Strategic Default, Foreclosure Delay and Post-Default Wealth Accumulation

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Abstract

This paper conducts research on the growth of household wealth after the Great Recession, with a particular focus on mortgage defaults and their motives (strategic and non-strategic). Ambrose, Buttimer and Capone (1997) theorise that mortgage defaulters benefit from two channels: negative equity resolution and free rent. We examine these channels by quantifying post-default changes in household wealth as net worth and housing capital user cost and rent levels, and household's post-default tenure choice. We find that strategic defaulters with severe negative equity (negative equity resolution channel) in states with significant delays in foreclosure processes during the recession (free rent channel) improved their overall balance sheets after default, with less decrease in housing user costs. These insights were not found for non-strategic defaulting households.

Keywords: Mortgage, Default, Strategic Default, Foreclosure, Consumer Finance, Wealth Accumulation

JEL Codes: D12, D14, G21, G51, R20, R31

1. Introduction

The collapse of the US mortgage market during the Great Recession revealed that many mortgage borrowers were exercising default options for strategic motives. They did so despite having the ability to pay their mortgages because their homes were in severe negative equity. In this sense, option theory suggests that strategic default behaviour is a kind of rational behaviour if a rapid recovery of the housing market is not expected. As well as this, there is another incentive to default strategically, which is "free rent" in the midst of the foreclosure process. Once a household decides, whether unwillingly or strategically, to default on its mortgage, the lender initiates foreclosure proceedings and there is no more incentive for the mortgagor to pay the mortgage. However, the foreclosure process did not end quickly and, worse still (although it may have benefited the defaulters), it was very slow, as the number of foreclosures increased rapidly during the recession. These two elements - the resolution of negative equity and free rent – should have been beneficial to the mortgagor, who had to take default into account. The paper aims to identify how these benefits affect the post-default outcomes of households' balance sheets, by differentiating between the motives for default, strategic and non-strategic.

In simplified option theory, negative equity could be a sufficient condition for homeowners to choose to default, but in practice, not everyone with negative equity defaulted (Foster and Van Order, 1984, 1985). However, negative equity had a significant positive impact on mortgage defaults, interacting with illiquidity in households' balance sheets (Elul *et al.*, 2010). Besides, the level of negative equity is a determinant, with households having higher levels of negative equity are more likely to default. In the late 2000s, US house prices fell sharply, most severely in the Sand States - Arizona, California, Florida and Nevada - where house prices fell drastically after a sharp increase just prior to the recession. Ruthless defaults, which are implied by option theory, began to attract media attention, particularly in these areas where the housing market has been severely depressed, suggesting that strategic defaults are widespread in the US (Bhutta, Dokko and Shan, 2017). Following the Great Recession, the housing markets in these four states have recovered more strongly than in other states, with house price indices already exceeding their peaks during the recession, supported by recent nationwide house price growth. As the housing market recovers, household balance sheets should improve post-recession, with or without default, but the extent to which the active resolution of negative equity through

default has contributed to such an improvement not yet clear, particularly the subsequent change in household liquidity following strategic default.

Ambrose, Buttimer and Capone (1997) extended the mortgage-pricing models to incorporate default costs associated with deficiency judgement after the foreclosure and default benefits from elimination of negative equity and free rent, theoretically showing that these are the key factors that determine whether the default option is in-the-money or not. In the conventional mortgage pricing framework based on option theory, a default on a mortgage is regarded as a put option whereby the mortgagor can sell the loan back to the mortgagee, and the defaults on underwater housing are known as ruthless defaults. On the theory of extended, the default probability is likely to be higher with longer expected foreclosure delays, which makes the default put option in-the-money more. Also, the higher the probability of deficiency judgement, the lower the probability of the default because lenders may claim on defaulters' other assets to compensate for the losses on the property by deficiency judgements. Some previous studies have not always succeeded in finding empirical evidence that foreclosure delays encourage households to default (Ghent and Kudlyak, 2011), while others have found that mortgagors who expected foreclosure delays were more likely to default (Zhu and Pace, 2015). However, to the best of our knowledge, no studies have so far examined the growth path of households' wealth that benefited from free rent by default.

Strategic defaults are defaults by households that have negative equity in their homes despite their ability to pay their mortgages. By this nature, strategic defaulters exercise the option with the aim of improving their financial position because they can remove the negative equity in their housing in exchange for home ownership. Mortgage defaults incur several types of costs, including not only the loss of the house, but also relocation costs, loss of credit, immorality and social stigmatisation (Guiso, Sapienza and Zingales, 2013). In addition, defaulting today means surrendering the option to default in the future. As a result, it might be better to wait for house prices to recover, even if they have negative equity (Kau, Keenan and Kim, 1994). Basically, involuntary defaulters, who have lost the ability to pay their mortgages, have very low liquidity and have to take the option of defaulting, even if they would prefer to wait for the housing market to recover. Strategic defaulters, on the other hand, are probably in a better financial position than involuntary defaulters and may have had the ability to wait for the housing market to recover. However, they still choose strategic default in order to avoid repaying their mortgages on the underwater housing, depending on their future discount preference and liquidity situation. In this sense, strategic defaulters appear to have anticipated

that their future financial position would be better off as a result of default rather than continuing to pay their mortgages.

