

# Household Debt Overhang and Bankruptcy Abuse Prevention<sup>†</sup>

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## Abstract

Bankruptcy abuse prevention has been criticized for *increasing* foreclosure rates, imposing negative impacts on housing markets, and aggravating the financial crisis. By contrast, this paper documents that bankruptcy abuse prevention *reduces* household debt overhang, a phenomenon harmful to home values and housing markets. Using a difference-in-differences analysis, we find that households in recourse states increased their home improvement and maintenance expenditures after the Bankruptcy Abuse Prevention and Consumer Protection Act, a period during which the households paid considerable attention to the downside risk of the housing market, and that the effects vary by home equity level. The results remain unchanged with alternative specifications and cannot be explained by credit changes, judicial and nonjudicial foreclosures, homestead exemption, house sales, or heterogeneous expectations. Last but not least, we use entropy balancing to eliminate the differences between the treatment and control groups and get similar results.

**Keywords:** Bankruptcy Abuse Prevention, Household Debt Overhang, Financial Crisis, Mortgages, Housing Markets

**JEL Classification:** G2, K3, R2

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## Abstract

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## 1 Introduction

Personal bankruptcy helps distressed households recover their balance sheets and obtain a fresh start. Nevertheless, bankruptcy may be abused by households that are able to repay their debt but choose not to do so, which intensifies default risks. Therefore, regulators take actions to inhibit bankruptcy abuse. However, the extant literature criticizes bankruptcy abuse prevention for *increasing* foreclosure rates and imposing downward pressure on housing markets. Researchers argue that overly indebted borrowers could file bankruptcy to free up income to pay their mortgages by discharging unsecured debts. Bankruptcy abuse prevention makes it more difficult to retain one’s home by filing bankruptcy (Morgan, Iverson, and Botsch 2012).<sup>1</sup> Therefore, bankruptcy abuse prevention increases foreclosures and the number of homes for sale, and the negative impact of the act on real estate markets has damaged the balance sheets of both debtors and creditors (Li, White, and Zhu 2011; Mitman 2016).<sup>2</sup>

In this paper, we document that bankruptcy abuse prevention *reduces* household debt overhang, a phenomenon harmful to home values and the housing market. Household debt overhang refers to the notion that if a household strategically defaults in case of negative home equity, it will reduce its investment in its property, which is the collateral of the mortgage, because the household will not gain the benefit of such investment in the event of a foreclosure. Melzer (2017) identifies household debt overhang in the U.S. He argued that debt overhang contributes to declines in the value of properties when borrowers strategically default and let the properties enter foreclosure.

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<sup>1</sup> The bankruptcy abuse prevention policy only targets “abused” bankruptcy filings. However, due to limited capacities to target such bankruptcy filers in the implementation of such a policy, many bankruptcy applications could be mistakenly rejected.

<sup>2</sup> Specifically, Li et al. (2011) find that the BAPCPA increased the frequency of mortgage defaults both before and after the outbreak of the financial crisis.

To elaborate on the story for this paper, we start with strategic defaults. In nonrecourse states, an underwater homeowner can simply “walk away from the home,” i.e., default without deficiency judgment. In other words, the homeowner does not need to repay the part of the loan balance that is above the home value. However, in a recourse state, even if the property enters foreclosure, the borrower still needs to pay the deficiency (the loan balance minus the home value). To shirk the repayment of deficiency, borrowers can file (Chapter 7) bankruptcy. Thus, bankruptcy can be exploited by homeowners to strategically default in recourse states but not in nonrecourse states. Note that these homeowners are not necessarily financially constrained, as they can strategically default when the housing price decreases to a level below the mortgage balance even if they have sufficient liquidity to service the mortgage debt.

If a homeowner has the option to strategically default, debt overhang occurs: The homeowner is not willing to invest in his or her property (e.g., expenditures of improvement and maintenance) because the beneficiary of the investment is the lender.<sup>3</sup> More importantly, in a more general case described by [Shiller and Weiss \(2000\)](#), debt overhang may exist even when the default option is currently *out of money*, i.e., when the loan value is lower than the *current* property value. [Shiller and Weiss \(2000\)](#) build a model and show that, if the borrower expects that *in the future*, the housing price *may* decline and lead to negative home equity and strategic default, her *current* expenditure on her property will be lower than the level without strategic default option; this is the type of household debt overhang this paper is interested in.

In recourse states, bankruptcy helps homeowners strategically default, as mentioned above, and hence increases the probability of debt overhang. By contrast, bankruptcy does not affect debt overhang in nonrecourse states since homeowners do not need to file for bankruptcy to strategically default. Therefore, we can compare the change in debt overhang in recourse and nonrecourse states after the implementation of bankruptcy abuse prevention to test this hypothesis.

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<sup>3</sup> Note that we do not argue that household debt overhang is relevant only for strategic defaults.

The policy shock we exploit is the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA) adopted in the U.S., which made it more difficult to file for Chapter 7 bankruptcy. Note that the recourse status of each state included in our sample was determined before 2005 and hence is exogenous to the federal policy shock. The BAPCPA increased the costs of filing for bankruptcy and reduced the amount of debt discharged (Li et al. 2011; Sommer 2005; White 2007), which made bankruptcy law much less friendly to debtors. The bankruptcy costs for both Chapters 7 and 13 have increased substantially, thus discouraging all homeowners from filing for bankruptcy (Li et al. 2011; Sommer 2005).

One may argue that during our sample period (2003–2007), the realized default rate was low, the housing price was high, and most households did not consider strategic defaults. We want to highlight that debt overhang in our paper is the decline in *current* home investment due to the *possibility* of *future* strategic default, which is described by aforementioned Shiller and Weiss (2000). Shiller and Weiss (2000) characterize future housing prices (which are unknown to the homeowner when she makes a home maintenance decision) by a log-normal distribution, which may lead to negative home equity. They find that if *future* home equity is insured to be nonnegative, which is similar to the availability of an option of strategic default in case of negative home equity, the *current* optimal investment in home maintenance will be lower than that in the situation without such an insurance. The rationale is that current investments in improvement and maintenance *may* not benefit the homeowner if *in future* the housing price declines to a certain level and triggers a strategic default, which discourages current investment. Thus, the premise of our argument is that, during our sample period, the general public was aware that there was a *possibility* of *future* housing price decline, and we do not need the *current* default rate (the default rate during the sample period) to be high.

Moreover, our theory does *not* require that the majority of the households have *pessimistic expectations*, i.e., that the expected value of future housing prices is lower than the current price. In fact, Shiller and Weiss (2000) *do not assume* that the *expectation* of future housing value must be lower than the current value to obtain

debt overhang. What we need is the *existence* of a nontrivial level of *downside risk* (the *possibility* of a price decline that leads to negative home equity) in households' beliefs on the distribution of future housing prices. The *expectation*, which is the *mean* of all possible outcomes in the distribution, is not necessarily *pessimistic* (lower than the current housing price). We elaborate the rationale in Section 3.1 using the concept of option value and provide supporting evidence using Google Trends.

Using quarterly data from the Consumer Expenditure Survey (CES), we test our predictions using a difference-in-differences (DiD) approach. We find that after the enactment of the act, homeowners in recourse states increased their investment expenditures on housing by 25.7% compared to those in nonrecourse states. The results are robust to various specifications. Heterogeneity analyses indicate that the effects were stronger for properties with a higher loan-to-value ratio (LTV). An event study also confirms the parallel pretreatment trends. We rule out the explanations of changes in credit, homestead exemption, house sales, and heterogeneous expectations of housing prices. We do not find similar patterns in non-housing expenditures.<sup>4</sup> We also discuss the period between April 2005 (the time the BAPCPA was signed into law), and October 17, 2005 (the time BAPCPA took effect), in Section 4.2.

We restrict the sample to pairs of neighboring recourse and nonrecourse states, and we also consider judicial and nonjudicial foreclosures. The results change little. More importantly, we exploit entropy balancing by which we assign a weight to each observation such that the distribution of the values of control variables for recourse states is similar to that for nonrecourse states for both the pretreatment and treatment periods. The estimates are similar. We also find that the growth rate of housing prices in recourse states increased relative to those in nonrecourse states

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<sup>4</sup> One may think about another identification strategy based on variation in income, as high-income borrowers are more likely to fail the mean test and the bankruptcy filing after BAPCPA. [Guiso, Sapienza, and Zingales \(2013\)](#), however, show that high-income borrowers are less likely to strategically default. Thus, high-income borrowers are less sensitive to changes in the opportunity for strategic default (and bankruptcy filing). These two effects could offset each other and result in high-income households not exhibiting additional responses.

after the reform.<sup>5</sup> Overall, we conclude that for recourse loans, bankruptcy abuse prevention reduces household debt overhang.

It may be argued that the *realized* strategic default during our sample period should be reduced by BAPCPA in our theory. As mentioned above, “debt overhang” in this paper refers mainly to the decline in current home improvement and maintenance expenditures due to the *possibility* of *future* defaults. In other words, households reduce home improvement because they expect that they may strategically default when the decline of the housing market is realized in the future. In reality, the housing crisis began at the end of 2007, and households' expectations were *not realized before the end of 2007*, so the decline in realized strategic defaults in recourse states compared with that in nonrecourse states after BAPCPA and *before the end of 2007* is not a premise of our argument. In other words, our results are driven by a difference-in-differences change in the possibility of future strategic defaults between 2003 and 2007 rather than by changes in realized defaults.

For the same reason, even if we extend the sample to the years after 2008 (the crisis period), the decline in strategic defaults due to BAPCPA still cannot be teased out in a difference-in-differences setting (where recourse states are the treated group and the years after BAPCPA are the treatment period). Most strategic defaults occurred after 2007, two years after the policy change, so the effect of BAPCPA on realized strategic defaults was realized during the crisis and is confounded by other factors in the crisis with different impacts on recourse and nonrecourse states (such as the outbreak of the crisis itself, see Footnote 12 for a detailed explanation). In addition, a simple cross-sectional comparison of strategic defaults between recourse and nonrecourse states cannot identify the source of this difference (whether a BAPCPA-induced or preexisting difference).

Therefore, we turn to a database on privately securitized residential mortgages, which have lower downpayment ratios than other mortgages. Negative home equity

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<sup>5</sup> We acknowledge that not all increases in housing prices are beneficial. However, as [Melzer \(2017\)](#) shows, household debt overhang hurts property values because of the incentive to strategically default, which normally occurs when housing prices bear downward pressure in the run-up to or during a crisis. Thus, mitigating household debt overhang helps to stabilize the housing market.

is more likely to be realized for these loans, and it is easier to capture the effects of BAPCPA on defaults during our sample period using information on them. Since county information is available in the data, we focus on counties at the state borders between recourse and nonrecourse states to further eliminate the effects of time-varying unobservable geographic characteristics. In this analysis, we find that BAPCPA reduced both strategic defaults and bankruptcies.

Note that the objective of this paper is to document the change in debt overhang caused by the bankruptcy reform. We do not intend to make any claim regarding the overall effects of the bankruptcy reform on foreclosures, and the comparison between the costs and benefits of the bankruptcy reform needs more investigation in future research.

Our paper contributes to the literature in the following respects. First, the paper contributes to the literature on bankruptcy reform. Due to the criticism that bankruptcy filings are being abused by people who do not need debt relief, the BAPCPA was aimed at preventing filing abuse. Many studies focus on the effects and influences of the reform of 2005 on different areas, such as [Chakrabarti and Pattison \(2019\)](#), [Berkowitz and White \(2004\)](#), and [Gross, Kluender, Liu, Notowidigdo, and Wang \(2021\)](#). One stream of the literature notes that the reform has had negative impacts on the housing market in the sense that it has increased the frequency of mortgage *liquidity* defaults and foreclosures. For example, [Li et al. \(2011\)](#) find that BAPCPA increased mortgage defaults, because filing bankruptcy allows households to shift funds from paying other debts to paying their mortgages, and BAPCPA increased the cost of filing and “reduced the amount of debt that is discharged”. By contrast, our paper, from the perspective of *strategic* default, finds that BAPCPA reduces household debt overhang, a phenomenon harmful to home values and the housing market, and makes homeowners invest more in the improvement and maintenance of their properties. Note that our findings do not contradict the results presented in this literature. The literature finds that BAPCPA reduces the cash diverted to the repayment of mortgages and increases default, so the default should be *liquidity* default. Our story is the decline in the probability of future strategic

defaults, and the increase in current liquidity defaults among households does not necessarily contradict the decline in the probability of future strategic defaults among them.

Second, this paper contributes to the emerging literature on household debt overhang. Since the classical work of [Myers \(1977\)](#), debt overhang has become a classical focus in corporate finance with many studies discussing various issues related to this topic.<sup>6</sup> [Shiller and Weiss \(2000\)](#) build a model to investigate homeowners' optimal investment in home maintenance in different scenarios and document household debt overhang. [Melzer \(2017\)](#) and [Bernstein \(forthcoming\)](#) empirically document the existence of household debt overhang. [Alpanda and Zubairy \(2019\)](#), [Mulligan \(2008\)](#), and [Donaldson, Piacentino, and Thakor \(2019\)](#) discuss how household debt overhang affects the transmission of monetary policy and labor supply, respectively. However, few works have discussed which factors affect debt overhang.

In particular, [Melzer \(2017\)](#) analyzes household overhang in the U.S. market and provides empirical evidence that homeowners at risk of default reduce their home investments. This paper lays a solid foundation for analyses of household debt overhang in terms of a reasoning framework, data selection, and measurement construction. Our paper is an extension of [Melzer \(2017\)](#) and contributes to this literature by showing that bankruptcy abuse prevention reform, which is a significant regulatory issue, increased homeowners' housing expenditures and reduced debt overhang.

Our paper is also related to [Corradin, Gropp, Huizinga, and Laeven \(2016\)](#). They find that households bias their portfolios toward home equity due to the protection offered by homestead exemption, an important part of bankruptcy. Instead of considering homestead exemption, our paper focuses on the waiver of unsecured debt, which can be exploited to strategically default. In other words, [Corradin et al. \(2016\)](#) and our paper study two related but different components of bankruptcy.

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<sup>6</sup> Two examples include [Hennessy \(2004\)](#) and [Admati, DeMarzo, Hellwig, and Pfleiderer \(2012\)](#).

This paper is organized as follows. Section 1 presents an introduction and reviews the literature on debt overhang. Section 2 introduces the data, sample construction, and descriptive statistics adopted. Section 3 describes the empirical results. Section 4 presents the regression results. Section 5 concludes the paper with some discussion.

## **2 Data**

### **2.1 Main data source**

The data used in this study are drawn from Public Use Microdata (PUMD) compiled through the CES conducted by the Bureau of Labor Statistics. The microdata include information collected from quarterly interview surveys and diary surveys. The CES tracks households' large expenditures, such as expenditures on major appliances and cars, and we use household characteristic and expenditure data. The CES also provides other variables for our analysis, including mortgage-related data on housing level, household characteristic data, and descriptions of houses. Details are introduced below.

First, the CES collects data on household expenditures for each housing property. CES data are superior to other resources in part because they rigorously distinguish between different types of expenditures. The CES specifies whether an expenditure is made to purchase a home or for the further maintenance or improvement of a home to further infer the different motivations of households. In addition, the CES provides a breakdown of housing expenditure data, dividing expenditures into material and labor costs. By summing the cost of materials provided by the contractor, the costs of household rental tools, the cost of materials purchased, and the contractor's labor costs, we obtain quarterly expenditure data on the maintenance and improvement of a home.

Second, the CES provides detailed mortgage debt information. The questionnaire classifies housing mortgages into first-lien mortgages, home equity mortgages, and home equity lines of credit and asks questions on these categories for

different types of housing properties. The survey collects quarterly repayment information and the outstanding balance of each loan. Based on the mortgage data, we have a good understanding of the mortgage status of each housing property and correlate it with home expenditures.

The CES provides other information on households, including data on annual household income, financial assets, and debt. By including household-level control variables, we distinguish between the effects of mortgage debt overhang and liquidity on home improvement and maintenance. In addition, we obtain housing characteristics data from the CES questionnaire, including information on the age of a house, the types and number of rooms present, and equipment in the house. Using each homeowner's valuation data for his or her house and the outstanding mortgage balance, we calculate the home equity for each household. While we do not observe the “true” market value, the perceived property value here is more suitable for our study because households make decisions based on the perceived value rather than the “true” market value.

## **2.2 Additional data sources**

As introduced in Section 1, we identify the impact of bankruptcy reform on home maintenance by comparing the responses of homeowners subject to different laws regarding recourse across U.S. states to the bankruptcy reform. We use state foreclosure law data from [Ghent and Kudlyak \(2011\)](#), which include state-level information on the requirements of recourse and judicial foreclosure. [Ghent and Kudlyak \(2011\)](#) define a mortgage as having nonrecourse status if deficiency judgments are either explicitly prohibited or impractical in the vast majority of cases. We also obtain state-level socioeconomic factors from the Bureau of Economic Analysis.

To investigate household expectation on housing market, we follow [Mian and Sufi \(2021\)](#) and [Piazzesi and Schneider \(2009\)](#), exploiting the Michigan Survey of Consumers (MSC). The MSC is a survey that randomly selects a nationally representative sample of consumers every month and asks about their expectations

regarding future economics. These consumers constitute a repeated cross-sectional sample.

We also exploit a mortgage dataset to analyze household default and bankruptcy. Details are presented in Section 4.7.

