 1.0*	.017 (.131)	.0002 (.016)
Loan-to-value ratio (0.8,1.0)*	.217 (.412)	.422 (.494)
If full documentation*	.365 (.482)	.564 (.496)
If partial documentation*	.076 (.264)	.022 (.148)
If documentation information "other"*	.314 (.464)	.289 (.453)
If documentation information missing*	.159 (.366)	.108 (.310)
If single-family house*	.747 (.435)	.811 (.392)
If fixed rate mortgage*	.609 (.489)	.244 (.430)
If jumbo mortgage*	.149 (.356)	.089 (.284)
If second home*	.021 (.145)	.007 (.083)
If investment property*	.027 (.162)	.034 (.182)
If occupancy type missing*	.566 (.495)	.347 (.476)
If loan was to re-finance*	.353 (.478)	.526 (.499)
If mortgage was securitized	.244 (.430)	.823 (.381)
If loan was originated by the lender	.513 (.500)	.433 (.496)
If loan was acquired wholesale, but not from a mortgage broker	.195 (.396)	.170 (.376)
If loan was acquired from a correspondent lender	.221 (.415)	.103 (.304)
Homeowner's gain from refinancing	1.069 (.240)	.840 (.145)
Lagged cumulative delinquency rate (zipcode)	.084 (.300)	.340 (.722)
Lagged unemployment rate (MSA) (%)	4.582 (1.281)	4.737 (1.306)
Lagged real income growth rate (state) (%)	1.567 (1.749)	1.432 (.494)

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. Because of the terms of our agreement with LPS Applied Analytics, results for the homeowner 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	Subprime Mortgages
If FICO score 650 to 750	3.946 (.309)***	1.784 (.207)***
If FICO score 550 to 650	13.537 (1.095)***	4.089 (.468)***
If FICO score 350 to 550	36.467 (3.630)***	6.805 (.790)***
If FICO score is missing	1.191 (.063)***	.847 (.020)***
Debt payment-to-income ratio > 0.5	1.057 (.074)	1.150 (.043)***
Debt payment-to-income ratio (0.4 to 0.5)	1.226 (.062)***	1.191 (.027)***
Debt payment-to-income ratio missing	1.191 (.063)***	.847 (.020)***
Loan-to-value ratio > 1.0	1.707 (.155)***	4.552 (.787)***
Loan-to-value ratio (0.8 to 1.0)	1.972 (.081)***	.965 (.015)***
If full documentation	.878 (.058)*	1.001 (.063)
If partial documentation	1.105 (.089)	1.236 (.093)***
If documentation information "other"	1.031 (.079)	1.082 (.070)
If documentation information missing	.809 (.069)***	.952 (.067)
If single-family house	1.066 (.044)	1.196 (.025)***
If fixed rate mortgage	.775 (.032)***	0.681 (.014)***
If jumbo mortgage	1.057 (.075)	1.134 (.036)***
If second home	.948 (.099)	1.091 (.087)
If investment property	1.070 (.095)	.981 (.039)
If occupancy type missing	1.002 (.047)	1.437 (.036)***
If loan was to re-finance	.898 (.037)***	.820 (.013)***
If mortgage was securitized	1.164 (.058)***	.809 (.020)***
If loan was originated by the lender	.651 (.041)***	.753 (.024)***
If loan was acquired wholesale, but not from a mortgage broker	.821 (.055)***	.873 (.026)***
If loan was acquired from a correspondent lender	.800 (.051)***	.753 (.024)***
Homeowner's gain from refinancing	.305 (.081)***	.164 (.012)***
Lagged average mortgage default rate (zipcode)	1.067 (.030)***	1.077 (.008)***
Lagged unemployment rate (MSA)	1.016 (.018)	1.053 (.008)***
Lagged real income growth rate (state)	.952 (.014)***	.972 (.004)***
Seasonal variable	Y	Y
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.

Table 5:
Results of Hazard Models Explaining Mortgage Default with Interaction Terms
Three Months Before to Three Months After Bankruptcy Reform

Prime Mortgages

	(1)	(2)	(3)	(4)	(5)
Bankruptcy reform (*BR*)	1.228*** (.046)	1.229*** (.046)	1.234*** (.047)	1.227*** (.046)	1.234*** (.047)
Income-only means test (*MT*1)		0.937* (.035)			0.849*** (.035)
Income/asset means test (*MT*2)			0.815*** (.035)		0.771*** (.035)
Homestead exemption cap (*HC*)				1.066 (.105)	1.087 (.110)
Bankruptcy reform*income-only means test (*BR*MT*1)		1.265*** (.068)			1.255*** (.067)
Bankruptcy reform *income/asset means test (*BR*MT*2)			1.029 (.065)		1.106* (.064)
Bankruptcy reform *homestead exemption cap (*BR*HC*)				1.427** (.203)	1.298 (.212)

Subprime Mortgages

	(1)	(2)	(3)	(4)	(5)
Bankruptcy reform (*BR*)	1.157*** (.026)	1.142*** (.025)	1.150*** (.026)	1.156*** (.026)	1.139*** (.025)
Income-only means test (*MT*1)		0.885*** (.015)			0.882*** (.015)
Income/asset means test (*MT*2)			1.043 (.029)		0.993** (.028)
Homestead exemption cap (*HC*)				0.963 (.072)	0.988 (.075)
Bankruptcy reform*income-only means test (*BR*MT*1)		1.073*** (.027)			1.054** (.027)
Bankruptcy reform* income/asset means test (*BR*MT*2)			0.854*** (.053)		0.892** (.052)
Bankruptcy reform* homestead exemption cap (*BR*HC*)				1.301** (.141)	1.277** (.146)

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. All equations include the control variables shown in table 3.