The financial position here includes not only the level of housing consumption, but also the projected overall household net wealth and debt balance. Marcato, Watanabe and Zhu (2022) investigated the role of asset type and portfolio composition in households' strategic default decisions. They found that households with more liquid assets are less likely to make strategic defaults, while households with more illiquid assets are more likely to default strategically through two channels: portfolio rebalancing and the relative cost of default. Their findings suggest that strategic defaulters appear to do so in order to achieve better overall portfolio performance, particularly through the former channel. This existing research has shed light on household assets as an unknown driver of strategic default, but whether this purpose of strategic default has been achieved afterwards has not yet been studied. This paper uses US nationwide household panel datasets, which are on-going surveys, and therefore allows us to track the financial condition of individual household in the post-recession periods.

Using the Panel Study of Income Dynamics Data (PSID), this paper studies post-recession household wealth accumulation, net worth and consumption levels of housing assets, with a focus on default and foreclosure initiation experiences, distinguishing between strategic and non-strategic motives. For the identification of strategic default motives, we applied the approach proposed by Gerardi *et al.* (2018), which drew a sample of mortgage holders from PSID across three waves from 2009 to 2013. We tracked the same households with this existing study across following three waves from 2015 to 2019 for the analysis of post-recession periods. Once the sample was drawn, we detected the year in which a household fell into default and foreclosure began and the ability to repay the mortgage in that year, and identified whether defaults leading to foreclosure were driven by strategic motives or not. In this manner, the impact of the experience of strategic and non-strategic defaults and the subsequent foreclosure process on changes in household net wealth and the levels of housing assets after the recession is analysed.

This paper aims to identify the impact of the default/foreclosure initiation experience on the financial position of households after these events. The study provides important findings on the levels of ownership user costs and rents as a proxy variable for the level of housing consumption, as well as changes in net wealth. In terms of user costs of homeownership, non-strategic defaulters have lowered such costs post-foreclosure than pre-foreclosure. However,

these costs for strategic defaulters did not change between pre- and post-foreclosure process. For household net wealth, strategic defaulters' is more likely to increase post-foreclosure than non-strategic defaulters. With regard to the housing tenure choice, the probability of households being owner-occupiers after default has decreased for both non-strategic and strategic defaulters, but the experience of a minor default with a strategic motive has not affected the future probability of home ownership. When defaults are divided into subgroups based on a combined loan-to-value (CLTV) ratios, strategic defaulters with severe negative equity (i.e., high CLTV ratios) have a greater increase in housing cost-bearing capacity and net wealth after foreclosure. The interaction between the state characteristics 'slow foreclosure process states' and 'delayed foreclosure process states' indicates that strategic defaulters in those states showed a higher rate of increase in net wealth after foreclosure.

The remainder of this paper is structured as follows. Section 2 briefly reviews the relevant literature and develops the hypotheses. Section 3 describes the methodology and data. Section 4 reports the estimation results and discusses the implications, and Section 5 concludes.

2. Literature Review and Hypothesis Development

First, an overview of the foreclosure process is provided[1]. This process varies from state to state and is closely related to households' mortgage default behaviour. The differences include the method of notification from lenders to borrowers, redemption periods and the schedule for auctioning the property. Mortgage lenders usually initiate foreclosure procedures approximately three to six months after the first mortgage payment is failed. Broadly speaking, there are three main types of foreclosure procedures - judicial, power of sale and strict foreclosure - which are chosen by the lender depending on state law and the borrower's and lender's own circumstances. Judicial foreclosure is a legally authorised procedure in any states, and some states have made it mandatory. First, the lender files a lawsuit in accordance with the judicial process and the borrower receives a notice demanding payment. The borrower must

[1] Typical foreclosure process and timeline described here, refer to U.S. Department of Housing and Urban Development website. https://www.hud.gov/topics/avoiding_foreclosure/foreclosureprocess

then pay within 30 days to avoid foreclosure. If payment is not made within a certain period, the property is auctioned, and the mortgagor loses the house. Power of Sale foreclosures are permitted in many states as long as the mortgage contract contains a Power of Sale clause. Non-judicial auctions are often speedy, as after a homeowner falls behind on mortgage payments several times, the lender sends a notice demanding payment, and if payment is not made after a certain period of lender waiting, the lender itself is allowed to conduct an auction. Strict Foreclosure, in which a lender brings an action against a defaulting homeowner and the property returns directly to the mortgagee if the borrower fails to pay the mortgage within a specific timeframe ordered by the court, is only permitted in a small number of states. As this is a foreclosure procedure legislated by state law, it is plausible that methods and timelines vary from state to state.