### 2.3 Sample construction

We first construct a property-quarter-level sample on household expenditure and household characteristics. We consider the sample period of 2003 to 2007 because there may be structural changes in the housing market before and after the start of the housing boom of 2003, and the subprime crisis starting at the end of 2007 may also have changed households' investment behavior.<sup>7</sup>

PUMD do not cover all states in all years, and PUMD documentation makes it clear that "States not listed are not in the CE sample." Thus, there are missing values in at least one year between 2003 and 2007 for eight states: Arkansas, Iowa, Mississippi, Montana, New Mexico, North Dakota, South Dakota, and Wyoming. Since we need a balanced sample in terms of the states, we remove observations for these eight states. In addition, in North Carolina, purchase mortgages have recourse status while nonpurchase mortgages have nonrecourse status. We could not find information on whether a mortgage is a purchase or nonpurchase mortgage and cannot assign recourse status for observations for North Carolina, so we remove observations for this state as well.

We then filter the observations following [Melzer \(2017\)](#). We remove observations with missing values for the state, the home value, and property and loans characteristics.<sup>8</sup> To avoid statistical bias, we also follow [Melzer \(2017\)](#) and exclude data for homes with a home value of less than \$30,000 and data records with a loan-to-value ratio of higher than 2. In robustness tests, we winsorize these two variables (rather than removing the observations with extreme values); further details are

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<sup>7</sup> In Footnote 12 in Section 3.2, we further elaborate the reason that our research design does not allow us to use the years after 2007.

<sup>8</sup> For households with missing values in some quarters, we remove observations with missing values for these quarters and retain observations for these households for other quarters.

introduced in Section 4.5.1. Since we focus on homeowners, we remove observations for renters. If a household owns and also rents houses, we remove only the observations for rented houses. In Table A1 of the Appendix, we list the number of observations removed for each of the above reasons. Figure 1 shows the recourse status distribution for all the states covered in the cleaned sample.

Table 1 shows the summary statistics for home improvement and maintenance expenditures. The quarterly average is \$694, accounting for 7% of total household quarterly expenses (not shown in the table) for the sample period. Home improvement and maintenance expenditures are valued at \$0 for 73.5% of the observations. When excluding these households, the average quarterly home improvement and maintenance expenditures of the households reach \$2,617.

[Insert Table 1 here]

[Insert Figure 1 here]

Table 2 shows the summary statistics of the independent variables. We also compare the summary statistics of the treatment and control groups for the pretreatment and treatment periods. We find that some variables differ between the two groups. We elaborate these differences in Table A2 in the appendix. In Section 4.6, we use entropy balancing to eliminate these differences.

[Insert Table 2 here]

For a supplementary test, we also construct a consumer-month level sample on housing market expectations using the MSC data. In the MSC, two questions related to our paper are “Generally speaking, do you think now is a good time or a bad time to buy a house?” and “Generally speaking, do you think now is a good time or a bad time to sell a house?”<sup>9</sup> For each question, the consumers are asked to provide up to two reasons: “Why do you say so? (Are there any other reasons?)” In total, each respondent can provide up to four reasons. The MSC groups the reasons into dozens of categories and assigns a category code to each of them. We list those answer categories in Table A3. We read the answers, infer the consumer’s expectations

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<sup>9</sup> There are several other questions that ask about future housing price changes. However, those questions are available only after 2007 and cannot be used.

regarding the housing market, and assign a value to each answer. We determine that an answer reflects an optimistic (pessimistic) expectation and assign one (negative one) to that answer if the answer mentions that the housing price will increase (decrease). A value of zero is assigned to the answer if it does not include any information on the housing price trend (such as reasons of taxes and credit availability). Since each respondent may provide up to four reasons, we aggregate the values for each respondent to a numeric variable, *Expectation*. A higher value of *Expectation* represents more optimistic expectations. The sample also includes demographic information and homeownership information on the consumers.

### 3 Research Design

#### 3.1 Intuition

Debt overhang theory states that homeowners who account for the possibility of negative home equity and subsequent strategic default will reduce maintenance expenses on their homes since the benefit of maintenance or improvement may be seized by debtholders rather than by themselves ([Melzer 2017](#)). The objective of this paper is to test whether the bankruptcy reform reduced household debt overhang by comparing the responses given by households in recourse and nonrecourse states. Our paper discusses debt overhang, so we focus on expenditures on properties the households already own rather than investment in new properties.

Note that these homeowners do not necessarily face liquidity constraints when they default. When a home value declines to a level below the mortgage balance, homeowners may try to reap the difference between the mortgage balance and the home value by strategic default and, if necessary, by filing bankruptcy, as explained below.

In recourse states, the lender has the right to apply for deficiency judgments, namely, a lender can require the homeowner to pay a portion of the loan with a loan balance exceeding the value of the house. At this point, if the homeowner applies for bankruptcy protection, he or she can obtain partial or full debt relief. Before the

bankruptcy bill reform of 2005, families could file for bankruptcy easily due to the relatively low cost of bankruptcy. However, bankruptcy relief became more expensive for almost all debtors and less effective for many debtors with the new bankruptcy code provisions in BAPCPA. The main tool of the BAPCPA is the means test, which calculates the debtor’s income available to repay creditors and determines who is “abusing” Chapter 7 relief (Tabb and McClelland 2006). After the BAPCPA was enacted, the cost of filing for bankruptcy increased significantly (Li et al. 2011; Sommer 2005; White 2007), making it difficult for high-income homeowners to obtain debt relief. Thus, households are less likely to strategically default, and debt overhang is relieved. In other words, the BAPCPA mitigates the debt overhang problem in recourse states.

In nonrecourse states, however, it is difficult or even impossible for a lender to apply for deficiency judgments. Borrowers can simply enter foreclosure and “walk away from the home” and do not need to file for bankruptcy. Thus, the increase in bankruptcy filing costs has less of an impact on households’ strategic defaults. Therefore, we can construct a DiD model to compare the different changes in debt overhang occurring before and after the BAPCPA in recourse and nonrecourse states.

As we elaborate in Section 1, the debt overhang in our setting is not due to *current* opportunities for strategic default. Instead, it is because the possibility that housing prices decline in the future and trigger strategic default is nontrivial in homeowners’ belief, which lowers the current investment in home maintenance and improvement, as explained in Section 1. Moreover, we do not require that households have *pessimistic expectations* during the boom period. Instead, we need only a nontrivial level of downside risk in households’ beliefs about the distribution of future housing prices. Now, we illustrate the rationale using the concept of option value.

For simplicity, let us assume that there are only two periods (present and future) and two possible outcomes for future housing prices, an upside potential and a downside risk, and that the property becomes underwater (i.e., has negative equity) once the downside risk is realized. We do not assume that the *expected value* of the two possible outcomes is higher or lower than the current housing price (i.e.,

pessimistic expectation). We consider the two scenarios below for residents in recourse states in Figure 2.

[Insert Figure 2 here]

In Scenario 1 (before BAPCPA), households can easily file Chapter 7 bankruptcy. If the downside risk is realized, then they have the (put) *option* to stop debt service and file bankruptcy, i.e., strategy default, to save money (which is the difference between the outstanding mortgage balance and the housing price). At this time, the option is in the money and has a positive value. If the upside potential is realized, then the option to strategic default is out of money and has a value of 0. Combining the two possibilities, the ex ante expected value of this option is positive. Current home improvement and maintenance increase future housing value and reduce the difference between loan balance and housing value when downside risk is realized, which reduces the value of the put option.

In Scenario 2 (after BAPCPA), households cannot file Chapter 7 bankruptcy. Thus, regardless of whether downside risk or upside potential is realized, they do not have the option to strategically default, and their home maintenance and improvement would *not* hurt the option value. Thus, compared with those in Scenario 1, homeowners are more likely to invest in home maintenance and improvement.

In summary, before BAPCPA, households in recourse states had the put option to file bankruptcy, and home improvement hurt the value of this option. After BAPCPA, the put option was almost gone, and households were much less likely to worry about the option value being hurt by home investment. The key here is the positive value of the put option, which does not require pessimistic expectations on underlying assets but rather requires a nontrivial level of *downside risk* in households' beliefs.

We provide supporting evidence for the role of downside risk in households' beliefs. It is difficult to directly observe the distribution of households' beliefs, and we adopt an indirect measure. We use the search index provided by Google Trends to capture households' concerns about the *possibility* of a house price decline. The search

index is based on actual search requests made to Google and reflects the intensity of queries for a given keyword.

We first consider the keyword “housing bubble”. A housing bubble means that housing prices are too high, and there is substantial risk that housing prices will decline in the future, which is a *downside risk*. An intensive search of the housing bubble implies that it has become an important topic in society, and the general public is *concerned* about the housing bubble. Thus, the *possibility* of a housing bubble exists in household beliefs, even if they are *not sure* whether there is a bubble. If households consider that the probability of a housing bubble is zero, i.e., the downside risk does not exist in households’ beliefs, they are unlikely to actively search for information about it.

For comparison, we then use the keyword “housing price.” This keyword contains an issue that the general public cares about in daily life and is neutral regarding future housing *trends*; hence, it serves as the reference keyword. Note that Google exploits an algorithm to construct the search index so that the popularity of different keywords is comparable.<sup>10</sup> We restrict the country to the United States and the category to “Real Estate” and download the monthly time series of the two keywords’ indices.

Figure 3 plots the trends. The data are available only after 2004. The search popularity of the keyword “housing bubble” was much lower than that of the “housing price” around January 2004. However, it rose sharply in April 2004 and approached that of “housing price” in May 2004. In April 2005, “*housing bubble*” even surpassed “*housing price*” and remained higher until September 2006. After that, although it declined, it stayed close to “*housing price*” through the end of 2007. The trend shows that during our sample period, the general public cared about “housing bubble” as much as they cared about “housing price,” an important topic in daily life, indicating

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<sup>10</sup> According to Google, “each data point is divided by the total searches of the geography and time range it represents to compare relative popularity. Otherwise, places with the most search volume would always be ranked highest. The resulting numbers are then scaled on a range of 0 to 100 based on a topic’s proportion to all searches on all topics.” See [https://support.google.com/trends/answer/4365533?hl=en-GB&ref\\_topic=6248052&sjid=12649316552265447199-NC](https://support.google.com/trends/answer/4365533?hl=en-GB&ref_topic=6248052&sjid=12649316552265447199-NC).

that the downside risk plays an important role in household beliefs during our sample period. If the possibility of a housing bubble was trivial and negligible in terms of households' beliefs, then it is difficult to explain the popularity of this topic, as shown in Figure 3.

[Insert Figure 3 here]

By controlling the preexisting differences between different groups of samples before the implementation of the policy, the policy impact can be effectively estimated. The treated group includes households in the recourse states, and the control group includes households in the nonrecourse states. By comparing the housing improvement and maintenance expenditures of the two groups before and after the BAPCPA, we can effectively document the impact of the BAPCPA on household housing maintenance expenditures.

To ensure comparability between the treatment and control groups, we perform entropy balancing in Section 4.6 to weight the main variables in the treatment and control groups so that the distributions of the values of the control variables are similar between these groups and to eliminate initial differences between the groups as much as possible.

Even after addressing differences in the observables between the treatment and control groups, one may suspect that unobserved differences may affect the results. We conduct an event study to show that the difference between the treatment and control groups is stable in the absence of the reform; therefore, even if there are unobserved differences, they are stable and can be eliminated under the DiD framework.

### 3.2 Regression model

We adopt the following DiD model:

$$\ln(y_{pst}) = \beta_0 + \beta_1 \text{Recourse}_{st} \times \text{Post}_t + \beta_2 \text{Recourse}_{st} + \beta_3 \mathbf{SE}_{st} + \beta_4 \mathbf{X}_i + \beta_5 \mathbf{Y}_p + \beta_6 \mathbf{Z}_p + \text{FEs} + \varepsilon_{pst} \quad (1).$$

Dependent variable  $\text{Ln}(y)$  is the natural logarithm of the quarterly improvement and maintenance expenditures on property  $p$  of family  $i$  in state  $s$  in quarter  $t$ . Since many observations for  $y$  are valued at zero, we add one to  $y$  for all observations such that there is no missing value after taking the natural logarithm. We use alternative specifications of the dependent variable for robustness tests in Section 4.5.1 to address potential drawbacks of the logarithmic dependent variable. Independent variables *Recourse* and *Post* are categorical variables, in which *Recourse* equals 1 if the observation is in a recourse state, and *Post* equals 1 if the observation is the treatment period (i.e., the period after the BAPCPA came into effect).<sup>11,12</sup> Home improvement and maintenance expenditures are winsorized by 1% at both tails to avoid the impact of extreme values.

**SE** represents time-varying state-level socioeconomic factors including the unemployment rate, per capita income, and population. **X** represents household characteristics: household annual income, household education, race, vehicle debt, financial assets, and unsecured debt. **Y** includes housing characteristics: home valuation; home age; the number of years a house has been owned; the number of bathrooms; the number of bedrooms; the number of rooms; and indicators for central air conditioning, a swimming pool, off-street parking, or a porch.<sup>13</sup> **Z** describes the characteristics of mortgages, including the mortgage balance, the mortgage interest rate, the type of mortgage interest rate (fixed rate or adjustable rate), the mortgage length, and whether there is mortgage insurance. The rich controls enable us to eliminate alternative explanations associated with them. *FEs* include time (quarter) and state fixed effects. We use robust standard errors to compute the p-values.

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<sup>11</sup> We apply the natural logarithm for most variables that are not ratios or dummies. We add “Ln” before the variable names in the results.

<sup>12</sup> The subprime crisis broke out at the end of 2007, and afterward, defaults increased sharply; this increase was less serious in recourse states (Ghent and Kudlyak 2011), and recourse states should thus have experienced an increase in home improvement relative to nonrecourse states during the crisis. This relative increase would inflate the coefficient of *Recourse*  $\times$  *Post* if the period after 2007 is included in our sample. However, this relative increase is not due to BAPCPA (but due to the outbreak of the crisis) and should be eliminated from the coefficient of *Recourse*  $\times$  *Post*. Including the years after 2007 would make the coefficient upward biased, and hence, we restrict the sample period to before 2007.

<sup>13</sup> Since we already control for property value and the balances of all the loans collateralized by the property, we do not control for home equity and loan-to-value ratio. Thus, we only show the summary statistics of LTV in Table 2 for reference but do not include it in the regression.

## 4 Does the BAPCPA Reduce Mortgage Debt Overhang?

### 4.1 Baseline analysis

We first conduct the DiD analysis using model (1). In the baseline analysis, we use the full sample, and the results are shown in Column (1) of Table 3. The coefficient of the interaction term of *Post* and *Recourse* is 0.257, indicating that the increase in housing improvement and maintenance expenditures was 25.7% higher in recourse states than in nonrecourse states. The results show that the coefficient is significantly positive, indicating that households in recourse states increased their expenditures on home improvement and maintenance after the BAPCPA was enacted. Table 3 details the estimates of all the variables. To save space, the estimates of control variables are omitted hereafter.<sup>14 15</sup>

Since the search index data are available only after 2004, we do not observe its value in 2003. In addition, foreclosures began to occur in many places in 2007. That could affect home investment, constituting a channel that homeowners directly experience, rather than one based on their beliefs, which differs from our main story. Thus, we restrict the sample to the period between 2004 and 2006 in Column (2). The results are similar.

[Insert Table 3 here]

### 4.2 Event study

We conduct an event study to validate the parallel trends of the treatment and control groups for before the reform. In other words, we test whether the difference

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<sup>14</sup> In addition, the sample period ends in 2007, and housing prices did not decline in this period, so we cannot test whether the results become more significant as house prices decline.

<sup>15</sup> Note that expenditures on home improvement and maintenance by nature are infrequent. Households do not need to substantially improve their home every quarter during the treatment period. Table 1 shows only 26.5% of the observations have positive values for home improvement and maintenance. Even among these 26.5% of observations, some are only minor maintenance and involve small dollar volumes: The 25% percentile is just 150 dollars. In the full sample, 88.6% of the observations are smaller than the sample mean (694 dollars). Therefore, it is not surprising that we obtain the large point estimates. The coefficients represent the growth rate. When the base is small, the growth rate tends to be large.

between the treatment and control groups changed in the three quarters before the reform. We replace *Post* in equation (1) with a quarter categorical variable *Quarter* and interact it with the treatment group dummy:

$$Ln(y_{pst}) = \beta_0 + \beta_{1t} Recourse_{st} \times Quarter_t + \beta_3 SE_{st} + \beta_4 X_i + \beta_5 Y_p + \beta_6 Z_p + FEs + \varepsilon_{pst} \quad (2).$$

All variables in equation (2) except the interaction term are identical to those in equation (1). In the test, the period before the first quarter of 2005 is used as the reference group. The event study ensures that the treatment and control groups did not change in the absence of the reform. The results are shown in Column (3) of Table 3. The coefficients of all interaction terms between recourse status and quarters (from the first quarter of 2005 to the third quarter of 2005) are insignificant before the BAPCPA came into effect, which means that there is little difference between the pre-trends of the two groups in terms of home improvement and maintenance expenditures. Thus, the parallel pretreatment trend assumption is established. In addition, five out of the eight quarters after BAPCPA show higher home improvement than the pretreatment period. We plot the point estimates and the 95% confidence intervals in Figure 4.

[Insert Figure 4 here]

One concern is that the BAPCPA was signed into law in April 2005 and went into effect in October 2005. Our event study shows that the increase in the expenditures changes after the implementation rather than the signing of the BAPCPA. An explanation for this finding is that while households perceived the heightened risk in the housing market, they could not forecast the accurate time of possible housing price decreases and did not know whether there would be a decrease in housing prices *before* the implementation. If they wanted to walk away from a home in the event of a housing price decline *occurring before* the implementation of BAPCPA, they could still easily apply for bankruptcy (as they could have done before April 2005) to avoid the repayment of deficiency. Therefore, they did not increase expenditures immediately after the signing of the BAPCPA.

### 4.3 Bad controls, standard error clustering, and zero values in the dependent variable

In the baseline regressions, we include many control variables to eliminate the effects of other factors. One may worry about the “bad control” problem. The control variables may be affected by the BAPCPA, which could bias the estimate of the main independent variable. We drop all control variables and repeat the DiD in Column (4) of Table 3. The results are similar to those of the baseline specification. In Column (5), we cluster the standard errors at the state level, and the results change little. In addition, one may have concerns about log transformation after one is added to home improvement to deal with zero values in the dependent variable. In Section 4.5.1, we follow [Melzer \(2017\)](#) and address this concern using a Tobit regression, obtaining similar results.