Table 6:
Results of Hazard Models Explaining Mortgage Default Using Varying Sample Periods

Prime Mortgages

	+-2 months	+-3 months	+-6 months
Bankruptcy reform (*BR*)	1.226*** (.053)	1.234*** (.047)	1.243*** (.039)
Bankruptcy reform*income-only means test (*BR*MT*1)	1.354*** (.082)	1.255*** (.067)	1.130** (.053)
Bankruptcy reform* income/asset means test (*BR*MT*2)	1.118* (.076)	1.106* (.064)	1.151*** (.053)
Bankruptcy reform * homestead exemption cap (*BR*HC*)	1.440* (.255)	1.298 (.212)	1.173 (.164)

Subprime Mortgages

	+2 months	+- 3 months	+- 6 months
Bankruptcy reform (*BR*)	1.213*** (.031)	1.139*** (.025)	1.154*** (.018)
Bankruptcy reform*income-only means test (*BR*MT*1)	1.043 (.033)	1.054** (.027)	1.048*** (.023)
Bankruptcy reform* income/asset means test (*BR*MT*2)	.900* (.056)	.892** (.052)	1.059 (.042)
Bankruptcy reform*homestead exemption cap (*BR*HC*)	1.557*** (.162)	1.277** (.146)	1.215** (.116)

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 the table 3, plus *MT*1, *MT*2 and *HC*. "+-2 months" indicates the sample period two months before through two months after bankruptcy reform. Other sample periods are defined in the same way.

Table 7:
Results of Placebo Tests Using Fictitious Dates for Bankruptcy Reform

Prime Mortgages

	+-3 months June 05	**+-3 months Feb 06**	**+-3 months Oct 06**
Bankruptcy reform (*BR*)	1.130 (.092)	1.122 (.109)	1.041 (0.043)
Bankruptcy reform*income-only means test (*BR*MT*1)	.796** (.092)	.771*** (.072)	.996 (.070)
Bankruptcy reform* income/asset means test (*BR*MT*2)	1.064 (.089)	1.034 (.069)	.950 (.064)
Bankruptcy reform* homestead exemption cap (*BR*HC*)	1.227 (.316)	.746 (.187)	.994 (.174)

Subprime Mortgages

	+-3 months June 05	**+-3 months Feb 06**	**+-3 months Oct 06**
Bankruptcy reform (*BR*)	1.026 (.038)	1.207*** (.061)	1.034 (.022)
Bankruptcy reform*income-only means test (*BR*MT*1)	.919*** (.036)	1.039 (.030)	1.056 (.034)
Bankruptcy reform* income/asset means test (*BR*MT*2)	1.017 (.171)	1.168*** (.047)	.994 (.066)
Bankruptcy reform *homestead exemption cap (*BR*HC*)	1.076 (.804)	.702*** (.103)	1.046 (.150)

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*. "+-3 months June 05" indicates that the sample period is three months before through three months after June 2005.

Table 8:
Results of Hazard Models Explaining Mortgage Default
Excluding Homeowners Who Filed for Bankruptcy in September - October 2005

Three Months Before to Three Months After Bankruptcy Reform

	Prime Mortgages	**Subprime Mortgages**
Bankruptcy reform (*BR*)	1.261*** (.048)	1.203*** (.035)
Bankruptcy reform*income-only means test (*BR*MT*1)	1.253*** (.067)	1.028* (.018)
Bankruptcy reform *income/asset means test (*BR*MT*2)	1.109* (.064)	.965 (.049)
Bankruptcy reform *homestead exemption cap (*BR*HC*)	1.307 (.211)	1.317*** (.140)

Notes: ***, ** and * indicate whether coefficients are significantly different from one at the 0.1%, 1%, and 5% levels, respectively. Standard errors are in parentheses. Both equations include the control variables shown in the table 3, plus *MT*1, *MT*2 and *HC*.

Table 9:
Results of Hazard Models Explaining Mortgage Default
Morgan et al's (2011) Specification

Three Months Before versus After Bankruptcy Reform

	Prime Mortgages	Subprime Mortgages
Bankruptcy reform (*BR*)	1.206*** (.045)	1.120*** (.024)
Homestead exemption	1.292*** (.166)	.876*** (.044)
Unlimited homestead exemption dummy	.815 (.113)	.724*** (.052)
Bankruptcy reform * Homestead exemption	1.118 (.551)	1.812 (.740)
Bankruptcy reform * Unlimited homestead exemption dummy	1.186*** (.072)	1.267*** (.034)

Notes: ***, ** and * indicate whether coefficients are significantly different from one at the 0.1%, 1%, and 5% levels, respectively. Standard errors are in parentheses. The value of the homestead exemption is normalized by the appraised value of the house. The unlimited homestead dummy equals one for mortgages in states with unlimited homestead exemptions. All of the control variables shown in table 3 are also included.

Table 10:
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	.265	.312	.045
Mortgage default rate/year	.024	.022	.014	.014
Increase in default rate after bankruptcy reform	.234	.255	.106	.298
Subprime mortgages:				
Proportion of all mortgages originated in 2004-05	.19	.19	.19	.19
Proportion affected by the change	1.00	.451	.108	.010
Mortgage default rate/year	.147	.132	.131	.150
Increase in default rate after bankruptcy reform	.139	.054	0	.277
Number of additional mortgage defaults/year	180,000	40,000	8,000	5,000

Note: The figure in the bottom row, left column, equals 22,000,000(.81*1.0*.024*.234 + .19*1.0*.147*.139). The other figures are calculated in the same way. We do not calculate an increase in the number of mortgage defaults by subprime mortgage-holders subject to the income/asset means test, since this result was non-positive. Mortgage default rates are converted from monthly to yearly using the conversion factor $\sum_{t=0}^{11}(1-m)^t$, where m is the monthly default rate.

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