As Ambrose, Buttimer and Capone (1997) theoretically demonstrates, the benefit of default leading to foreclosure is the dissolution of negative equity and free rent from the start of mortgage delinquency up to the point of being foreclosed and forced to evict, while the cost is the risk of a deficiency judgement. Negative equity has been identified in a number of studies as one of the main drivers of mortgage default and is positioned as one of the double triggers alongside income shocks. (Foote, Gerardi and Willen, 2008; Bhutta, Dokko and Shan, 2010; Gerardi *et al.*, 2018). Another benefit, free rent, would have been more attractive to those in default or likely to be in default, because during the Great Recession, the number of foreclosures increased dramatically and the courts and banks lost control, resulting in a very slow foreclosure process (Chan *et al.*, 2016). Moreover, the increase in the number of foreclosures caused delays in foreclosure, which in turn triggered further defaults (Chatterjee and Eyigungor, 2015). Consistent with the theoretical predictions of Ambrose, Buttimer and Capone (1997), borrowers are more likely to default if they expect the foreclosure process to take longer, and this likelihood is higher for households with higher LTVs (Zhu and Pace, 2015). Ghent and Kudlyak (2011) uses the availability of judicial foreclosure as a proxy variable for foreclosure delay and explain its importance, even though they do not obtain significant results; Chan *et al.* (2016) uses direct estimates of the expected time between default and eviction to analyse the effect of expected foreclosure delay on the probability of default and found a significantly positive effect, consistent with the theoretical model. The latter paper also notes the importance of mortgage defaults for households' balance sheets and analyses the relationship between foreclosure delay and the credit use/default of other unsecured debt such as credit cards. Therefore, it should be worth studying the relationship between default and post-default household wealth change.

The risk of deficiency judgement, also reworded as the risk of recourse, poses a major threat to households considering default on mortgages. A deficiency judgment secures the lender's right to reclaim additional funds from the defaulter if the sale price of the property is less than the outstanding debt, and in “recourse states”, lenders are allowed to seek the judgment. In “non-recourse or anti-deficiency states”, on the other hand, the law makes it almost impossible in practice for mortgage lenders to pursuit deficiency judgments (Corbae and Quintin, 2015). Ghent and Kudlyak (2011) empirically shows that recourse, interacting with house values and negative equity, plays an important role against household default. In non-recourse state, households with negative equity and households with relatively high priced housing are more likely to default. Meanwhile, Bhutta, Dokko and Shan (2017) suggest that the lack of recourse risk by lenders is not necessarily the key driver of default, even ruthless default. In non-recourse states, lenders might have selected and originated loans to more creditworthy borrowers, which might have offset the positive impact on default. Indeed, legislative changes closer to a non-recourse system in Nevada have reduced the equilibrium size of loans as lenders have become more conservative in their lending practices (Li and Oswald, 2017). Nevertheless, due to the nature of the non-recourse legal system, once a house is underwater, it seems more reasonable for households to exercise the default option. This should have a positive impact on household wealth after default with subsequent foreclosure through the channels of negative equity elimination and free rent. However, lenders may have attempted to avoid foreclosure in non-recourse states, as it would be difficult to recover the deficiency loss even if they initiated foreclosure. In such a case, the lender would be forced to accept a borrower-friendly loan modification, but it is not clear whether this would have resulted in an improvement in the lender's post-default balance sheet.

Lenders' responses to default have already been studied in various literature (Ambrose and Capone, 1998; Capozza and Thomson, 2006; Gerardi, Shapiro and Willen, 2007); Chan *et al.*, (2014) identify possible outcomes between the post-default and pre-foreclosure phases. Even if a borrower has fallen behind on their mortgage repayments, they may be able to restore their ability to repay or, in some cases, refinance back to current on the mortgage or qualify for a mortgage modification. If the defaulting borrower is eventually allowed to vacate the property, they may choose to either sell the property publicly (short sale) or return the property to the lender (deed in lieu of transfer) in order to reduce the negative impact on their credit history or for future credit access. Some lenders allow them to continue to remain in the property securing the mortgage for some time without seeking immediate repayment. Once foreclosure processes

are initiated, the lender auctions off the property and ownership is transferred to the new owner. However, the property is not always sold for more than the lender's asking price and a deficiency loss is inevitable. In some cases, the lender may reclaim the property from the auction and hold it as its own property, which is known as a Real Estate Owned (REO) property. In many states, borrowers also have the right to reclaim the property auctioned during the redemption period and regain ownership in exchange for repayment of the outstanding mortgage balance and all costs associated with the auction process. Not many, but sometimes the borrower defaults and the lender does nothing. In order to analyse the impact of the default experience on the future financial position of households, post-default outcomes also need to be considered. Strategic defaulters may have benefited financially from any of the post-default responses by lenders, such as mortgage modifications, deed in lieu transfer or post-foreclosure auctions.