### 4.4 Heterogeneity in ex ante LTV

As mentioned in Section 1, our rationale for debt overhang is related to the LTV. Mortgages with a higher LTV are more likely to become underwater and trigger debt overhang in the event of a housing price decline; hence, these households are more likely to have been affected by the reform. Thus, a natural question is how the effects documented above depend on the LTV. Note that we cannot use the mark-to-market LTV during the treatment period since the LTV was also affected by the bankruptcy reform and was *negatively* correlated with home improvement expenditure. First, home improvement induced by the bankruptcy reform increased the (self-assessed) property value and reduced LTV. Second, since the bankruptcy reform eliminated the strategic default option, potential negative equity in the event of a housing price decline cannot be exploited, and households have more incentives to repay their mortgage and reduce their LTV. In sum, those affected more by the reform are likely to repay more of their mortgages and are also more likely to increase their home improvement expenditure. Thus, if we use the mark-to-market LTV in the treatment period, the negative correlation between the LTV and home improvement

expenditures (for the above two reasons) would offset the positive relationship between the bankruptcy reform’s effects on home improvement and the LTV.

We exploit the LTV in the quarter before the bankruptcy reform (the third quarter of 2005) to address the above concern. However, as our sample is repeated cross-sectional, and each household was surveyed for only five consecutive quarters, only 7.7% of the sample is left if we restrict the sample to households that have observations in both the pretreatment and the treatment period and that were also surveyed in the third quarter of 2005. This substantially hurts the statistical power and makes the estimates less statistically significant. Nevertheless, we display the results as additional supportive evidence in Table A6 in the appendix to show that the sign and the magnitude of the point estimate are consistent with the theory.<sup>16</sup>

We calculate the LTV by dividing the mortgage balance by the homeowner’s valuation of the property. Note that the homeowner’s decision is determined by his or her perceived housing price rather than the real value. We add three interaction terms,  $Recourse \times Post \times LTV$ ,  $Recourse \times LTV$ , and  $Post \times LTV$ , in equation (1) and construct a triple difference (DDD) specification. The definitions of *Recourse* and *Post* are similar to those in equation (1). *LTV* is the LTV of the property in September 2005. In an alternative specification, we replace *LTV* with *Negative Equity*, a dummy variable indicating whether the LTV is higher than 100%. [Campbell, Giglio, and Pathak \(2011\)](#) find that houses are sold at a lower price in foreclosure sales than in ordinary sales and that the “foreclosure discounts” are, on average, 28%. Therefore, we adjust the definition of *Negative Equity*: we consider a homeowner to have negative equity if the LTV is greater than 72% (i.e., 100% - 28%).

The results are displayed in Table A6. In Column (1), we use the *Negative Equity* dummy; the point estimate of the coefficient for the triple interaction term  $Recourse \times Post \times Negative Equity$  is positive (0.534) and much larger than that of the main

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<sup>16</sup> Another strategy is to use the full sample and infer the ex ante LTV by estimating the corresponding home value and mortgage balance. The way to estimate mortgage balance is to estimate monthly debt service based on loan characteristics at origination and subtract the estimated repayments from the original balance. However, [McCollum, Lee, and Pace \(2015\)](#) show that partial prepayments (curtailments) are prevalent, especially after 2004, which makes the true balance deviates from the estimated balance. This measurement error would bias the coefficients of the corresponding variables toward zero.

effect ( $Recourse \times Post$ , 0.152), suggesting that the effects were indeed bigger for properties with higher leverage. In Column (2), we use  $LTV$  and obtain similar findings. Both estimates are statistically insignificant due to the substantial sample size reduction as mentioned above. (In fact, the coefficient of the main effect  $Recourse \times Post$  also becomes statistically insignificant.) However, given the substantial magnitude, we believe that the results support the argument that the effects are greater for highly leveraged properties. In addition, the point estimate of the main effect  $Recourse \times Post$  in Column (2) becomes negative when we add interactions of  $LTV$ , which suggests that the effects depend heavily on  $LTV$ , consistent with the debt overhang explanation.

## 4.5 Robustness tests

### 4.5.1. Alternative specifications

We apply several alternative specifications to test for robustness. First, improvement spending is truncated at zero. Following [Melzer \(2017\)](#), we use the dollar volume of improvement spending (rather than its natural logarithm) as the dependent variable and apply a Tobit regression to account for the observations with zero values used for the dependent variable. The results for the Tobit regression are shown in Column (1) of Table 4. The increase in housing improvement and maintenance expenditures was higher by 0.11 standard deviation (634.254/5554.3) in recourse states than in nonrecourse states.<sup>17</sup> In the baseline analysis, we follow [Melzer \(2017\)](#) and remove observations with outliers in property value and the  $LTV$  as reported in Section 2.3. As a robust test, we winsorize property value and  $LTV$  (instead of removing the outliers) to eliminate the effects of extreme values and repeat the regression in model (1). The results are reported in Column (2) of Table 4 and are consistent with the results listed in Section 4.1. We also use the baseline sample to perform a logit regression, where the dependent variable equals one if the home maintenance and improvement expenditures are greater than zero and zero

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<sup>17</sup> The standard deviation is reported in Table 1.

otherwise. The results are reported in Column (3) of Table 4. Households in the recourse states are more likely to maintain and improve their homes during the treatment period.

[Insert Table 4 here]

#### **4.5.2. Changes in credit**

One alternative explanation is changes in credit. When it is more difficult to strategically default on home loans, both the default rate and the loss given default decline, and banks are more willing to supply loans backed by houses, among which home equity loans are usually used for home renovation. Increases in the supply of home equity loans and home equity lines of credit (HELOCs) can boost expenditures on home improvement and maintenance. However, in all our regressions, we control for the balance of home equity loans and HELOCs (as well as mortgages), and the results are not driven by changes in the credit supply. In addition, we use the balance of home equity loans and HELOCs as the dependent variables respectively and repeat the baseline regression. The covariates in these two regressions are similar to the baseline specification except that the balance of home equity loans and HELOCs are excluded from the control variables. Columns (1) and (2) in Table 5 show the regression results. Neither changed after the reform. Households may also use unsecured loans for home improvement. However, in Column (3), we find that unsecured credit did not change either.

Note that the result here shows only the equilibrium credit volume, which is the combined effect of the changes in both credit supply and credit demand. We do not make any claims regarding changes in credit supply or demand separately, as this is beyond the scope of this paper. The findings can be reconciled based on the possibility that households generally have access to liquidity sources before the subprime crisis (such as their savings or reducing nonhousing expenditures, as demonstrated in Section 4.5.3) and do not need to borrow even when the credit supply increases.

[Insert Table 5 here]

### 4.5.3. Nonhousing expenditures

We conduct another test to rule out the explanation that some unobservable characteristics drive up the total household expenditure and hence increase the housing expenditures. We explore how non-housing expenditures were affected by the bankruptcy policy reform. Non-housing expenditures equal total expenditures minus the down payment for the home purchase; outlays on maintenance, fuel, public services, household operations, and home furnishings; and the principal and interest repayment of the mortgage, home equity loans, and HELOCs.<sup>18</sup> The results in Column (4) in Table 5 shows that non-housing expenditures did not increase following the reform. Instead, their decrease implies that households reallocated their resources for expenses from nonhousing to housing expenditures.

### 4.5.4. Homestead exemption

Another potential concern is that homestead exemption may be correlated with the recourse laws, and homestead exemption may affect investment in home equity (Corradin et al. 2016). However, if homestead exemption matters in our setting, it affects borrowers' decision only when the borrower has another house (*without liens*) that could be liquidated to repay the deficiency in the case of bankruptcy.<sup>19</sup> In our sample, around 91.9% of consumers have only one house. We restrict the sample to these households and repeat the baseline regression. The results are displayed in Column (5) of Table 5 and are similar to those of the baseline regression.

Then, using the full sample, we include the variables associated with homestead exemption in the regression. The data on homestead exemption come from Indarte (2020), who collected the details on homestead exemption and wildcard exemption for

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<sup>18</sup> In the calculation, we use total household expenditure minus the down payment for the home purchase and EHOUSNGP from CES. The down payment is the difference between the house transaction price and the original balance of the mortgage. We assume that the down payment occurs in the quarter of the housing transaction. EHOUSNGP includes the following four types of expenditures. 1. Shelter: mortgage (and home equity loans and lines of credit) principal and interest; property tax; maintenance, repairs, insurance, and other expenses; rented dwelling; other lodging. 2. Utilities, fuel and public service. 3. Household operations, domestic services, and other household expenses. 4. House furnishings and equipment: household textiles, furniture, floor coverings, major appliances, small appliances, miscellaneous housewares, and miscellaneous household equipment.

<sup>19</sup> The homestead exemption does not prevent a bank foreclosure if the homeowner defaults on his or her mortgage.

each state.<sup>20, 21</sup> We carefully calculate the amount of exemption considering age, marital status, number of children, and whether the borrower is disabled. We then include the dollar volume of homestead exemption and its interaction with *recourse* in the baseline regression. Column (6) of Table 5 shows that after controlling for these two variables, the coefficient for *recourse*  $\times$  *post* is still statistically and economically significant.

#### 4.5.5. Selling the house to pay back debt

As mentioned in Section 1, BAPCPA increased the probability of mortgage default. One may argue that since bankruptcy costs are higher in recourse states, households may consider home sales to repay their unsecured debts, and they may need to perform home improvements before undertaking such sales. We exploit information on the disposition of properties from the Consumer Expenditure Survey (CES) to test this conjecture. The CES obtains property disposition information, including the sales price and the year and month of disposition. We construct a household-quarter level sample on property disposition and run the following regression:

$$\ln(y_{ist}) = \beta_0 + \beta_1 \text{Recourse}_{st} \times \text{Post}_t + \beta_2 \text{Recourse}_{st} + \beta_3 \text{SE}_{st} + \beta_4 \mathbf{X}_i + \text{FEs} + \varepsilon_{ipst} \quad (3).$$

Model (2) is similar to Model (1) except for three differences. First, Model (1) is constructed at the property-quarter level, while Model (3) is constructed at the household-quarter level (as we do not observe which house is sold). Second, the characteristics and mortgage information of sold houses are not observed or controlled. Third,  $y$  in the dependent variable denotes the total value of the focal house disposition. Column (7) of Table 5 reports the results. We do not observe increased sales in the recourse states after BAPCPA. Thus, the explanation concerning selling a house for debt repayment does not hold.

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<sup>20</sup> We thank Sasha Indarte for sharing the data.

<sup>21</sup> Since New York state has county-level exemptions and we do not observe county exemptions, we remove observations from New York in this test.

#### 4.5.6. Housing Boom in Sand States

Sand states (California, Florida, Arizona, and Nevada) experienced a much larger housing boom than other states during our sample period. One may wonder whether our results are driven by something special about these states. To alleviate this concern, we drop the four sand states and repeat the DiD regression in Column (8) of Table 5. The results are similar.

#### 4.5.7. Heterogeneous Expectations of Housing Prices

An additional alternative explanation concerns the different trends in expectations of housing prices between recourse and nonrecourse states. [Mian and Sufi \(2021\)](#) and [Piazzesi and Schneider \(2009\)](#) show that pessimism spread among the general population during the boom period due to the high cost of housing, and expectations on the future of the housing market gradually worsened. During this process, if, relative to households in nonrecourse states, households in recourse states became more optimistic about the future housing market after 2005, they might have become more willing to make home improvement investments. Note that the change in expectation of *housing prices* studied here is different from the change in the belief of *strategic default possibility* mentioned in Section 1 and Section 3.1.<sup>22</sup> To address this concern, we exploit *Expectation*, which was constructed in Section 2.3, to show how recourse affects the expectation trend. We investigate the changes in expectations using the following difference-in-differences regression:

$$Expectation_{it} = \beta_0 + \beta_1 Recourse_{ry} \times \beta_2 Post_t + \beta_3 Recourse_{ry} + \beta_4 Controls_i + FEs + \varepsilon_{it} \quad (4)$$

where  $i$ ,  $t$ ,  $y$ , and  $r$  represent consumer, year-by-month, and region fixed effects, respectively. The sample period is the same as that used in Model (1), spanning from 2003 to 2007. A limitation of the data is that we can observe only regions rather than states of residence. Thus, we redefine *Recourse* as the region-year-level weighted

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<sup>22</sup> In this section, we want to rule out changes in the expectation of housing prices. In Section 1 (the introduction) and Section 3.1, the changes in the belief in our theory was on the possibility of *future strategic default*, which was caused by *the different effects of bankruptcy reform* between recourse and nonrecourse states and *not by different housing price* changes between recourse and nonrecourse states.

average value of the state recourse status. First, we keep all the states in our baseline sample in Section 4.1 and match them to regions. Then, region  $r$ 's value for  $Recourse_{rt}$  in year  $y$  is the weighted average of the state-level *Recourse* (in Model (1), either zero or one) of all the states in the region, where the weight is the ratio of the state population to the region population. Since the population is time varying,  $Recourse_{ry}$  is also time varying, and we need to control for its main effects. *Post* is similar to that used in Model (1). *Controls* include the demographic information of consumers. *FES* are year-by-month fixed effects and region fixed effects. Note that the main effects of *Post* are absorbed by the year-by-month fixed effects and are not included in the model. Table 6 reports the results, where Panel A shows the summary statistics and Panel B shows the regression results. In Panel B, Columns (1) and (2) show that the estimates are *negative* and statistically significant regardless of whether we add control variables. In Columns (3) to (4), we restrict the sample to homeowners and obtain similar results. The results above show that households in recourse states became *less* optimistic about the future housing market after 2005, which is *opposite* to the alternative explanation. Therefore, the results rule out the explanation that households in recourse states became more optimistic and invested more in their homes.

[Insert Table 6 here]

Overall, the results support our hypothesis that the BAPCPA alleviates the household debt overhang problem. The enactment of the policy led homeowners to increase housing expenses and to some extent offset the negative impact of the bankruptcy reform on real estate markets.

#### **4.5.8. Heterogeneity analysis of judicial procedures**

Lenders may face either a judicial or nonjudicial procedure during the foreclosure process. Compared to the nonjudicial foreclosure process, the process of judicial foreclosure is lengthier, and the procedures involved are more complex, which affects a household's propensity to default. In this section, we rule out the impact of the foreclosure procedure on our results. We divide the sample into two subsamples

by state laws on whether to conduct judicial foreclosures based on the information from [Ghent and Kudlyak \(2011\)](#) and study whether our results are robust after considering judicial foreclosure conditions. In our sample, four states adopt both judicial and nonjudicial foreclosures, Hawaii, Nebraska, New York, and Texas, and we cannot assign values to the judicial foreclosure dummy for these states.<sup>23</sup> Therefore, observations for these four states are removed in this section. The sample includes 17 judicial states and 21 nonjudicial states. The details are listed in Table A4 in the Appendix.

We then repeat the DiD test using the judicial and nonjudicial subsamples. The regression results are shown in Columns (1) and (2) of Table 7. The point estimates for both subsamples are positive, and the estimate for the nonjudicial states is 0.188 and statistically significant. Thus, the different foreclosure procedures cannot fully explain our previous results. In addition, the coefficient for judicial states, 0.127, is smaller and statistically insignificant. An explanation for this finding is that the lengthier foreclosure process adopted in judicial states prevents lenders from foreclosing houses even if borrowers stop servicing their mortgages. Thus, borrowers cannot easily walk away from their homes.<sup>24</sup>

[Insert Table 7 here]

#### 4.5.9. Neighboring states

In this section, we match recourse states to their neighboring nonrecourse states without replacement to further eliminate geographic and economic differences. Note that we cannot conduct a similar analysis at the county level since county information is missing for most observations. We consider only states with recourse policies that differ from those of neighboring states. The distribution of the sampled states after matching is shown in Figure 5. After pairing, the sample size is reduced from 75,817

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<sup>23</sup> In addition to these four states, North Carolina adopts both judicial and nonjudicial foreclosures. Nevertheless, this state has already been removed from the sample due to its within-state heterogeneity of recourse status as described in Section 2.3.

<sup>24</sup> The purpose of this section is to show that the different foreclosure procedures cannot fully explain our previous results. We are not arguing that the effects are statistically significantly different between judicial and nonjudicial states.

to 23,951 with 8,246 unique households. The regression results are shown in Table 8. The magnitude of the effect is substantial: An increase in one unit of the independent variable brings a 16.4% increase in house improvement and maintenance expenditures.

[Insert Figure 5 here]

[Insert Table 8 here]

#### 4.6 Entropy balancing

In the previous analyses, we control for time-varying household, mortgage, and property characteristics to eliminate the effects of the other factors on the outcome variable. In this section, we further construct treatment and control groups that are more comparable. We use entropy balancing, which reweights each observation such that the distribution of covariates is similar between the treatment and control groups ([Hainmueller 2012](#)).<sup>25</sup> We apply entropy balancing to the periods before and after the adoption of the BAPCPA to address the differences in covariates including home value, home age, the length of homeownership, the amount of household unsecured debt, loan length, whether home loan insurance is adopted, household income, race and the number of family members. Table 9 shows the t-tests for means of these controls after reweighting, and the differences in all of the control variables between the treatment and control groups are statistically indistinguishable from zero.

[Insert Table 9 here]

Table 10 shows the regression results of the entropy-balanced samples. The magnitude of the effects is about 20%. After the BAPCPA's adoption, homeowners in recourse states substantially increased their housing investment expenditures. This result is statistically significant at the 1% level.