In response to the housing market downturn, the federal and state governments aimed to stabilise the housing market and help seriously delinquent households through policy interventions in mortgage markets, such as household debt reduction and foreclosure prevention. The Home Affordable Modification Programme (HAMP), which became effective in 2009, was a prime representative of the governmental actions and was intended to encourage servicers and borrowers to modify distressed mortgages. However, Agarwal *et al.*, (2017) suggest that the programme only reached fewer severely delinquent households than originally intended due to a lack of incentives for large financial intermediaries to come to the renegotiating table. This shortfall in renegotiation has been attributed to a lack of appropriate infrastructure and well-trained staff at servicers. Information asymmetries between lenders and borrowers also inhibited renegotiations, as lenders were unable to correctly observe the borrower's willingness to repay, resulting in a lack of successful renegotiations and leading to increased foreclosures (Adelino, Gerardi and Willen, 2013). Even if the programme had successfully reached households in default on their mortgages, some of them were willing to strategically utilise it for the benefits of reduced monthly repayments and partial forgiveness of principal (Mayer *et al.*, 2014). In other words, the existence of the programme was causing default itself.

Of course, mortgage modifications benefit lenders through more realistic cash flows for future repayments, but the moral hazard associated with borrower friendly mortgage modification is a kind of cost, which in turn reduces lenders' willingness to modify. Ideally, lenders would like to modify mortgages of potential strategic defaulters and prevent them from doing so, but similarly, information asymmetries make this very difficult (Collins, Harrison and

Seiler, 2015). Furthermore, estimates suggest that more than half of the households saved by the HAMP programme have defaulted again after modification of payment schedules and terms (Haughwout, Okah and Tracy, 2016). Thus, in the post-default but pre-foreclosure phase, strategic defaulters have multiple opportunities to improve their financial position regardless of the lender's response. They may benefit from a strategic modification of their mortgage whilst holding the option to default, and they may subsequently choose to default. Indeed, this redefault option is realistic given that the rates are not low. In addition, the eventual release of the property can still waive the rent up to the point and eliminate the negative equity. In this way, strategic default decisions would positively affect future wealth growth pathways.

Housing quality in the broad sense may follow different growth paths between non-defaulters and (strategic) defaulters, as may household net worth after default. However, some households might have continued to live in the same housing after the Great Recession, while others might have relocated to different housing, with different tenure choices. As it is not straightforward to compare the quality of such housing before and after default, the user cost of home ownership is applied. Homeowners in the United States are entitled to tax credits for related expenditures such as property tax and mortgage interest and are generally not taxed on imputed rent associated with home ownership. Taking into account the variety of costs associated with home ownership, the user cost of owner-occupation is the sum of mortgage interest, taxes, maintenance and depreciation, and a risk premium, which should be equal to rent in equilibrium under simplistic assumptions (Hendershott and Slemrod, 1982; Poterba, Poterba and Poterba, 1992). In this framework, housing quality is proxied by user costs and rents, allowing changes in households' capacity for housing-related expenditure to be tracked over multiple time periods, independent of their tenure choice. Basically, a severe recession should have had a negative impact on the ex-post user costs of home acquisition, forcing defaulting borrowers without strategic motive to lower their costs. On the other hand, strategic defaulters may have been able to maintain similar levels of the costs even after default.

Post-default housing tenure choice should also be influenced by a household's default and foreclosure history. In general, mortgage defaults reduce the creditworthiness of defaulting borrowers, with a history of defaults remaining on their credit report for an average of seven years(Chan *et al.*, 2016). In addition, records of deficiency judgements remain for 10 years, which is the same length as a personal bankruptcy case (Seiler, 2014). If circumstances were equivalent, both non-strategic and strategic defaulters would find it much more difficult to acquire a home after experiencing default and foreclosure equally than non-defaulting

households. However, if strategic default households had a better balance sheet than non-strategic default households, strategic defaulters may be more likely to become owner-occupiers after default, despite such experience. Following the Great Recession, the US housing market grew steadily, and households had significant incentives to hold wealth in the form of housing assets. Households that failed to acquire housing during this period may not have directly reaped the fruits of housing market growth. Even the same mortgage default may have had different effects on post-default tenure choices for strategic and non-strategic motives, possibly making the disparity in wealth accumulation between these households more severe. In this context, it is also worth considering the impact of the default experience on future tenure choices, with a focus on the motives for default. From the review of previous studies, several hypotheses can be derived. First, strategic defaulters should experience greater post-default wealth growth because their negative equity was eliminated, and they were rent free until eviction at foreclosure. In areas such as sand states, where house prices once fell drastically and many mortgage holders had negative equity, the wealth accumulation of strategic defaulters is likely to be greater than for others. This is because the value of negative equity resolution is greater. In addition, strategic defaulters are also expected to benefit more than others because the longer it takes to foreclose, the longer the period of free rent should contribute to future wealth accumulation.

3. Methodology & Data

3.1. Identification of Default Motive: Strategic vs Non-Strategic

A large body of research on strategic default detects the motive for default in different manners. An intuitive definition of strategic default is the deliberate default by households that have negative equity on their housing and the ability to repay (Guiso, Sapienza and Zingales, 2013). In empirical studies, researchers are required to quantify these equity positions and payment capabilities of the households. Ghent and Kudlyak (2011) focus on recourse statutes in states where mortgages exist and argue for the prevalence of strategic defaults due to the high volume of defaults in non-recourse states. Goodstein *et al.* (2017) define strategic default by both serious negative equity and high credit scores, focusing on LTV at default and the FICO score of the mortgagor at origination, which implies the borrower's ability to repay, in order to determine whether the motivation for default is involuntary or strategic. Gerardi *et al.* (2018)

used The Panel Study of Income Dynamics (PSID) dataset, a biennial survey, to directly assess mortgage repayment capacity by comparing income and consumption expenditure deducted by mortgage repayments over the previous year of the survey. If the residual income is equal to or above the previous consumption level, the household 'Can Pay' the mortgage while maintaining a regular consumption level, which can be one of the necessary conditions for a strategic default. Another condition for strategic default is the negative equity on secured housing, which can be calculated as the difference between the current house price and the combined balance of the first, second (and subsequent) mortgages. This combined LTV (CLTV) of 100 percentage points or more, i.e., negative equity, is another requirement for strategic default. Defaults by households that meet these two conditions may reasonably be considered strategic defaults. This identification method was originally proposed by Gerardi *et al.* (2018) and later extended by Marcato, Watanabe and Zhu, (2022) and was adopted in this study.

3.2. Household Net Wealth and User Cost of Housing Capital

For the analysis of changes in household net worth post-default, as with Gerardi *et al.* (2018), we deployed PSID dataset, which provides details on the amount of different types of assets and debts held by households. We tracked changes in several types of household wealth. First, home equity is the current house price reported by the survey respondents themselves, minus the total balance of the mortgage(s). Total net wealth consists of two types with home equity and without home equity. The individual type of net wealth recorded in the PSID is cash, checking and savings accounts; stocks; other real estate (other than main residential property); vehicles; other assets; and pensions/IRAs. Survey participants responded with the net worth of their personal assets, assuming a sale value. The user cost of housing capital can be calculated in two ways. The simplest method is to multiply the current housing value by the mortgage interest rate. A drawback of this method is that for households that have already paid off their mortgage, the user cost cannot be defined from the housing value, as the mortgage interest rate is not recorded in PSID. Therefore, the average of 30-year fixed-rate mortgage in the US for the corresponding year is used as a proxy for the calculation of user costs with respect to the fully-paid-off housing loans. Besides, property taxes, insurance premiums and house repairs were added to the simplest user cost and, eventually, this user cost was selected for the estimation. As rent expenditure was also included in the dataset, changes in these figures were

properly compared on an annual basis. Household tenure choice is also detectable, as survey respondents were asked whether they owned or rented their homes.

3.3. Experience of Mortgage Default and Foreclosure Start

The PSID has covered information on mortgage characteristics such as monthly loan payments, interest rates and origination year since the survey began in 1968, but since 2009 it has also included mortgage performance (mortgage distress) information. As shown in Table 1, the PSID questions are multi-item and can be divided into two main categories: questions about the current main residence, looking at the past, present and future (questions from A-1 to A-6), and retrospective questions about properties the household had ever owned in the past, not limited to the main residence (questions from B-1 to B-7). As the interest of this paper is in the impact of strategic default behaviour on net worth following the default on the primary residence, we define the default experience by the Group A questions in Table 1. Whatever the motive, default is often captured by a 60- or 90-day delinquent mortgage, i.e. the mortgagor has missed two or three payments on the mortgage (Gerardi *et al.*, 2018; Marcato, Watanabe and Zhu, 2022). Although this method can be applicable using question A-2, as mortgage delinquencies cannot be traced back to before 2009, it is impossible to identify default experience prior to that date. Therefore, although there is a risk of underestimating the experience of default, the object of this study is to analyse how the experience of default during the Great Recession affects the economic situation of households in the post-recession period, and it makes sense to follow previous literatures and use one of the definitions of default according to mortgage delinquency status.

<< **Error! Reference source not found.**Table 1 about here >>

Question A-3, on the other hand, asks about the current foreclosure status, but also refers to past experience, which may be preferable to detect experiences of strategic default. Of course, the number of defaults may be underestimated, depending on the definition of default, as foreclosures are essentially initiated after default (i.e., several missed mortgage payments). The main benefits of (strategic) default discussed in this paper are the elimination of negative equity and rent free until the end of foreclosure, and these benefits become more substantial with the initiation of foreclosure. Therefore, it is also reasonable to define strategic default by focusing on those mortgages that are seriously delinquent. In order to identify the motive for default, the

information on the year the foreclosure started in question A-4 is crucial in assessing the household's ability to repay the mortgage (i.e., 'Can Pay' status) in that year. This is because, for example, some households participating in the 2009 survey indicated that the foreclosure start year was 2007; as the PSID is a biennial survey, in such cases the mortgage affordability of the previous survey, rather than the current survey year, was used to identify motives and adjusted for lag[2]. Negative equity was adjusted in the same way for the year in which foreclosure began, and the level of equity in that year was used to determine the motivation for default. When defining default in the context of current mortgage delinquency status, the year of default was simply the year in which the survey was conducted, for the purpose of identifying the motivation for default. As a result, those three factors - mortgage delinquency/foreclosure initiation, 'Can Pay' status and negative equity - can determine whether a household defaults strategically or not, which can be expressed numerically as follows.