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<sup>25</sup> Past work shows that entropy balancing performs better with respect to balancing treatment and control groups than conventional matching methods such as propensity score matching ([Matschinger, Heider, and König 2020](#)). We also tried propensity score matching. We find that the matching results are much worse than the entropy balancing results in terms of the covariate distribution. The means of many control variables are still statistically different between the treatment and control groups after propensity score matching (Table A5 in the appendix); therefore, we do not use propensity score matching.

[Insert Table 10 here]

#### **4.7 Strategic defaults and bankruptcy**

One implication of our theory is that BAPCPA reduced mortgage defaults and bankruptcies in the recourse states when negative home equity is realized. Testing the implications using the CES data is challenging for two reasons. First, in the CES data, there is no information on mortgage delinquency and bankruptcy for the period before 2007. Second, as elaborated in Section 1, during our sample period, housing prices are high, and negative equity and defaults were not common. Thus, identifying the effects of BAPCPA on default is difficult if we consider ordinary mortgage loans.

Therefore, we exploit an alternative database provided by Blackbox Logic to perform the test. The data contain information on loan characteristics and the longitudinal repayment history of privately securitized residential mortgages. The data cover approximately 90% of all privately securitized mortgages originating after Jan. 1, 1998, in the U.S. market. Privately securitized mortgages are those securitized by non-Government Sponsored Enterprises (GSEs) and are riskier and have lower downpayment ratios than GSE-securitized mortgages (such as those securitized by Fannie and Freddie). Negative home equity is more likely to be realized for these loans, and it is easier to capture the effects of BAPCPA on defaults using information on them.

More importantly, the data include records of borrowers' monthly repayments in a panel sample, which enables us to analyze their default behavior. The repayment status includes many categories, such as current (performing), delinquent (accompanied by the number of months the loan has become delinquent), foreclosure, and liquidation. We observe many delinquency records followed by performance records, indicating that the delinquencies were just temporarily late in repayment and did not lead to foreclosure. Thus, we impose a stricter criterion and define default as the loan has entered the foreclosure process. Such a method would identify those "true" defaults. Another feature of the Blackbox data is that it contains a dummy indicating whether the borrower is bankrupt in the current month. In the final

sample, all bankruptcies occurred only for some of the borrowers who were in default, and they are essentially all “bankruptcies with mortgage default.”

To examine *strategic* defaults, we need to identify observations with negative home equity. We merge the county-year-level housing price index from the Federal Housing Financing Agency (FHFA) with the mortgage data.<sup>26</sup> We then compute the mark-to-market loan-to-value ratio (LTV) for each observation by the following equation:

$$\text{Mark-to-market LTV} = \text{Outstanding balance} / ((\text{Loan original balance} / \text{LTV at origination}) \times (\text{Current housing price index} / \text{Housing price index at loan origination})).$$

Data on *outstanding balance*, *Loan original balance*, and *LTV at origination* are provided by the original Blackbox data. We keep observations with negative equity, namely, a mark-to-market LTV higher than one hundred percent. Defaults occurring in these observations are more likely to be strategic defaults. We also drop records after the beginning of liquidation since the length of liquidation may depend on the efficiency of related parties.

We then collapse the data into a county-month-level sample of default rates and bankruptcy rates. In other words, for each county, among all outstanding loans with negative home equity, we obtain the monthly proportions of loans whose borrowers are in default or bankruptcy. We use the default rate and bankruptcy rate as the dependent variables and perform a DiD regression similar to the baseline analyses. We expect that the default rate and bankruptcy decline in the recourse states relative to the nonrecourse states.

Since county information can be inferred in the mortgage sample, we apply a specification that is much cleaner than the baseline analyses. We exploit a spatial regression discontinuity design (RDD) by [Holmes \(1998\)](#) that focuses on counties that are located at state borders. This design helps us further enhance the comparability of the treatment and control groups. We first restrict the sample to neighboring

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<sup>26</sup> The Blackbox data include 5-digit zip code for the property of each mortgage loan. We identify the county by the crosswalk file from the Geocorr Applications by Missouri Census Data Center. For zip codes straddling across multiple counties, we keep the county that contains the largest portion of the zip codes.

recourse and nonrecourse states as introduced in Section 4.5.9 and generate four matched “pairs”: (ID: WA, OR), (NV: CA), (UT: AZ), (IL, MI: WI). For each pair, we restrict the sample to counties that adjoin the state borders between the recourse and nonrecourse states. For example, in the first pair, Idaho shares a border with Washington and another with Oregon. We restrict the sample to counties adjoining the two borders. These counties are close to each other, and the differences between them are likely to be much smaller than those in the full sample used in the baseline. Figure 6 shows the counties in the final sample.

[Insert Figure 6 here]

We then exploit the DiD of the baseline analyses to the refined sample with the quarter fixed effects replaced by pair-quarter fixed effects. Since the counties within a pair are close to each other, we consider that they have a similar time trend and allow the trend to be heterogeneous across different pairs. We also control for the natural logarithm of the county population and per capita income. The results are displayed in Table 11. Both default and bankruptcy rates decline, supporting the main argument. The magnitude of the coefficient for bankruptcy is smaller than that for default because borrowers strategically default before filing bankruptcy; thus, there is a period during which borrowers default but do not bankrupt in the panel sample.

[Insert Table 11 here]

## 4.8 Housing markets

We now perform some tests on the housing market. Note that the focus of this paper is to document the change in debt overhang caused by the bankruptcy reform, and in this section, we simply want to show that the housing market outcome *does not contradict* our previous findings. We do not intend to make a claim that the difference in housing price growth captured below is solely driven by changes in household debt overhang. In fact, the lower strategic default rate in late 2007 in recourse states may also contribute to the difference.

We obtain the housing price index from the Federal Housing Finance Agency (FHFA) and construct a state-quarter-level sample for the growth rate of housing prices. The sample period is the same as that of the baseline sample (the first quarter of 2003 to the fourth quarter of 2007). We apply the baseline DiD to this sample as follows:

$$\Delta HPI_{st} = \beta_0 + \beta_1 Recourse_{st} \times Post + \beta_2 SE_{st} + FEs + \varepsilon_{st} \quad (5)$$

$\Delta HPI$  is the percentage growth of housing prices. The definition of  $Recourse \times Post$  is the same as that in equation (1).  $FEs$  include time (quarter) and state fixed effects.  $SE$  represents time-varying state-level socioeconomic factors, including the unemployment rate, per capita income, and population. We also show the results without the control variables to address potential ineffective control problems. We use robust standard errors to compute the p-values.

Table 12 displays the results. The growth rate in recourse states after the reform is higher by 0.7% to 0.8%, while the mean growth rate is 1.7%. The results hold regardless of whether we control for time-varying state characteristics or not.

[Insert Table 12 here]

## 5 Conclusion and Discussion

This paper explores how bankruptcy prevention abuse affects household debt overhang. Bankruptcy can be exploited by homeowners to avoid the payment of deficiency judgment as a result of a strategic default in recourse states but not in nonrecourse states. We use the BAPCPA promulgated by the U.S. as a policy shock and compare the change in debt overhang in recourse and nonrecourse states within a DiD framework.

Our findings show that after the enactment of the act, homeowners in recourse states increased their investment expenditures on housing relative to those in nonrecourse states; this effect seems greater for properties with a higher LTV. The effects cannot be explained by changes in credit, homestead exemptions, house sales, or heterogeneous expectations. We do not find similar effects on nonhousing

expenditures. The results are robust after we consider foreclosure procedures, use neighboring states to account for different economic conditions, and construct comparable treatment and control groups using entropy balancing. The findings help us better understand the effects of bankruptcy prevention on housing markets and improve regulators' policy decisions.

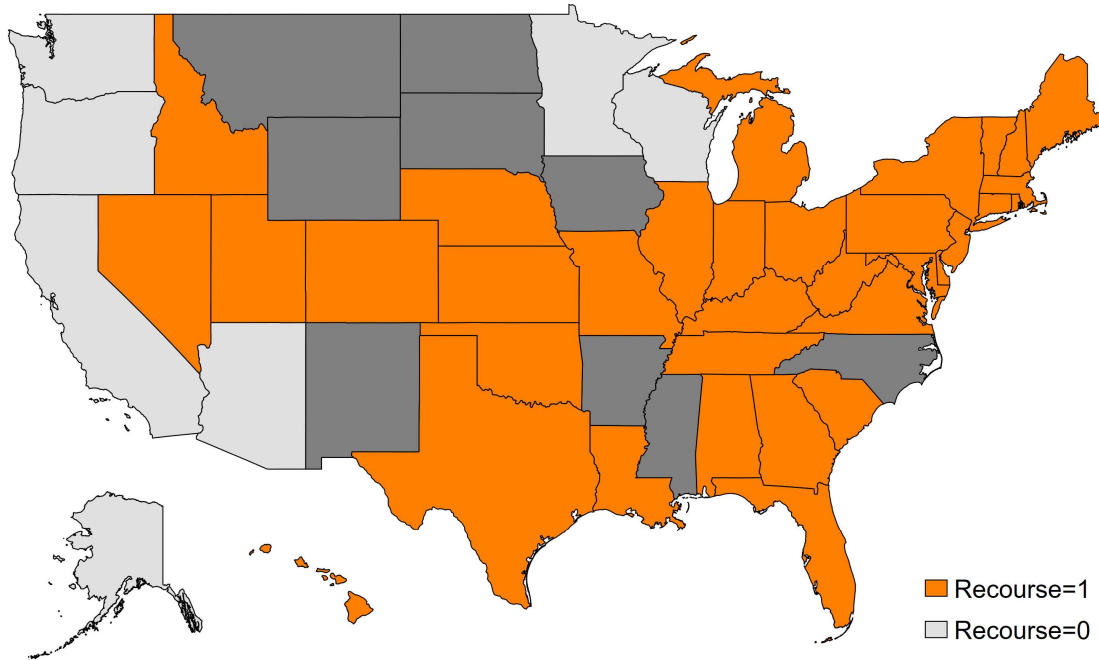
The literature shows that the bankruptcy reform increases foreclosures because households cannot easily file bankruptcy to free up money to pay the mortgage, which is expected to incur more debt overhang. While our paper finds an opposite effect, the net effect of the reform on debt overhang is still unclear and is an important topic for future research.

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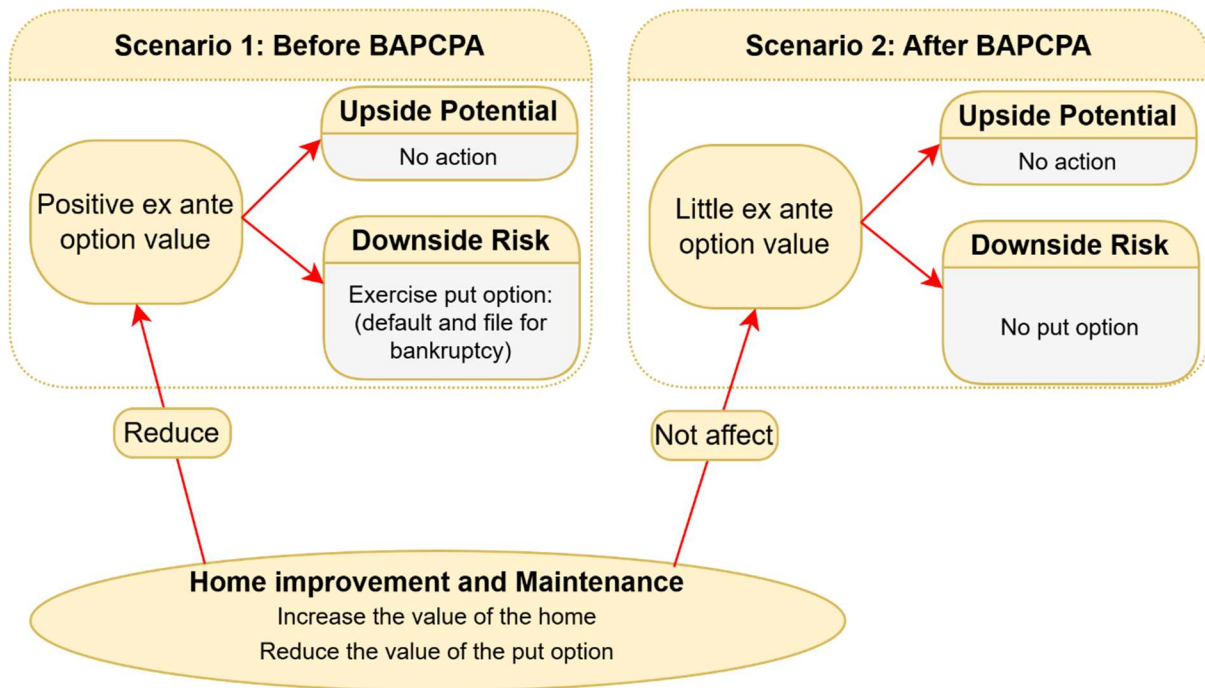
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**Figure 1: Recourse and Nonrecourse States, Full Sample**



The figure shows the geographic distribution of the treatment and control groups for the full sample. Several states are not included in the sample due to the coverage of PUMD and the within-state heterogeneity of recourse status. Further details are provided in Section 2.3.

**Figure 2: The Effect of BAPCAP on Debt Overhang**



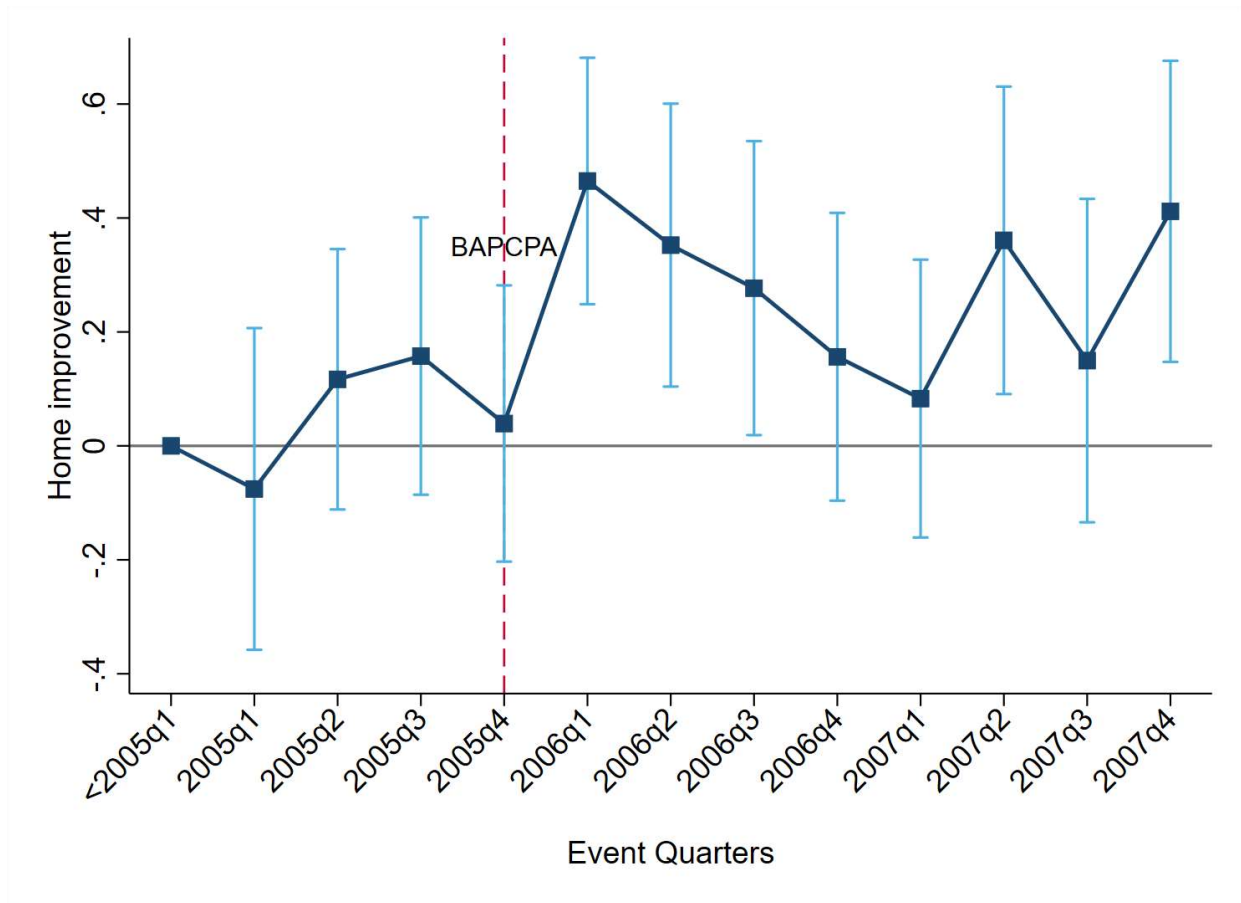
This diagram illustrates the rationale of the debt overhang.

**Figure 3: Google Search Index**



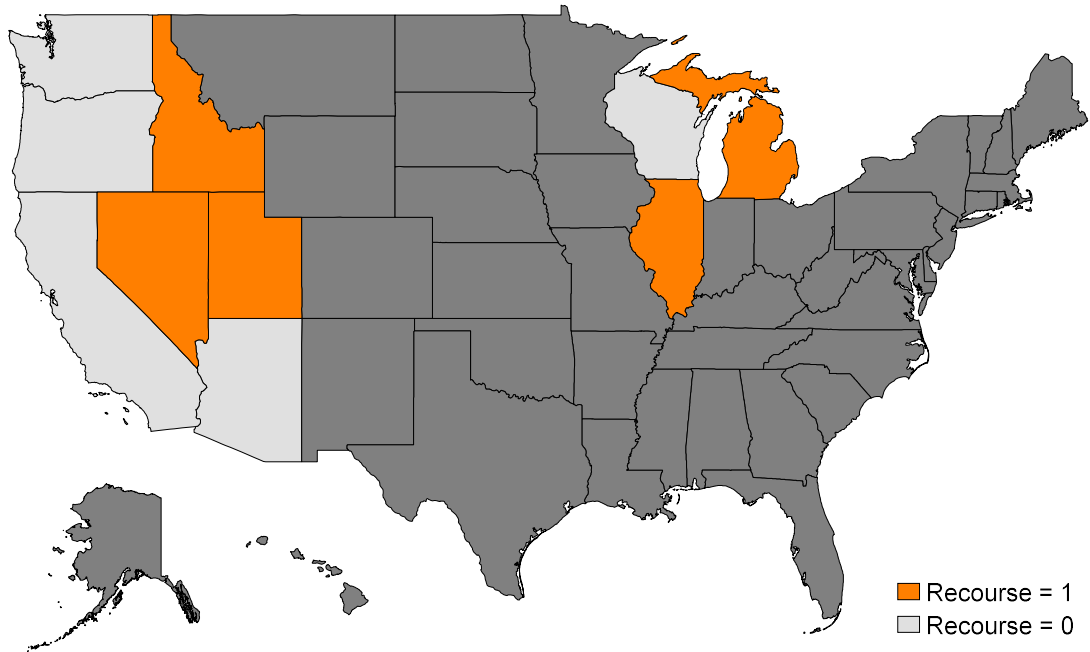
This figure displays the Google search index of the keywords “housing bubble” and “housing price.”

**Figure 4: Event Study**



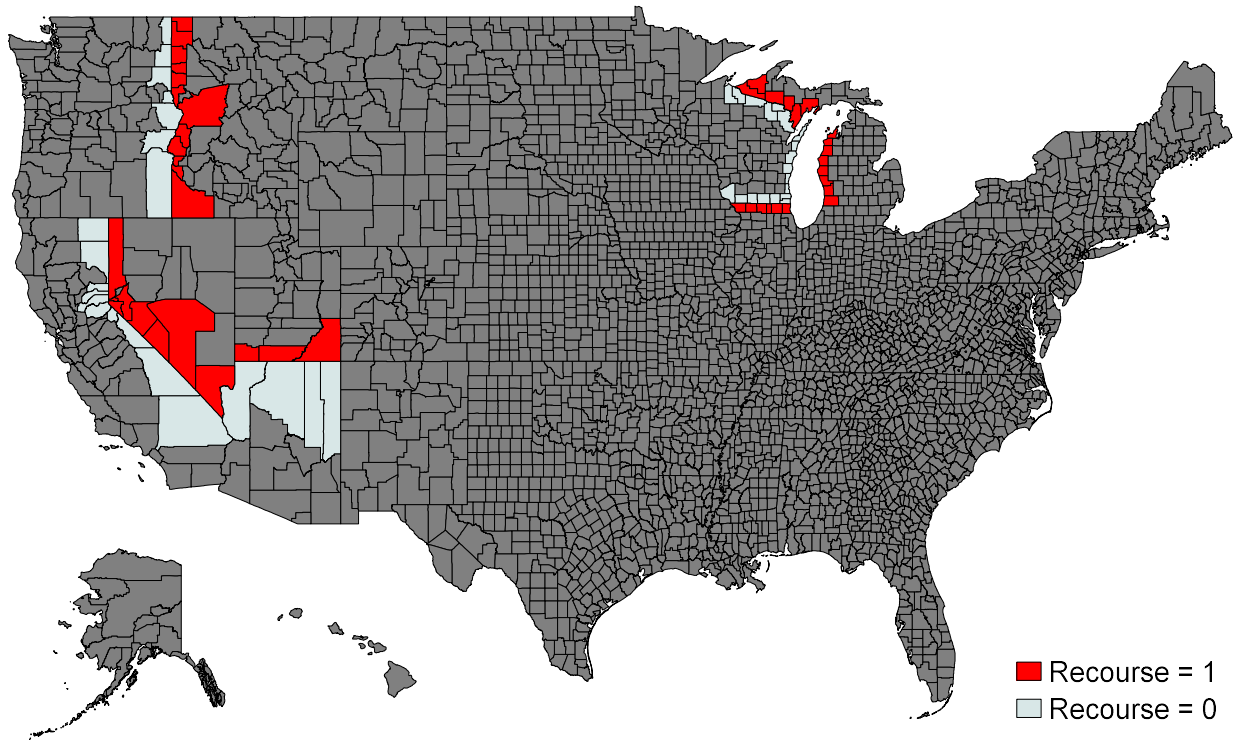
The figure plots the point estimates and the 95% confidence intervals for the coefficients of the interaction terms in the event study.

**Figure 5: Subsample - Neighboring States**



We manually match adjacent states of the treatment and control groups without replacement and remove states without neighboring states of the opposite recourse status. The figure shows the geographic distribution of the neighboring treatment and control groups.

**Figure 6: Subsample of Counties at State Borders**



The figure shows the counties at the state borders of the neighboring treatment and control groups.

**Table 1: Summary Statistics of the Dependent Variable: Quarterly Spending on Home Improvement and Maintenance**

|                                         |         |
|-----------------------------------------|---------|
| Mean (\$)                               | 694     |
| Standard deviation(\$)                  | 5554.3  |
| Fraction with spending <\$694 (%)       | 88.6    |
| Fraction with spending >\$0 (%)         | 26.5    |
| Number of observations with spending >0 | 20,116  |
| <i>Conditional on Spending &gt; 0</i>   |         |
| Mean (\$)                               | 2,617   |
| 5 <sup>th</sup> percentile              | 30      |
| 25 <sup>th</sup> percentile             | 150     |
| 50 <sup>th</sup> percentile             | 500     |
| 75 <sup>th</sup> percentile             | 1,999.5 |
| 95 <sup>th</sup> percentile             | 10,000  |

This table displays the descriptive statistics for the dependent variable. The sample period runs from the first quarter of 2003 to the fourth quarter of 2007.

**Table 2: Summary Statistics for the Independent Variables**

| Panel A: Main Independent Variables    |        |         |          |
|----------------------------------------|--------|---------|----------|
|                                        | Obs    | Mean    | Std.Dev. |
| Recourse                               | 75,817 | 0.759   | 0.427    |
| Post                                   | 75,817 | 0.387   | 0.487    |
| Panel B: Socioeconomic Factors         |        |         |          |
|                                        | Obs    | Mean    | Std.Dev. |
| Unemployment rate                      | 75,817 | 0.052   | 0.010    |
| Ln(Population)                         | 75,817 | 15.695  | 0.903    |
| Ln(Per capita income)                  | 75,817 | 10.767  | 0.139    |
| Panel C: Housing Characteristics       |        |         |          |
|                                        | Obs    | Mean    | Std.Dev. |
| Ln(Property value)                     | 75,817 | 12.146  | 0.797    |
| Age of home (years)                    | 75,817 | 42.474  | 33.992   |
| Years owned                            | 75,817 | 14.626  | 13.405   |
| Bathrooms                              | 75,817 | 1.841   | 0.753    |
| Bedrooms                               | 75,817 | 3.177   | 0.9      |
| Rooms                                  | 75,817 | 6.81    | 2.033    |
| Central air                            | 75,817 | 0.676   | 0.468    |
| Swimming pool                          | 75,817 | 0.121   | 0.326    |
| Off-street parking                     | 75,817 | 0.853   | 0.354    |
| Porch                                  | 75,817 | 0.845   | 0.362    |
| Panel D: Mortgage Characteristics      |        |         |          |
|                                        | Obs    | Mean    | Std.Dev. |
| Ln(Total mortgage balance)             | 75,817 | 6.672   | 5.636    |
| Ln(First mortgage balance)             | 75,817 | 6.505   | 5.668    |
| Ln(Home equity loan balance)           | 75,817 | 0.507   | 2.202    |
| Ln(Home equity line of credit balance) | 75,817 | 0.016   | 0.397    |
| Mortgage interest rate (%)             | 75,817 | 0.039   | 0.035    |
| Fixed rate mortgage                    | 75,817 | 0.45    | 0.497    |
| Adjustable rate mortgage               | 75,817 | 0.053   | 0.224    |
| Mortgage insurance                     | 75,817 | 0.041   | 0.198    |
| Length of mortgage in months (\$)      | 75,817 | 176.499 | 163.672  |
| LTV ratio                              | 75,817 | 0.322   | 0.36     |
| Panel E: Household Characteristics     |        |         |          |
|                                        | Obs    | Mean    | Std.Dev. |
| <i>Income/Wealth</i>                   |        |         |          |
| Ln(Annual income)                      | 75,817 | 10.689  | 1.879    |
| <i>Education</i>                       |        |         |          |
| Less than high school diploma          | 75,817 | 0.098   | 0.298    |
| High school graduate                   | 75,817 | 0.234   | 0.424    |
| Some college                           | 75,817 | 0.198   | 0.399    |
| College degree                         | 75,817 | 0.102   | 0.302    |
| Graduate degree                        | 75,817 | 0.367   | 0.482    |
| <i>Race</i>                            |        |         |          |
| White                                  | 75,817 | 0.868   | 0.339    |
| Black                                  | 75,817 | 0.075   | 0.263    |
| Native American                        | 75,817 | 0.004   | 0.062    |
| Asian                                  | 75,817 | 0.04    | 0.197    |
| Pacific Islander                       | 75,817 | 0.003   | 0.053    |
| Multi-race                             | 75,817 | 0.011   | 0.102    |
| Ln(Vehicle debt)                       | 75,817 | 3.53    | 4.577    |
| Ln(Financial assets)                   | 75,817 | 1.346   | 3.406    |

|                    |        |        |        |
|--------------------|--------|--------|--------|
| Ln(Unsecured debt) | 75,817 | 7.199  | 1.508  |
| Age (year)         | 75,817 | 52.397 | 15.442 |
| Family size        | 75,817 | 2.723  | 1.469  |

This table displays the summary statistics for the full sample. The sample period is from the first quarter of 2003 to the fourth quarter of 2007.

**Table 3: Baseline Results**

|                                                                          | (1)                | (2)                | (3)                | (4)                | (5)                  |
|--------------------------------------------------------------------------|--------------------|--------------------|--------------------|--------------------|----------------------|
| Dep. var.:<br>Ln(home<br>improvement and<br>maintenance<br>expenditures) | Baseline<br>DiD    | 2004-2006          | Event study        | DiD-no<br>controls | Cluster std.<br>err. |
| Recourse $\times$ Post                                                   | 0.257***<br>(4.63) | 0.310***<br>(4.28) |                    | 0.202***<br>(3.59) | 0.257***<br>(3.15)   |
| Time<2005q1 $\times$<br>Recourse                                         |                    |                    | Reference          |                    |                      |
| Time=2005q1 $\times$<br>Recourse                                         |                    |                    | -0.076<br>(-0.53)  |                    |                      |
| Time=2005q2 $\times$<br>Recourse                                         |                    |                    | 0.117<br>(1.00)    |                    |                      |
| Time=2005q3 $\times$<br>Recourse                                         |                    |                    | 0.158<br>(1.27)    |                    |                      |
| Time=2005q4 $\times$<br>Recourse                                         |                    |                    | 0.039<br>(0.32)    |                    |                      |
| Time=2006q1 $\times$<br>Recourse                                         |                    |                    | 0.465***<br>(4.22) |                    |                      |
| Time=2006q2 $\times$<br>Recourse                                         |                    |                    | 0.352***<br>(2.78) |                    |                      |
| Time=2006q3 $\times$<br>Recourse                                         |                    |                    | 0.276**<br>(2.10)  |                    |                      |
| Time=2006q4 $\times$<br>Recourse                                         |                    |                    | 0.147<br>(1.14)    |                    |                      |
| Time=2007q1 $\times$<br>Recourse                                         |                    |                    | 0.083<br>(0.67)    |                    |                      |
| Time=2007q2 $\times$<br>Recourse                                         |                    |                    | 0.361***<br>(2.62) |                    |                      |
| Time=2007q3 $\times$<br>Recourse                                         |                    |                    | 0.150<br>(1.03)    |                    |                      |
| Time=2007q4 $\times$<br>Recourse                                         |                    |                    | 0.412***<br>(3.06) |                    |                      |

|                               |                       |                       |                       |                      |
|-------------------------------|-----------------------|-----------------------|-----------------------|----------------------|
| Ln(Annual income)             | 0.056***<br>(9.04)    | 0.119***<br>(7.55)    | 0.056***<br>(9.05)    | 0.056***<br>(8.30)   |
| Family size                   | -0.008<br>(-0.92)     | -0.009<br>(-0.81)     | -0.008<br>(-0.91)     | -0.008<br>(-0.61)    |
| Age (years)                   | 0.005***<br>(4.82)    | 0.006***<br>(5.33)    | 0.005***<br>(4.81)    | 0.005***<br>(2.90)   |
| <b><i>Education</i></b>       |                       |                       |                       |                      |
| Less than high school diploma | Reference             | 0.000<br>(.)          | Reference             | Reference            |
| High school graduate          | 0.120***<br>(3.22)    | 0.121**<br>(2.57)     | 0.120***<br>(3.21)    | 0.120***<br>(3.13)   |
| Some college                  | 0.206***<br>(5.19)    | 0.231***<br>(4.59)    | 0.207***<br>(5.21)    | 0.206***<br>(4.76)   |
| College degree                | 0.343***<br>(7.22)    | 0.352***<br>(5.87)    | 0.343***<br>(7.22)    | 0.343***<br>(6.68)   |
| Graduate degree               | 0.417***<br>(10.54)   | 0.424***<br>(8.38)    | 0.416***<br>(10.52)   | 0.417***<br>(12.64)  |
| <b><i>Race</i></b>            |                       |                       |                       |                      |
| White                         | Reference             | 0.000<br>(.)          | Reference             | Reference            |
| Black                         | -0.252***<br>(-6.45)  | -0.256***<br>(-5.27)  | -0.251***<br>(-6.44)  | -0.252***<br>(-6.01) |
| Native American               | -0.088<br>(-0.50)     | 0.074<br>(0.34)       | -0.086<br>(-0.50)     | -0.088<br>(-0.45)    |
| Asian                         | -0.670***<br>(-11.99) | -0.722***<br>(-10.24) | -0.673***<br>(-12.03) | -0.670***<br>(-7.38) |
| Pacific Islander              | -0.003<br>(-0.01)     | -0.017<br>(-0.06)     | -0.004<br>(-0.02)     | -0.003<br>(-0.01)    |
| Multiracial                   | 0.027<br>(0.23)       | 0.012<br>(0.08)       | 0.024<br>(0.20)       | 0.027<br>(0.18)      |
| Ln(Vehicle debt)              | 0.009***<br>(3.29)    | 0.007**<br>(2.25)     | 0.009***<br>(3.29)    | 0.009**<br>(2.07)    |
| Ln(Financial assets)          | 0.024***<br>(6.87)    | 0.024***<br>(5.39)    | 0.024***<br>(6.86)    | 0.024***<br>(7.13)   |
| Ln(Unsecured debt)            | 0.090***<br>(11.27)   | 0.098***<br>(9.44)    | 0.090***<br>(11.26)   | 0.090***<br>(8.69)   |
| Bathrooms                     | -0.078***<br>(-3.73)  | -0.057**<br>(-2.10)   | -0.078***<br>(-3.74)  | -0.078***<br>(-4.27) |
| Bedrooms                      | 0.021<br>(1.12)       | 0.014<br>(0.57)       | 0.021<br>(1.13)       | 0.021<br>(0.92)      |
| Rooms                         | 0.055***<br>(6.12)    | 0.053***<br>(4.49)    | 0.055***<br>(6.11)    | 0.055***<br>(6.34)   |
| Central air                   | 0.045                 | 0.032                 | 0.044                 | 0.045                |

|                                        |           |           |           |           |
|----------------------------------------|-----------|-----------|-----------|-----------|
|                                        | (1.53)    | (0.88)    | (1.51)    | (1.07)    |
| Swimming pool                          | -0.030    | -0.088**  | -0.030    | -0.030    |
|                                        | (-0.85)   | (-1.97)   | (-0.84)   | (-0.59)   |
| Off-street parking                     | 0.111***  | 0.170***  | 0.111***  | 0.111***  |
|                                        | (3.55)    | (4.39)    | (3.57)    | (2.74)    |
| Porch                                  | 0.075**   | 0.050     | 0.076**   | 0.075     |
|                                        | (2.44)    | (1.27)    | (2.47)    | (1.66)    |
| Years owned                            | -0.002    | -0.003**  | -0.002    | -0.002    |
|                                        | (-1.58)   | (-2.23)   | (-1.59)   | (-1.04)   |
| Age of home(years)                     | 0.003***  | 0.003***  | 0.003***  | 0.003***  |
|                                        | (7.79)    | (6.70)    | (7.79)    | (6.34)    |
| Mortgage interest rate                 | -4.739*** | -5.399*** | -4.761*** | -4.739*** |
|                                        | (-6.60)   | (-6.13)   | (-6.63)   | (-4.60)   |
| Mortgage insurance                     | 0.055     | 0.034     | 0.054     | 0.055     |
|                                        | (0.97)    | (0.47)    | (0.96)    | (0.79)    |
| Fixed rate mortgage                    | 0.047     | 0.074     | 0.047     | 0.047     |
|                                        | (1.17)    | (1.52)    | (1.15)    | (1.05)    |
| Adjustable rate mortgage               | 0.035     | 0.070     | 0.034     | 0.035     |
|                                        | (0.57)    | (0.93)    | (0.56)    | (0.52)    |
| Length of mortgage in months           | -0.000*** | -0.000    | -0.000*** | -0.000**  |
|                                        | (-2.63)   | (-0.17)   | (-2.60)   | (-2.66)   |
| Ln(First mortgage balance)             | 0.042***  | 0.031***  | 0.042***  | 0.042***  |
|                                        | (6.76)    | (4.15)    | (6.77)    | (7.51)    |
| Ln(Home equity line of credit balance) | -0.032    | 0.009     | -0.032    | -0.032    |
|                                        | (-1.10)   | (0.21)    | (-1.08)   | (-1.12)   |
| Ln(Home equity loan balance)           | 0.031***  | 0.028***  | 0.031***  | 0.031***  |
|                                        | (5.41)    | (3.94)    | (5.43)    | (4.95)    |
| Ln(Property value)                     | 0.393***  | 0.368***  | 0.393***  | 0.393***  |
|                                        | (21.29)   | (15.71)   | (21.28)   | (10.66)   |
| Unemployment rate                      | 3.790     | 11.016*** | 2.745     | 3.790     |
|                                        | (1.20)    | (2.66)    | (0.85)    | (0.97)    |
| Ln(Population)                         | 0.779     | -0.236    | 0.760     | 0.779     |
|                                        | (0.81)    | (-0.15)   | (0.79)    | (0.51)    |
| Ln(Per capita income)                  | 0.435     | 0.720     | 0.343     | 0.435     |
|                                        | (0.59)    | (0.66)    | (0.47)    | (0.47)    |

| Time FE and<br>State FE | Yes   | Yes   | Yes   | Yes   | Yes   |
|-------------------------|-------|-------|-------|-------|-------|
| Observations            | 75817 | 46889 | 75817 | 75817 | 75817 |
| $R^2$                   | 0.042 | 0.046 | 0.042 | 0.010 | 0.042 |
| Mean DV                 | 1.651 | 1.653 | 1.651 | 1.651 | 1.651 |

This table presents the results of regressions estimating the effect of the BAPCPA on home improvement and maintenance expenditures. The regression is conducted at the property level. The sample period covered by Column (1) runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of p-values from Columns (1) to (3) and are clustered at the state level in Column (4). t-statistics are reported in parentheses. The mean dependent variable is reported at the bottom to assess marginal effects. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively.