$$SD(Strategic\ Default)_i: (DF_i = 1)\ and\ (CP_i = 1)\ and\ (NE_i = 1)$$

$$NSD(NonStrategic\ Default)_i: (DF_i = 1)\ and\ \big((CP_i \neq 1)\ or\ (NE_i \neq 1)\big)$$

$$ND(NonDefault)_i: DF_i \neq 1$$

where DF_i is a dummy variable, which is 1 if household i experienced 60-days mortgage delinquency (twice missed payments) or foreclosure start and 0 otherwise. These two definitions of default cover the early and late stages of mortgage default, making it possible to compare their effects. CP_i is also a dummy variable and is 1 if the mortgage repayment ability was categorized as 'Can Pay', 0 otherwise. NE_idistinguishes household i with a negative equity in the year of foreclosure commencement and is 1 if so and 0 otherwise. These interactions (SD_i, NSD_i) are used in the estimation model described below as dummies that distinguish the experiences and motivation of initiating foreclosure triggered by default.

[2] Similarly, some households answered the foreclosure start year as the year prior to the survey, but in this case no year adjustment is made for the assessment of mortgage affordability, as the assessment of their ability to pay is based on their residual income and consumption levels in the year preceding the survey.

3.4. Model

The idea of the model for analysing the impact of default experience on future household wealth growth paths is founded on a comparison of household wealth in recession and post-recession periods. There, a factor of default experience characterised by the experience of foreclosure initiation is introduced to assess its impact. First, to assess household wealth change, the sample period was organised into two windows: in recessionary and post-recessionary periods. For the recession window, we focused on the PSID dataset in three waves in 2009, 2011 and 2013. For the post-recession window, household wealth is assessed over three waves in 2015, 2017 and 2019. Strategic and non-strategic default experiences are defined on the basis of survey records during the recession window[3]. Accordingly, the change in wealth and other financial position of households experiencing default and foreclosure start is calculated as the difference between the value in any year in the post-recession window and the value in the year of foreclosure in the recession window. For households that have not experienced the start of foreclosure, changes in wealth are assessed by the difference between the average value (mean) during the recession window and the value for any given period in the post-recession window[4]. Hence, a baseline model of our hypotheses is presented below and estimated by the weighted least squares method on an unbalanced panel setting:

$$\Delta W_{i,t} = \alpha + \beta_1 \cdot NSD_{i,2009-2013} + \beta_2 \cdot SD_{i,2009-2013} + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (1)$$

$$t = \{2015,\ 2017,\ 2019\}$$

where $\Delta W_{i,t}$ shows the change of net worth (total household net wealth) and of user cost of housing capital and rent in period t within the post-recession window from 2015 to 2019. The change in total household net wealth is calculated by relative (proportional) difference [5] and the housing user cost and rent is calculated by log first difference as well as by actual difference,

[3] In the PSID sample, some households started to be in foreclosure process in the post-recession window, but less than a third of the number sample did so during the recession. The proportion of households experiencing foreclosure start to the total sample was 0.45% during the recession and 0.14% after the recession.

[4] Even when the median of the recession window was applied instead of the mean, there was no significant change in the distribution of changes in household net worth.

[5] As total the net wealth variables can sometimes be negative, changes were calculated using relative differences rather than the log first difference to suppress the generation of missing values.

in order to mitigate problems such as the possibility that strategic defaulters have larger household wealth by nature and right-skewed distributions in the latter variable. The other dependant variable is homeownership status, $tenure_{i,t}$, which is equal to 1 if a household is an owner-occupier. This variable is not a change, it only indicates post-default housing tenure choice. $SD_{i,2009-2013}, NSD_{i,2009-2013}$ are dummy variables, indicating the experience of strategic and non-strategic defaults during the recession, respectively, which are time invariant variables. The coefficients of the variables of interest are therefore β_1 and β_2. These quantify the effect of non-strategic and strategic default experiences on post-recession wealth changes, respectively. As strategic defaulters are assumed to default in order to improve their financial situation, β_2 is expected to be significantly positive. $X_{n\,i,t}$ captures both time variant and invariant control variables, including total income and liquid asset to income ratio, and other household demographic, socioeconomic and geographic characteristics referring related literatures (Han and Li, 2011; Gerardi *et al.*, 2018; Herkenhoff and Ohanian, 2019). A full list of all controls is provided in the Appendix.