**Table 4: Alternative Specifications**

| Dep. var.                                                   | (1)<br>Home improvement<br>and maintenance<br>expenditures<br><br>Tobit | (2)<br>Ln(home<br>improvement and<br>maintenance<br>expenditures)<br>OLS, winsorized | (3)<br>Home improvement<br>and maintenance<br>expenditures > 0<br><br>Logit |
|-------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Recourse $\times$ Post                                      | 634.254**<br>(2.27)                                                     | 0.219**<br>(2.66)                                                                    | 0.207***<br>(4.83)                                                          |
| Housing-level characteristics                               | Yes                                                                     | Yes                                                                                  | Yes                                                                         |
| Mortgage-level characteristics                              | Yes                                                                     | Yes                                                                                  | Yes                                                                         |
| Household-level<br>characteristics                          | Yes                                                                     | Yes                                                                                  | Yes                                                                         |
| Socioeconomic factors                                       | Yes                                                                     | Yes                                                                                  | Yes                                                                         |
| Time FE and State FE                                        | Yes                                                                     | Yes                                                                                  | Yes                                                                         |
| Observations                                                | 75817                                                                   | 82967                                                                                | 75817                                                                       |
| $R^2$                                                       |                                                                         | 0.047                                                                                |                                                                             |
| Pseudo $R^2$                                                | 0.006                                                                   |                                                                                      | 0.032                                                                       |
| Mean DV                                                     | 679.907                                                                 | 1.547                                                                                | 0.263                                                                       |
| Marginal Effects of <i>Recourse</i> $\times$<br><i>Post</i> |                                                                         |                                                                                      | 0.039***<br>(4.83)                                                          |

This table presents the results of regressions estimating the effect of the BAPCPA on home improvement and maintenance expenditures using alternative specifications. The dependent variable and regression model type are displayed at the top of each column. Specifically, Column (2) addresses the effects of extreme property value by winsorizing instead of removing them, as we do in all other regressions described in this paper. The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of the p-values. t-statistics (and z-statistics for Column (3)) are reported in parentheses. The mean dependent variable is reported at the bottom to assess marginal effects. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Other control variables are omitted from this table. Specific variables measured are listed in Table 3.

**Table 5: Alternative Explanations**

|                                                              | (1)                              | (2)                  | (3)                             | (4)                          | (5)                    | (6)                   | (7)                           | (8)               |
|--------------------------------------------------------------|----------------------------------|----------------------|---------------------------------|------------------------------|------------------------|-----------------------|-------------------------------|-------------------|
| Dep. var.: Ln(home improvement and maintenance expenditures) | Ln(Balance of home equity loans) | Ln(Balance of HELOC) | Ln(Balance of Unsecured credit) | Ln(Non-housing expenditures) | Single-home households | Control for Homestead | Dep. var.: Ln(Disposal value) | Drop Sand States  |
| Recourse $\times$ Post                                       | -0.041<br>(-1.01)                | 0.005<br>(0.58)      | 0.037<br>(1.31)                 | -0.181**<br>(-2.48)          | 0.264***<br>(4.24)     | 0.222***<br>(3.87)    | -0.018<br>(-1.47)             | 0.192**<br>(2.40) |
| Post $\times$ Ln(homestead exemption volume)                 |                                  |                      |                                 |                              |                        | -0.018**<br>(-2.13)   |                               |                   |
| Ln(homestead exemption volume)                               |                                  |                      |                                 |                              |                        | 0.051**<br>(2.09)     |                               |                   |
| Housing-level characteristics                                | Yes                              | Yes                  | Yes                             | Yes                          | Yes                    | Yes                   | No                            | Yes               |
| Mortgage-level characteristics                               | Yes                              | Yes                  | Yes                             | Yes                          | Yes                    | Yes                   | No                            | Yes               |
| Household-level characteristics                              | Yes                              | Yes                  | Yes                             | Yes                          | Yes                    | Yes                   | Yes                           | Yes               |
| Socioeconomic factors                                        | Yes                              | Yes                  | Yes                             | Yes                          | Yes                    | Yes                   | Yes                           | Yes               |
| Time FE and State FE                                         | Yes                              | Yes                  | Yes                             | Yes                          | Yes                    | Yes                   | Yes                           | Yes               |
| Observations                                                 | 75817                            | 75817                | 75817                           | 75817                        | 62719                  | 75817                 | 68774                         | 60340             |
| $R^2$                                                        | 0.113                            | 0.004                | 0.156                           | 0.027                        | 0.047                  | 0.042                 | 0.002                         | 0.044             |
| Mean DV                                                      | 0.514                            | 0.017                | 7.173                           | 5.435                        | 1.740                  | 1.651                 | 0.025                         | 1.637             |

This table presents the results of regressions estimating the effect of the BAPCPA on various outcome variables. The regression is conducted at the property-quarter level for Columns (1) to (6) and Column (8) and at the household-quarter level for Column (7). The mortgage-level control variables exclude the balance of home equity loans and HELOCs for Columns (1) and (2). Housing and mortgage characteristics are unobserved and not controlled for Column (7). The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of the p-values. t-statistics are reported in parentheses. The mean dependent variable is reported at the bottom to assess marginal effects. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively.

**Table 6: Expectations**

| Panel A Summary Statistics |       |           |           |      |        |        |
|----------------------------|-------|-----------|-----------|------|--------|--------|
|                            | Obs   | Mean      | Std.Dev.  | Min  | Median | Max    |
| Expectation                | 27676 | -0.031    | 0.485     | -1   | 0      | 1      |
| Family Income              | 27676 | 69133.830 | 62482.650 | 1000 | 55000  | 500000 |
| Age                        | 27676 | 49.908    | 16.408    | 18   | 49     | 97     |
| Male=1                     | 27676 | 0.4530    | 0.498     | 0    | 0      | 1      |
| Number of Children         | 27676 | 0.671     | 1.056     | 0    | 0      | 5      |
| Number of Adults           | 27676 | 1.887     | 0.743     | 1    | 2      | 5      |

| Panel B Estimation Results    |                       |                       |                       |                       |
|-------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Dep. var.: <i>Expectation</i> | Full Sample           |                       | Homeowners            |                       |
|                               | (1)                   | (2)                   | (3)                   | (4)                   |
| Recourse_w $\times$ Post      | -0.086**<br>(-2.46)   | -0.085**<br>(-2.43)   | -0.100**<br>(-2.49)   | -0.099**<br>(-2.47)   |
| Recourse_w                    | -11.855***<br>(-3.37) | -11.634***<br>(-3.31) | -14.510***<br>(-3.65) | -14.291***<br>(-3.59) |
| Ln(family income)             |                       | -0.010**<br>(-2.12)   |                       | -0.008<br>(-1.53)     |
| Age                           |                       | -0.001***<br>(-3.71)  |                       | -0.001***<br>(-3.42)  |
| Gender (Male=1)               |                       | -0.008<br>(-1.38)     |                       | -0.007<br>(-1.06)     |
| Number of children (<18)      |                       | -0.008**<br>(-2.49)   |                       | -0.011***<br>(-2.96)  |
| Number of adults (18+)        |                       | 0.008*<br>(1.73)      |                       | 0.004<br>(0.69)       |
| Marital Status FE             | Yes                   | Yes                   | Yes                   | Yes                   |
| Education FE                  | Yes                   | Yes                   | Yes                   | Yes                   |
| Time FE and Region FE         | Yes                   | Yes                   | Yes                   | Yes                   |
| Observations                  | 27676                 | 27676                 | 21920                 | 21920                 |

|         |        |        |        |        |
|---------|--------|--------|--------|--------|
| $R^2$   | 0.013  | 0.014  | 0.015  | 0.016  |
| Mean DV | -0.031 | -0.031 | -0.029 | -0.029 |

This table presents the results of regressions estimating the change in expectations regarding the housing markets. The regression is conducted at the consumer-month level. The sample period runs from 2003 to 2007. The “time FE” refers to year by month fixed effects. Robust standard errors are used in the calculation of the p-values in Columns (1) and (3) and are clustered at the region level in Columns (2) and (4). t-statistics are reported in parentheses. The mean dependent variable is reported at the bottom to assess marginal effects. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively.

**Table 7: Subsample Regression Results**

|                                                              | (1)               | (2)               |
|--------------------------------------------------------------|-------------------|-------------------|
| Dep. var.: Ln(home improvement and maintenance expenditures) | DiD<br>Judicial=1 | DiD<br>Judicial=0 |
| Recourse $\times$ Post                                       | 0.127<br>(0.85)   | 0.188**<br>(2.48) |
| Housing-level characteristics                                | Yes               | Yes               |
| Mortgage-level characteristics                               | Yes               | Yes               |
| Household-level characteristics                              | Yes               | Yes               |
| Socioeconomic factors                                        | Yes               | Yes               |
| Time FE                                                      | Yes               | Yes               |
| State FE                                                     | Yes               | Yes               |
| Observations                                                 | 31936             | 33345             |
| $R^2$                                                        | 0.041             | 0.049             |
| Mean DV                                                      | 1.599             | 1.715             |

This table presents the results of regressions estimating the effect of the BAPCPA on home improvement and maintenance expenditures. Columns (1) and (2) present the results of regressions of the nonjudicial and judicial foreclosure state samples, respectively. The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of the p-values. t-statistics are reported in parentheses. The mean dependent variable is reported at the bottom to assess marginal effects. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Other control variables are omitted from this table. Specific variables measured are listed in Table 3.

**Table 8: Neighboring States**

| Dep. var.: Ln(home improvement and maintenance expenditures) |                  |
|--------------------------------------------------------------|------------------|
| Recourse $\times$ Post                                       | 0.164*<br>(1.88) |
| Housing-level characteristics                                | Yes              |
| Mortgage-level characteristics                               | Yes              |
| Household-level characteristics                              | Yes              |
| Socioeconomic factors                                        | Yes              |
| Time FE                                                      | Yes              |
| State FE                                                     | Yes              |
| Observations                                                 | 23951            |
| $R^2$                                                        | 0.044            |
| Mean DV                                                      | 1.747            |

This table presents the results of regressions estimating the effect of the BAPCPA on home improvement and maintenance expenditures using neighboring states. The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of p-values. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Other control variables are omitted in this table. Specific variables measured are listed in Table 3.

**Table 9: Summary Statistics of Socioeconomic Factors After Entropy Balancing****Panel A: Socioeconomic Factors**

| Post=0                 |            |            |           |         |
|------------------------|------------|------------|-----------|---------|
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Unemployment rate      | 0.054      | 0.054      | 0.000     | 0.992   |
| Ln(Population)         | 15.627     | 15.627     | 0.000     | 0.994   |
| Ln(Per capita income)  | 10.710     | 10.710     | 0.000     | 0.997   |
| Number of observations | 11,514     | 34,924     |           |         |
| Post=1                 |            |            |           |         |
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Unemployment rate      | 0.045      | 0.045      | 0.000     | 0.960   |
| Ln(Population)         | 15.663     | 15.663     | 0.000     | 0.991   |
| Ln(Per capita income)  | 10.830     | 10.830     | 0.000     | 0.997   |
| Number of observations | 6,731      | 22,648     |           |         |

**Panel B: Housing Characteristics**

| Post=0                 |            |            |           |         |
|------------------------|------------|------------|-----------|---------|
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Property value)     | 11.947     | 11.947     | 0.000     | 0.999   |
| Age of home (years)    | 43.971     | 43.971     | 0.000     | 0.999   |
| Years owned (years)    | 15.022     | 15.022     | 0.000     | 1.000   |
| Bathrooms              | 1.792      | 1.801      | -0.009    | 0.386   |
| Bedrooms               | 3.173      | 3.173      | 0.000     | 1.000   |
| Rooms                  | 6.857      | 6.857      | 0.000     | 1.000   |
| Central air            | 0.704      | 0.704      | 0.000     | 0.996   |
| Swimming pool          | 0.122      | 0.122      | 0.000     | 0.999   |
| Off-street parking     | 0.857      | 0.857      | 0.000     | 1.000   |
| Porch                  | 0.835      | 0.835      | 0.000     | 1.000   |
| Number of observations | 11,514     | 34,924     |           |         |
| Post=1                 |            |            |           |         |
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Property value)     | 12.164     | 12.164     | 0.001     | 0.973   |
| Age of home (year)     | 43.745     | 43.745     | 0.000     | 1.000   |
| Years owned (year)     | 14.947     | 14.948     | -0.001    | 0.998   |
| Bathrooms              | 1.846      | 1.846      | 0.000     | 0.990   |
| Bedrooms               | 3.189      | 3.189      | 0.000     | 0.995   |
| Rooms                  | 6.869      | 6.869      | 0.000     | 1.000   |
| Central air            | 0.728      | 0.729      | 0.000     | 0.968   |
| Swimming pool          | 0.113      | 0.113      | 0.000     | 0.997   |
| Off-street parking     | 0.827      | 0.827      | 0.000     | 0.997   |
| Porch                  | 0.836      | 0.836      | 0.000     | 0.997   |
| Number of observations | 6,731      | 22,648     |           |         |

**Panel C: Mortgage Characteristics**

| Post=0                                 |            |            |           |         |
|----------------------------------------|------------|------------|-----------|---------|
|                                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Total mortgage balance)             | 6.445      | 6.442      | 0.003     | 0.975   |
| Ln(First mortgage balance)             | 6.260      | 6.260      | 0.000     | 0.999   |
| Ln(Home equity loan balance)           | 0.476      | 0.476      | 0.000     | 1.000   |
| Ln(Home equity line of credit balance) | 0.008      | 0.008      | 0.000     | 1.000   |

|                                        |            |            |           |         |
|----------------------------------------|------------|------------|-----------|---------|
| Mortgage interest rate (%)             | 0.039      | 0.039      | 0.000     | 1.000   |
| Fixed rate mortgage                    | 0.436      | 0.436      | 0.000     | 1.000   |
| Adjustable rate mortgage               | 0.044      | 0.044      | 0.000     | 1.000   |
| Mortgage insurance                     | 0.043      | 0.043      | 0.000     | 1.000   |
| Length of mortgage in months           | 170.537    | 170.537    | 0.000     | 0.999   |
| Number of observations                 | 11,514     | 34,924     |           |         |
| Post=1                                 |            |            |           |         |
|                                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Total mortgage balance)             | 6.652      | 6.631      | 0.020     | 0.873   |
| Ln(First mortgage balance)             | 6.454      | 6.454      | 0.000     | 0.999   |
| Ln(Home equity loan balance)           | 0.574      | 0.574      | 0.000     | 0.997   |
| Ln(Home equity line of credit balance) | 0.022      | 0.022      | 0.000     | 0.999   |
| Mortgage interest rate (%)             | 0.039      | 0.039      | 0.000     | 0.999   |
| Fixed rate mortgage                    | 0.466      | 0.466      | 0.000     | 0.998   |
| Adjustable rate mortgage               | 0.056      | 0.056      | 0.000     | 0.999   |
| Mortgage insurance                     | 0.041      | 0.041      | 0.000     | 0.998   |
| Length of mortgage in months           | 177.151    | 177.151    | -0.002    | 1.000   |
| Number of observations                 | 6,731      | 22,648     |           |         |

**Panel D: Household Characteristics**

|                               |            |            |           |         |
|-------------------------------|------------|------------|-----------|---------|
| Post=0                        |            |            |           |         |
|                               | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| <i>Income / Wealth</i>        |            |            |           |         |
| Ln(Annual income)             | 10.427     | 10.427     | 0.000     | 1.000   |
| <i>Education</i>              |            |            |           |         |
| Less than high school diploma | 0.103      | 0.103      | 0.000     | 1.000   |
| High school graduate          | 0.257      | 0.257      | 0.000     | 0.999   |
| Some college                  | 0.192      | 0.192      | 0.000     | 1.000   |
| College degree                | 0.094      | 0.094      | 0.000     | 1.000   |
| Graduate degree               | 0.354      | 0.354      | 0.000     | 1.000   |
| <i>Race</i>                   |            |            |           |         |
| White                         | 0.864      | 0.864      | 0.000     | 0.999   |
| Black                         | 0.090      | 0.090      | 0.000     | 1.000   |
| Native American               | 0.003      | 0.003      | 0.000     | 0.994   |
| Asian                         | 0.031      | 0.031      | 0.000     | 0.999   |
| Pacific Islander              | 0.002      | 0.002      | 0.000     | 0.989   |
| Multiracial                   | 0.010      | 0.010      | 0.000     | 1.000   |
| Ln(Vehicle debt)              | 3.594      | 3.594      | 0.000     | 1.000   |
| Ln(Financial assets)          | 1.245      | 1.245      | 0.000     | 1.000   |
| Ln(Unsecured debt)            | 7.251      | 7.251      | 0.000     | 0.999   |
| Age (year)                    | 52.526     | 52.526     | 0.000     | 0.999   |
| Family size                   | 2.696      | 2.696      | 0.000     | 1.000   |
| Number of observations        | 11,514     | 34,924     |           |         |
| Post=1                        |            |            |           |         |
|                               | Recourse=0 | Recourse=1 | Diff      | p-value |
| <i>Income / Wealth</i>        |            |            |           |         |
| Ln(Annual income)             | 10.970     | 10.970     | 0.000     | 0.997   |
| <i>Education</i>              |            |            |           |         |
| Less than high school diploma | 0.099      | 0.099      | 0.000     | 1.000   |
| High school graduate          | 0.245      | 0.245      | 0.000     | 0.996   |
| Some college                  | 0.192      | 0.192      | 0.000     | 1.000   |
| College degree                | 0.101      | 0.101      | 0.000     | 1.000   |
| Graduate degree               | 0.363      | 0.363      | 0.000     | 0.996   |

|                        |        |        |        |       |
|------------------------|--------|--------|--------|-------|
| <i>Race</i>            |        |        |        |       |
| White                  | 0.865  | 0.865  | 0.000  | 0.993 |
| Black                  | 0.087  | 0.087  | 0.000  | 0.995 |
| Native American        | 0.003  | 0.003  | 0.000  | 0.951 |
| Asian                  | 0.035  | 0.034  | 0.000  | 0.977 |
| Pacific Islander       | 0.002  | 0.002  | 0.000  | 0.996 |
| Multiracial            | 0.008  | 0.008  | 0.000  | 0.997 |
| Ln(Vehicle debt)       | 3.490  | 3.490  | 0.000  | 0.999 |
| Ln(Financial assets)   | 1.319  | 1.319  | 0.000  | 0.996 |
| Ln(Unsecured debt)     | 7.071  | 7.071  | 0.000  | 0.998 |
| Age (year)             | 52.548 | 52.549 | -0.001 | 0.997 |
| Family size            | 2.701  | 2.701  | 0.000  | 0.994 |
| Number of observations | 6,731  | 22,648 |        |       |

This table displays the socioeconomic factors, housing characteristics, mortgage characteristics, and household characteristics of the sample after entropy balancing. The sample period runs from the first quarter of 2003 to the fourth quarter of 2007.

**Table 10: Regression Results of Samples After Entropy Balancing**

| Dep. var.: Ln(home improvement and maintenance expenditures) | (1)                | (2)                |
|--------------------------------------------------------------|--------------------|--------------------|
|                                                              | DiD-no controls    | DiD                |
| Recourse $\times$ Post                                       | 0.200***<br>(2.85) | 0.201***<br>(3.05) |
| Housing-level characteristics                                | No                 | Yes                |
| Mortgage-level characteristics                               | No                 | Yes                |
| Household-level characteristics                              | No                 | Yes                |
| Socioeconomic factors                                        | No                 | Yes                |
| Time FE                                                      | Yes                | Yes                |
| State FE                                                     | Yes                | Yes                |
| Observations                                                 | 75817              | 75817              |
| $R^2$                                                        | 0.007              | 0.048              |
| Mean DV                                                      | 1.614              | 1.614              |

This table presents the results of regressions estimating the effect of the BAPCPA on home improvement and maintenance expenditures with entropy balancing. The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of p-values. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Other control variables are omitted in this table. Specific variables measured are listed in Table 3.

**Table 11: Strategic Default and Bankruptcy**

| Dep. var.:             | Default              |                      | Bankruptcy (with Default) |                     |
|------------------------|----------------------|----------------------|---------------------------|---------------------|
|                        | (1)                  | (2)                  | (3)                       | (4)                 |
| Recourse $\times$ Post | -0.035***<br>(-3.79) | -0.032***<br>(-3.61) | -0.008**<br>(-2.20)       | -0.008**<br>(-2.17) |
| Ln(Population)         |                      | 0.000<br>(0.19)      |                           | 0.003***<br>(4.33)  |
| Ln(Per capita income)  |                      | -0.123***<br>(-4.57) |                           | -0.022**<br>(-2.22) |
| Pair $\times$ Time FE  | Yes                  | Yes                  | Yes                       | Yes                 |
| State FE               | Yes                  | Yes                  | Yes                       | Yes                 |
| Observations           | 2325                 | 2325                 | 2325                      | 2325                |
| $R^2$                  | 0.168                | 0.114                | 0.065                     | 0.070               |
| Mean DV                | 0.073                | 0.032                | 0.008                     | 0.008               |

This table presents the results of regressions estimating the effect of the BAPCPA on strategic default and bankruptcy. The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of p-values. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively.

**Table 12: The Housing Market Outcome**

| Dep. var.: $\Delta$ HPI | (1)                | (2)                |
|-------------------------|--------------------|--------------------|
| Recourse $\times$ Post  | 0.007***<br>(2.71) | 0.008***<br>(2.91) |
| Ln(Population)          |                    | 0.066<br>(1.51)    |
| Ln(Per capita income)   |                    | 0.096***<br>(4.72) |
| Time FE                 | Yes                | Yes                |
| State FE                | Yes                | Yes                |
| Observations            | 840                | 840                |
| $R^2$                   | 0.606              | 0.616              |
| Mean DV                 | 0.017              | 0.017              |

This table presents the results of regressions estimating the effect of the BAPCPA on the growth of housing prices. The sample period runs from 2003q1 to 2007q4. Robust standard errors are used in the calculation of p-values. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively.

## Appendix A

Table A1 lists the reasons for removing observations.

Table A2 compares the characteristics of recourse and nonrecourse states for the periods before and after the adoption of the BAPCPA.

Table A3 lists the categories of responses to the reasons for home buying/selling attitudes in the MSC survey.

Table A4 lists the recourse and judicial foreclosure status for each state in the sample.

Table A5 shows the t-tests for means of control variables after propensity score matching (PSM). We regress recourse on all the control variables in Column (1) of Table 3 and use 1:1 nearest-neighbor matching based on the fitted propensity score. Similar to the entropy balancing, we apply the matching to the periods before and after the adoption of the BAPCPA separately. The means are still statistically different between the treatment group and control group for many variables, which implies that the matching results are worse than that of entropy balancing.

Table A6 tests the heterogeneous effects on households with different ex ante LTV as described in Section 4.4.

**Table A1: Removed Observations****Panel A Breakdown of Missing Values**

| <b>Variable</b>     | <b>Observations</b> |
|---------------------|---------------------|
| State               | 21,459              |
| Housing value       | 47,848              |
| Financial assets    | 16,820              |
| Years owned         | 55,774              |
| Age of home         | 2,305               |
| Number of rooms     | 1,083               |
| Number of bedrooms  | 1,008               |
| Number of bathrooms | 989                 |
| Mortgage balance    | 105                 |

**Panel B Other Observations Removed from the Main Sample**

| <b>Reason</b>                                           | <b>Removed Observations</b> |
|---------------------------------------------------------|-----------------------------|
| Rented house                                            | 47,340                      |
| Heterogeneity in recourse status in North Carolina      | 505                         |
| LTV > 2 ( <a href="#">Melzer 2017</a> )                 | 780                         |
| Property value < 30,000 ( <a href="#">Melzer 2017</a> ) | 6,869                       |

This table outlines the reasons for removing observations. Panel A displays the number of missing values for different variables. Note that an observation may have a missing value for more than one variable, and the aggregate number of observations listed in Panel A is greater than the total number of observations removed from the sample due to missing values. Panel B lists the number of observations removed for other reasons as introduced in Section 2.3. A total of 76,817 observations are ultimately retained, covering 26,841 unique households.

**Table A2: Summary Statistics of the Baseline Sample: T Tests****Panel A: Socioeconomic Factors**

| Post=0                 |            |            |           |          |
|------------------------|------------|------------|-----------|----------|
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| Unemployment rate      | 0.059      | 0.054      | 0.005     | 0.000*** |
| Ln(Population)         | 15.840     | 15.627     | 0.212     | 0.000*** |
| Ln(Per capita income)  | 10.751     | 10.710     | 0.041     | 0.000*** |
| Number of observations | 11,514     | 34,924     |           |          |
| Post=1                 |            |            |           |          |
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| Unemployment rate      | 0.050      | 0.045      | 0.005     | 0.000*** |
| Ln(Population)         | 15.910     | 15.663     | 0.248     | 0.000*** |
| Ln(Per capita income)  | 10.875     | 10.830     | 0.046     | 0.000*** |
| Number of observations | 6,731      | 22,648     |           |          |

**Panel B: Housing Characteristics**

| Post=0                 |            |            |           |          |
|------------------------|------------|------------|-----------|----------|
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| Ln(Property value)     | 12.358     | 11.947     | 0.411     | 0.000*** |
| Age of home (years)    | 38.083     | 43.971     | -5.888    | 0.000*** |
| Years owned            | 13.404     | 15.022     | -1.618    | 0.000*** |
| Bathrooms              | 1.881      | 1.801      | 0.080     | 0.000*** |
| Bedrooms               | 3.140      | 3.173      | -0.032    | 0.001*** |
| Rooms                  | 6.616      | 6.857      | -0.241    | 0.000*** |
| Central air            | 0.567      | 0.704      | -0.137    | 0.000*** |
| Swimming pool          | 0.133      | 0.122      | 0.011     | 0.003*** |
| Off-street parking     | 0.889      | 0.857      | 0.032     | 0.000*** |
| Porch                  | 0.879      | 0.835      | 0.044     | 0.000*** |
| Number of observations | 11,514     | 34,924     |           |          |
| Post=1                 |            |            |           |          |
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| Ln(Property value)     | 12.750     | 12.164     | 0.586     | 0.000*** |
| Age of home (years)    | 37.940     | 43.745     | -5.805    | 0.000*** |
| Years owned            | 13.576     | 14.948     | -1.372    | 0.000*** |
| Bathrooms              | 1.964      | 1.846      | 0.118     | 0.000*** |
| Bedrooms               | 3.217      | 3.189      | 0.028     | 0.028**  |
| Rooms                  | 6.703      | 6.869      | -0.167    | 0.000*** |
| Central air            | 0.543      | 0.729      | -0.185    | 0.000*** |
| Swimming pool          | 0.126      | 0.113      | 0.013     | 0.003*** |
| Off-street parking     | 0.856      | 0.827      | 0.029     | 0.000*** |
| Porch                  | 0.869      | 0.836      | 0.033     | 0.000*** |
| Number of observations | 6,731      | 22,648     |           |          |

**Panel C: Mortgage Characteristics**

| Post=0                                 |            |            |           |          |
|----------------------------------------|------------|------------|-----------|----------|
|                                        | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| Ln(Total mortgage balance)             | 7.148      | 6.442      | 0.706     | 0.000*** |
| Ln(First mortgage balance)             | 7.039      | 6.260      | 0.779     | 0.000*** |
| Ln(Home equity loan balance)           | 0.425      | 0.476      | -0.051    | 0.023**  |
| Ln(Home equity line of credit balance) | 0.020      | 0.008      | 0.012     | 0.001*** |
| Mortgage interest rate (%)             | 0.040      | 0.039      | 0.001     | 0.001*** |

|                                        |            |            |           |          |
|----------------------------------------|------------|------------|-----------|----------|
| Fixed rate mortgage                    | 0.448      | 0.436      | 0.012     | 0.020**  |
| Adjustable rate mortgage               | 0.064      | 0.044      | 0.020     | 0.000*** |
| Mortgage insurance                     | 0.041      | 0.043      | -0.001    | 0.505    |
| Length of mortgage in months (\$)      | 187.239    | 170.535    | 16.704    | 0.000*** |
| Number of observations                 | 11,514     | 34,924     |           |          |
| Post=1                                 |            |            |           |          |
|                                        | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| Ln(Total mortgage balance)             | 7.153      | 6.631      | 0.522     | 0.000*** |
| Ln(First mortgage balance)             | 7.009      | 6.454      | 0.555     | 0.000*** |
| Ln(Home equity loan balance)           | 0.579      | 0.574      | 0.005     | 0.880    |
| Ln(Home equity line of credit balance) | 0.028      | 0.022      | 0.007     | 0.326    |
| Mortgage interest rate (%)             | 0.039      | 0.039      | 0.000     | 0.492    |
| Fixed rate mortgage                    | 0.470      | 0.466      | 0.005     | 0.506    |
| Adjustable rate mortgage               | 0.069      | 0.056      | 0.014     | 0.000*** |
| Mortgage insurance                     | 0.032      | 0.041      | -0.009    | 0.001*** |
| Length of mortgage in months           | 186.090    | 177.151    | 8.939     | 0.000*** |
| Number of observations                 | 6,731      | 22,648     |           |          |

**Panel D: Household Characteristics**

|                               |            |            |           |          |
|-------------------------------|------------|------------|-----------|----------|
| Post=0                        |            |            |           |          |
|                               | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| <i>Income/Wealth</i>          |            |            |           |          |
| Ln(Annual income)             | 10.695     | 10.427     | 0.268     | 0.000*** |
| <i>Education</i>              |            |            |           |          |
| Less than high school diploma | 0.091      | 0.103      | -0.012    | 0.000*** |
| High school graduate          | 0.185      | 0.257      | -0.072    | 0.000*** |
| Some college                  | 0.226      | 0.192      | 0.034     | 0.000*** |
| College degree                | 0.120      | 0.094      | 0.025     | 0.000*** |
| Graduate degree               | 0.378      | 0.354      | 0.024     | 0.000*** |
| <i>Race</i>                   |            |            |           |          |
| White                         | 0.882      | 0.864      | 0.018     | 0.000*** |
| Black                         | 0.029      | 0.090      | -0.062    | 0.000*** |
| Native American               | 0.008      | 0.003      | 0.005     | 0.000*** |
| Asian                         | 0.060      | 0.031      | 0.029     | 0.000*** |
| Pacific Islander              | 0.006      | 0.002      | 0.005     | 0.000*** |
| Multiracial                   | 0.015      | 0.010      | 0.005     | 0.000*** |
| Ln(Vehicle debt)              | 3.593      | 3.594      | -0.001    | 0.985    |
| Ln(Financial assets)          | 1.582      | 1.245      | 0.338     | 0.000*** |
| Ln(Unsecured debt)            | 7.323      | 7.251      | 0.072     | 0.000*** |
| Age (year)                    | 52.197     | 52.527     | -0.330    | 0.047**  |
| Family size                   | 2.810      | 2.696      | 0.114     | 0.000*** |
| Number of observations        | 11,514     | 34,924     |           |          |
| Post=1                        |            |            |           |          |
|                               | Recourse=0 | Recourse=1 | Mean Diff | p-value  |
| <i>Income/Wealth</i>          |            |            |           |          |
| Ln(Annual income)             | 11.099     | 10.970     | 0.129     | 0.000*** |
| <i>Education</i>              |            |            |           |          |
| Less than high school diploma | 0.083      | 0.099      | -0.016    | 0.000*** |
| High school graduate          | 0.165      | 0.245      | -0.079    | 0.000*** |
| Some college                  | 0.208      | 0.192      | 0.017     | 0.002*** |
| College degree                | 0.114      | 0.101      | 0.013     | 0.002*** |
| Graduate degree               | 0.429      | 0.363      | 0.066     | 0.000*** |
| <i>Race</i>                   |            |            |           |          |

|                        |        |        |        |          |
|------------------------|--------|--------|--------|----------|
| White                  | 0.871  | 0.865  | 0.005  | 0.277    |
| Black                  | 0.031  | 0.087  | -0.056 | 0.000*** |
| Native American        | 0.009  | 0.003  | 0.006  | 0.000*** |
| Asian                  | 0.073  | 0.034  | 0.038  | 0.000*** |
| Pacific Islander       | 0.005  | 0.002  | 0.003  | 0.000*** |
| Multiracial            | 0.011  | 0.008  | 0.003  | 0.021**  |
| Ln(Vehicle debt)       | 3.229  | 3.490  | -0.261 | 0.000*** |
| Ln(Financial assets)   | 1.560  | 1.319  | 0.241  | 0.000*** |
| Ln(Unsecured debt)     | 7.146  | 7.071  | 0.074  | 0.001*** |
| Age (year)             | 51.560 | 52.549 | -0.989 | 0.000*** |
| Family size            | 2.793  | 2.701  | 0.092  | 0.000*** |
| Number of observations | 6,731  | 22,648 |        |          |

This table compares control variables between the treatment and the control groups using the original sample. The sample period runs from the first quarter of 2003 to the fourth quarter of 2007.