In the next step, sub-definitions of default/foreclosure experience and interaction terms are introduced to detect the impact of default on future wealth accumulation, in particular the channels of negative equity dissolution and free rent up to the point of foreclosure end. The channel of negative equity elimination can be assessed in direct and indirect methods. The direct method applies several types of equity levels for the identification of strategic default: positive but low $(CLTV < 0.8: PosEq)$; positive but low $(0.8 \leq CLTV < 1: LowEq)$; negative $(1 \leq CLTV < 1.2: NegEq)$; and seriously negative $(1.2 \leq CLTV: HighNegEq)$, resulting in the three types of default indicators. The inclusion of several combined LTV ratio thresholds in the identification of strategic default assumes that households would also default strategically even if they had positive equity in their homes. As Bhutta, Dokko and Shan (2017) show, households are more likely to exercise the default option even with a strategic motive if they are unable to pay their mortgage and have low or negative equity as double triggers. In the indirect method, mortgages in the Sand States (Arizona, California, Florida and Nevad), where house prices fell significantly and households were more likely to suffer from serious negative equity, were differentiated by the interaction of default indicators and a dummy variable, $Sand_i$. The models for the test of the negative equity channel are as follows:

$$\Delta W_{i,t} = \alpha + \beta_1 \cdot PosEqNSD_{i,2009-2013} + \beta_2 \cdot LowEqNSD_{i,2009-2013} + \beta_3 \cdot NegEqNSD_{i,2009-2013} + \beta_4 \cdot HighNegEqNSD_{i,2009-2013} + \beta_5 \cdot LowEqSD_{i,2009-2013} + \beta_6 \cdot NegEqSD_{i,2009-2013} + \beta_7 \cdot HighNegEqSD_{i,2009-2013} + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (2)$$

$$\Delta W_{i,t} = \alpha + \beta_1 \cdot NSD_{i,2009-2013} + \beta_2 \cdot NSD_{i,2009-2013} \cdot Sand_i + \beta_3 \cdot SD_{i,2009-2013} + \beta_4 \cdot SD_{i,2009-2013} \cdot Sand_i + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (3)$$

Since the benefits of resolving negative equity are greater for households with more serious negative equity, $0 < \beta_5 < \beta_6 < \beta_7$ in Model 2 is expected to be statistically significant and β_4 in Model 3 is expected to be significantly positive.

In order to examine another channel, free-rent, we need information on typical duration of foreclosure process by state. Ghent and Kudlyak (2011) shows an optimal foreclosure timeline by state, which is the time required to close an uncontested foreclosure in the state a property is located. However, this information is pre-recession and is inappropriate for this analysis as the foreclosure timeline has slowed down so much during the recession. The literature discusses the impact of delays in the foreclosure process on the probability of default, by state-specific foreclosure legal requirements, judicial and non-judicial foreclosure system. This could be one of proxies for states with delayed foreclosure. As more directly assessed foreclosure slow states, Herkenhoff and Ohanian (2019) classified Top-10 foreclosure slow states from 2009 to 2011 by ranking the foreclosure liquidation hazard with LPS data[6]. This literature also build on a group of states with a significant increase in time to foreclosure (i.e. significant foreclosure delays) compared to pre-recession levels.[7] As the benefit of free rent should depend more on the actual time taken to complete foreclosure than on the increase in time, the Top-10 foreclosure slow state dummy, $Slow_i$, were mainly employed as the identifier of the foreclosure delay effect, with an additional supportive indicator for states with significant delays in foreclosure process, $Delay_i$,. The model for testing the free-rent channel is as follows:

[6] Specifically, New Jersey, Delaware, New York, Hawaii, Connecticut, Florida, Maine, Massachusetts, West Virginia and Louisiana are the 10 slowest states of foreclosure timeline.

[7] States where these foreclosures was substantially delayed include California, Florida, Illinois, Indiana, Maryland, Massachusetts, New Jersey, New York, Oklahoma, Pennsylvania and Wisconsin.

$$\Delta W_{i,t} = \alpha + \beta_1 \cdot NSD_{i,2009-2013} + \beta_2 \cdot NSD_{i,2009-2013} \cdot Slow_i + \beta_3 \cdot SD_{i,2009-2013} + \beta_4 \cdot SD_{i,2009-2013} \cdot Slow_i + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (4)$$

$$\Delta W_{i,t} = \alpha + \beta_1 \cdot NSD_{i,2009-2013} + \beta_2 \cdot NSD_{i,2009-2013} \cdot Delay_i + \beta_3 \cdot SD_{i,2009-2013} + \beta_4 \cdot SD_{i,2009-2013} \cdot Delay_i + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (5)$$

As free rent is expected to contribute to an increase in the future wealth of strategic defaulters, β_4 is expected to be significantly positive in both Model 4 and 5.