**Table A3: Answer Categories in MSC Data**

| Reasons: a good time to buy a house / a bad time to sell a house | Reasons: a bad time to buy a house / a good time to sell a house         |
|------------------------------------------------------------------|--------------------------------------------------------------------------|
| 10 FAV Interest rate won't get any lower                         | 10 FAV Interest rate won't get any lower (not codeable elsewhere)        |
| 11 FAV Prices are low/stable/not too high                        | 11 FAV Prices are high/higher/won't get any lower                        |
| 12 FAV Good buys available                                       | 12 FAV Seller's market (under-supply of houses)                          |
| 13 FAV Prices are going up                                       | 13 FAV Prices going down; sell before prices lower                       |
| 14 FAV Prices won't get any lower                                | 14 FAV Prices won't get any higher (not codeable13)                      |
| 15 FAV Lower down payment                                        | 15 FAV Lower down payment                                                |
| 16 FAV Interest rates are low                                    | 16 FAV Interest rates are low (now)                                      |
| 17 FAV Credit easy to get, easy money                            | 17 FAV Credit easy to get; easy money, NA if15,16,17, or18               |
| 18 FAV Credit will be tighter later                              | 18 FAV Credit will be tighter later; interest rates will go up           |
| 19 FAV Lower taxes, taxes higher later                           | 19 FAV Lower taxes; taxes will be higher later                           |
| 21 FAV People can afford to buy now                              | 21 FAV People can afford to buy now                                      |
| 23 FAV Buying makes for good times, prosperity                   | 23 FAV Buying makes for good times/prosperity/high employment            |
| 27 FAV Other references to employment and purchasing power       | 31 FAV Supply inadequate, shortages now; may be shortages later          |
| 31 FAV Supply adequate, no shortages now                         | 33 FAV Good time for existing homes, costs more to build new ones        |
| 32 FAV Quality is good, better, may get worse                    | 41 FAV Seasonal references only                                          |
| 33 FAV New models have improvements, new features                | 42 FAV R only says: If need to sell/need money this is good time         |
| 34 FAV Good selection, variety                                   | 44 FAV Can use cash/capital for other investments                        |
| 41 FAV Seasonal references only                                  | 45 FAV Better to sell now, value of home may decline                     |
| 42 FAV R only says: if you need it this is a good time           | 46 FAV Capital appreciation: value of houses increased; good profits now |
| 43 FAV Low sales won't last, will pick up soon                   | 47 FAV Other good reasons (miscellaneous)                                |
| 44 FAV Renting is unfavorable b/c high rents, shortage           | 48 FAV Variable mortgage rate                                            |
| 45 FAV Owning is always a good idea, renting is a bad idea       | 49 FAV Economic policy; references to gov't/new president                |
| 46 FAV Capital appreciation: buying is a good investment         | 50 UNFAV Interest rates won't get any lower (not codeable elsewhere)     |
| 47 FAV Other good reasons (misc.)                                | 51 UNFAV Prices are low/lower                                            |
| 48 FAV Variable mortgage rate                                    | 52 UNFAV Buyer's market; difficult to find buyers;                       |
| 49 FAV Economic policy, references to gov't/president            | 53 UNFAV Prices will rise later; future uncertainty about prices         |
| 50 UNFAV Interest rates won't get any lower                      | 54 UNFAV Interest rates low/lower                                        |
| 51 UNFAV Prices are too high, houses cost too much               | 55 UNFAV Higher/Larger down payment required                             |
| 52 UNFAV Seller's market, few sales or discounts                 | 56 UNFAV Interest rate too high; will go up                              |
| 53 UNFAV Prices will fall later, will come down                  | 57 UNFAV Credit hard to get; financing difficult                         |
| 54 UNFAV Debt or credit bad (NA why)                             |                                                                          |
| 55 UNFAV Higher/larger down payment required                     |                                                                          |
| 56 UNFAV Interest rate too high, will go up                      |                                                                          |
| 57 UNFAV Credit hard to get, financing difficult                 |                                                                          |

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|                                                          |                                                                       |
|----------------------------------------------------------|-----------------------------------------------------------------------|
| 58 UNFAV Interest rates will come down later             | difficult; pt system; tight money                                     |
| 59 UNFAV Tax increase, property taxes too high           | 58 UNFAV Interest rates will come down later; credit easier later     |
| 61 UNFAV People can't afford to buy now, times are bad   | 59 UNFAV Tax increase; (property) taxes too high; going higher        |
| 62 UNFAV People should save money, uncertain of future   | 61 UNFAV People can't afford to buy now; recession; inflation         |
| 63 UNFAV Buying contributes to inflation/makes bad times | 62 UNFAV People should save money; future uncertain; bad times ahead  |
| 65 UNFAV Energy crisis, shortage of fuels                | 63 UNFAV Buying contributes to inflation/makes for bad times          |
| 71 UNFAV Supply inadequate, few houses on market         | 65 UNFAV Energy crisis; shortages of fuels; high price of utilities   |
| 72 UNFAV Quality is poor, quality may improve            | 71 UNFAV Supply adequate; (no reference to influence on prices/deals) |
| 73 UNFAV Poor designs, unattractive styling              | 73 UNFAV Bad time for older homes; people want newer homes            |
| 81 UNFAV R mentions only seasonal factors                | 81 UNFAV R mentions only seasonal factors                             |
| 82 UNFAV Difficult to get rid of present house           | 84 UNFAV Home is good\better investment                               |
| 83 UNFAV Better return on alternative investments        | 85 UNFAV Rents are too high                                           |
| 84 UNFAV Renting favorable b/c of low rents              | 86 UNFAV Capital depreciation: would lose money if sold now           |
| 85 UNFAV Renting is always better than owning            | 87 UNFAV Other reasons why now is a bad time to sell                  |
| 86 UNFAV Capital depreciation, buying is bad investment  | 88 UNFAV Variable mortgage rate                                       |
| 87 UNFAV Other reasons why now is a bad time to buy      | 89 UNFAV Economic policy; references to government/new president      |
| 88 UNFAV Variable mortgage rate                          |                                                                       |
| 89 UNFAV Economic policy, references to gov't/president  |                                                                       |

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This table lists the categories of responses to the reasons of home buying/selling attitudes in MSC survey. The number before each category is the code. Note the code is not continuous.

**Table A4: Recourse and Nonrecourse States**  
**Judicial and Nonjudicial States**

|             | Recourse             | Nonrecourse |
|-------------|----------------------|-------------|
| Judicial    | Connecticut          |             |
|             | Delaware             |             |
|             | Florida              |             |
|             | Illinois             |             |
|             | Indiana              |             |
|             | Kansas               |             |
|             | Kentucky             |             |
|             | Louisiana            |             |
|             | Maine                | Wisconsin   |
|             | Maryland             |             |
|             | Massachusetts        |             |
|             | New Jersey           |             |
|             | Ohio                 |             |
|             | Pennsylvania         |             |
|             | South Carolina       |             |
|             | Vermont              |             |
| Nonjudicial | Alabama              |             |
|             | Colorado             |             |
|             | District of Columbia |             |
|             | Georgia              |             |
|             | Idaho                | Alaska      |
|             | Michigan             | Arizona     |
|             | Missouri             | California  |
|             | Nevada               | Minnesota   |
|             | New Hampshire        | Oregon      |
|             | Oklahoma             | Washington  |
|             | Rhode Island         |             |
|             | Tennessee            |             |
|             | Utah                 |             |
|             | Virginia             |             |
|             | West Virginia        |             |

This table lists judicial and nonjudicial states included in the sample tested in Section 4.5.8. We categorize the states into four types by foreclosure process and recourse status.

**Table A5: Summary Statistics of Socioeconomic Factors After PSM****Panel A: Socioeconomic Factors**

| Post=0                 |            |            |           |         |
|------------------------|------------|------------|-----------|---------|
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Unemployment rate      | 0.053      | 0.059      | -0.006    | 0.000   |
| Ln(Population)         | 15.532     | 15.712     | -0.180    | 0.000   |
| Ln(Per capita income)  | 10.706     | 10.744     | -0.038    | 0.000   |
| Number of observations | 7,051      | 6,830      |           |         |
| Post=1                 |            |            |           |         |
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Unemployment rate      | 0.046      | 0.051      | -0.005    | 0.000   |
| Ln(Population)         | 15.558     | 15.788     | -0.23     | 0.000   |
| Ln(Per capita income)  | 10.818     | 10.849     | -0.031    | 0.000   |
| Number of observations | 4,186      | 4,055      |           |         |

**Panel B: Housing Characteristics**

| Post=0                 |            |            |           |         |
|------------------------|------------|------------|-----------|---------|
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Property value)     | 11.970     | 12.405     | -0.435    | 0.000   |
| Age of home (year)     | 42.173     | 37.698     | 4.475     | 0.000   |
| Years owned (year)     | 14.555     | 13.095     | 1.46      | 0.000   |
| Bathrooms              | 1.782      | 1.888      | -0.106    | 0.000   |
| Bedrooms               | 3.125      | 3.117      | 0.008     | 0.488   |
| Rooms                  | 6.788      | 6.576      | 0.212     | 0.000   |
| Central air            | 0.746      | 0.609      | 0.137     | 0.000   |
| Swimming pool          | 0.122      | 0.117      | 0.005     | 0.585   |
| Off-street parking     | 0.856      | 0.881      | -0.025    | 0.003   |
| Porch                  | 0.837      | 0.879      | -0.042    | 0.000   |
| Number of observations | 7,051      | 6,830      |           |         |
| Post=1                 |            |            |           |         |
|                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Property value)     | 12.143     | 12.779     | -0.636    | 0.000   |
| Age of home (year)     | 43.936     | 38.215     | 5.721     | 0.000   |
| Years owned (year)     | 14.028     | 13.254     | 0.774     | 0.081   |
| Bathrooms              | 1.870      | 1.990      | -0.12     | 0.000   |
| Bedrooms               | 3.208      | 3.178      | 0.03      | 0.419   |
| Rooms                  | 6.881      | 6.777      | 0.104     | 0.136   |
| Central air            | 0.767      | 0.583      | 0.184     | 0.000   |
| Swimming pool          | 0.127      | 0.118      | 0.009     | 0.441   |
| Off-street parking     | 0.816      | 0.843      | -0.027    | 0.086   |
| Porch                  | 0.853      | 0.879      | -0.026    | 0.024   |
| Number of observations | 4,186      | 4,055      |           |         |

**Panel C: Mortgage Characteristics**

| Post=0                                 |            |            |           |         |
|----------------------------------------|------------|------------|-----------|---------|
|                                        | Recourse=0 | Recourse=1 | Mean Diff | p-value |
| Ln(Total mortgage balance)             | 6.344      | 7.106      | -0.762    | 0.000   |
| Ln(First mortgage balance)             | 6.165      | 6.990      | -0.825    | 0.000   |
| Ln(Home equity loan balance)           | 0.494      | 0.427      | 0.067     | 0.234   |
| Ln(Home equity line of credit balance) | 0.020      | 0.021      | -0.001    | 0.918   |
| Mortgage interest rate (%)             | 0.038      | 0.041      | -0.003    | 0.001   |

|                                        |           |           |           |         |
|----------------------------------------|-----------|-----------|-----------|---------|
| Fixed rate mortgage                    | 0.420     | 0.444     | -0.024    | 0.063   |
| Adjustable rate mortgage               | 0.052     | 0.071     | -0.019    | 0.006   |
| Mortgage insurance                     | 0.043     | 0.042     | 0.001     | 0.921   |
| Length of mortgage in months           | 165.739   | 184.625   | -18.886   | 0.000   |
| Number of observations                 | 7,051     | 6,830     |           |         |
| Post=1                                 |           |           |           |         |
|                                        | Recurse=0 | Recurse=1 | Mean Diff | p-value |
| Ln(Total mortgage balance)             | 6.112     | 6.654     | -0.542    | 0.010   |
| Ln(First mortgage balance)             | 5.937     | 6.532     | -0.595    | 0.005   |
| Ln(Home equity loan balance)           | 0.523     | 0.492     | 0.031     | 0.643   |
| Ln(Home equity line of credit balance) | 0.009     | 0.012     | -0.003    | 0.742   |
| Mortgage interest rate (%)             | 0.036     | 0.036     | 0.000     | 0.913   |
| Fixed rate mortgage                    | 0.423     | 0.441     | -0.018    | 0.334   |
| Adjustable rate mortgage               | 0.047     | 0.068     | -0.021    | 0.006   |
| Mortgage insurance                     | 0.025     | 0.033     | -0.008    | 0.112   |
| Length of mortgage in months           | 156.57    | 172.082   | -15.512   | 0.008   |
| Number of observations                 | 4,186     | 4,055     |           |         |

**Panel D: Household Characteristics**

|                               |           |           |           |         |
|-------------------------------|-----------|-----------|-----------|---------|
| Post=0                        |           |           |           |         |
|                               | Recurse=0 | Recurse=1 | Mean Diff | p-value |
| <i>Income/Wealth</i>          |           |           |           |         |
| Ln(Annual income)             | 10.577    | 10.767    | -0.190    | 0.000   |
| <i>Education</i>              |           |           |           |         |
| Less than high school diploma | 0.086     | 0.080     | 0.006     | 0.359   |
| High school graduate          | 0.257     | 0.179     | 0.078     | 0.000   |
| Some college                  | 0.204     | 0.235     | -0.031    | 0.005   |
| College degree                | 0.106     | 0.130     | -0.024    | 0.008   |
| Graduate degree               | 0.347     | 0.376     | -0.029    | 0.018   |
| <i>Race</i>                   |           |           |           |         |
| White                         | 0.894     | 0.878     | 0.016     | 0.073   |
| Black                         | 0.065     | 0.035     | 0.03      | 0.000   |
| Native American               | 0.003     | 0.009     | -0.006    | 0.040   |
| Asian                         | 0.027     | 0.059     | -0.032    | 0.000   |
| Pacific Islander              | 0.002     | 0.006     | -0.004    | 0.019   |
| Multiracial                   | 0.010     | 0.013     | -0.003    | 0.081   |
| Ln(Vehicle debt)              | 3.433     | 3.337     | 0.096     | 0.410   |
| Ln(Financial assets)          | 1.395     | 1.721     | -0.326    | 0.001   |
| Ln(Unsecured debt)            | 7.304     | 7.301     | 0.003     | 0.952   |
| Age (year)                    | 52.597    | 52.360    | 0.237     | 0.557   |
| Family size                   | 2.654     | 2.774     | -0.12     | 0.003   |
| Number of observations        | 7,051     | 6,830     |           |         |
| Post=1                        |           |           |           |         |
|                               | Recurse=0 | Recurse=1 | Mean Diff | p-value |
| <i>Income/Wealth</i>          |           |           |           |         |
| Ln(Annual income)             | 11.039    | 11.174    | -0.077    | 0.000   |
| <i>Education</i>              |           |           |           |         |
| Less than high school diploma | 0.082     | 0.085     | -0.003    | 0.708   |
| High school graduate          | 0.240     | 0.166     | 0.074     | 0.000   |
| Some college                  | 0.189     | 0.204     | -0.015    | 0.261   |
| College degree                | 0.104     | 0.108     | -0.004    | 0.777   |
| Graduate degree               | 0.388     | 0.437     | -0.049    | 0.008   |

|                        |        |        |        |       |
|------------------------|--------|--------|--------|-------|
| <i>Race</i>            |        |        |        |       |
| White                  | 0.905  | 0.875  | 0.03   | 0.040 |
| Black                  | 0.057  | 0.028  | 0.029  | 0.012 |
| Native American        | 0.002  | 0.017  | -0.015 | 0.002 |
| Asian                  | 0.029  | 0.063  | -0.034 | 0.000 |
| Pacific Islander       | 0.000  | 0.004  | -0.004 | 0.003 |
| Multiracial            | 0.006  | 0.014  | -0.008 | 0.045 |
| Ln(Vehicle debt)       | 3.343  | 3.037  | 0.306  | 0.057 |
| Ln(Financial assets)   | 1.398  | 1.713  | -0.315 | 0.019 |
| Ln(Unsecured debt)     | 7.078  | 7.141  | -0.063 | 0.375 |
| Age (year)             | 52.587 | 52.587 | 0.000  | 0.596 |
| Family size            | 2.783  | 2.786  | -0.003 | 0.971 |
| Number of observations | 4,186  | 4,055  |        |       |

This table displays the socioeconomic factors, housing characteristics, mortgage characteristics, and household characteristics of the sample after PSM. The sample period runs from the first quarter of 2003 to the fourth quarter of 2007.

**Table A6: Heterogeneity in Ex Ante LTV**

|                                                                              | (1)                | (2)               |
|------------------------------------------------------------------------------|--------------------|-------------------|
| Dep. var.: Ln(home improvement and maintenance expenditures)                 | Negative Equity    | LTV               |
| Recourse $\times$ Post                                                       | 0.152<br>(0.72)    | -0.015<br>(-0.06) |
| <b>Recourse <math>\times</math> Post <math>\times</math> Negative Equity</b> | 0.534<br>(1.06)    |                   |
| Post $\times$ Negative Equity                                                | -0.779*<br>(-1.74) |                   |
| Recourse $\times$ Negative Equity                                            | 0.065<br>(0.19)    |                   |
| Negative Equity                                                              | 0.119<br>(0.38)    |                   |
| <b>Recourse <math>\times</math> Post <math>\times</math> LTV</b>             |                    | 0.701<br>(1.23)   |
| Post $\times$ LTV                                                            |                    | -0.820<br>(-1.59) |
| Recourse $\times$ LTV                                                        |                    | -0.178<br>(-0.48) |
| LTV                                                                          |                    | 0.681*<br>(1.85)  |
| Housing-level characteristics                                                | Yes                | Yes               |
| Mortgage-level characteristics                                               | Yes                | Yes               |
| Household-level characteristics                                              | Yes                | Yes               |
| Socioeconomic factors                                                        | Yes                | Yes               |
| Time FE and State FE                                                         | Yes                | Yes               |
| Observations                                                                 | 5860               | 5860              |
| $R^2$                                                                        | 0.072              | 0.073             |
| Mean DV                                                                      | 1.721              | 1.721             |

This table presents the results of regressions estimating the effect of the BAPCPA on home improvement and maintenance expenditures considering heterogeneity in ex ante LTV. Robust standard errors are used in the calculation of the p values. t statistics are reported in parentheses. The mean dependent variable is reported at the bottom to assess marginal effects. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1 percent levels, respectively. Other control variables are omitted from this table. The specific variables measured are listed in Table 3.