Although the direction of impact is not clear, state-specific mortgage recourse system may be worth analysing as supplemental test. With less recourse risk, households are more likely to default strategically, and their post-default balance sheets may improve. However, alongside this, due to the highly difficult nature of recourse, lenders may quickly give up on foreclosure and accept a borrower-friendly mortgage modification, which may not necessarily be positive for household balance sheet. The model for testing recourse risk introduces a non-recourse state dummy[8], NR_i, and is formulated as follows:

$$\Delta W_{i,t} = \alpha + \beta_1 \cdot NSD_{i,2009-2013} + \beta_2 \cdot NSD_{i,2009-2013} \cdot NR_i + \beta_3 \cdot SD_{i,2009-2013} + \beta_4 \cdot SD_{i,2009-2013} \cdot NR_i + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (6)$$

The coefficient of interest here is β_4, but its direction is not exactly clear. If it were negative, it is possible that strategic defaulters would have modified their mortgages and the effect on wealth would not have been as large.

Lastly, as default has so far been defined as a severely delinquent mortgage where households experience the foreclosure start and the outcome of the foreclosure process is not controlled for, the impact of mortgage holders' action post-foreclosure start is analysed. The benefits of strategic default on future financial position are the elimination of negative equity and free rent, which should be realised after eviction following the end of foreclosure. However, the PSID dataset does not contain information to detect the consequences of foreclosure process.

[8] Non-recourse state dummy was created following Ghent and Kudlyak's (2011) classification of recourse/non-recourse states, with 1 if located in a non-recourse state.

To address this shortcoming, we applied information on relocation and mortgage modification history after the start of foreclosure[9, 10]. For this purpose, we assume that households that have moved at least once since the start of foreclosure have moved out after being evicted. These time-variant two factors, relocation $(RL_{i,t})$ and modification $(MD_{i,t})$, interact with indicators of default experience as follows:

$$\begin{aligned}\Delta W_{i,t} = \alpha + \beta_1 \cdot NSD_{i,2009-2013} + \beta_2 \cdot NSD_{i,2009-2013} \cdot RL_i + \beta_3 \cdot NSD_{i,2009-2013} \cdot MD_i \\ + \beta_4 \cdot SD_{i,2009-2013} + \beta_5 \cdot SD_{i,2009-2013} \cdot RL_i + \beta_6 \cdot SD_{i,2009-2013} \cdot MD_i \\ + \sum \gamma_n \cdot X_{n\,i,t} + u_{i,t} \quad (7)\end{aligned}$$

Since the benefits of default should be secured by eviction as a result of foreclosure, β_5 is expected to be at least significantly positive, and the same may be true for non-strategic default, which means that β_2 may also be positive. The effect of the modification history is not clear, as modifications should have been made to rescue households with severe mortgage delinquencies, and at the same time the modifications may have deprived them of the profit-making opportunities after the foreclosure close.

In addition to these regression models, treatment effect analysis was also conducted. Treatment and control groups were created based on whether the household experienced mortgage default, taking into account the motive for default. Specifically, non-strategic defaulting and strategic defaulting households were designated as treatment groups, while non-defaulting households were designated as control groups, for a total of three groups. Referring to O'Malley (2021), two-step matching method was applied to ensure the similarity among the groups. First, treatment propensity scores were estimated using probit regression methods incorporating observable factors related to household financial positions, and observations without nearest neighbour matches were removed in the second step. As well as propensity score matching algorithm, nearest-neighbour matching and regression adjustment algorithm were applied. These samples were matched to obtain difference-in-differences variation in wealth

[9] Of the 260 defaulting households for which foreclosure has been initiated, 67.7% of non-strategic defaulters have relocated since foreclosure began and 92.3% have modified their mortgages. In contrast, 80.0% of strategic defaulters have relocated after foreclosure was initiated and 88.0% have modified their mortgages.

[10] For non-strategic defaulters, relocation and modification history is defined as these experience in both in-recession and post-recession periods (2009-2019). Alternatively, these experiences could be defined as post-recession period (2015-2019) only, but the estimation results were consistent with each other.

accumulation and financial position after default. The effectiveness of the default experience is measured as average treatment effect on the treated (ATET) focused on one of the types of defaulting households, strategic or non-strategic. This value indicates the effect of the default experience on the defaulted household group. In other words, the estimates show differences between groups of households in the same group that have defaulted, as if they were assumed to be in one group that has experienced default and another group that has not. Using this method, the impact of default experience on household wealth and financial position after default was tested.

3.5. Sample Construction

The sample for the analysis is drawn from the PSID dataset, specifically the subsequent status of the panel sample drawn by (Gerardi *et al.*, 2018). The original sample in this literature covered panels from three waves in 2009, 2011 and 2013. The sample households are restricted to mortgage borrowers who participate in the labour market and are aged between 24 and 65. In contrast, our sample follows the same households in the subsequent three waves in 2015, 2017 and 2019 resulting in 8,482 observations. As described above, the experience of default and foreclosure start is measured on the basis of survey data on the first three waves. Changes in household wealth are measured as the difference between the average value in the first three waves for non-defaulting households and the value in the adjusted foreclosure wave for defaulting households and the value in any of the three subsequent waves.

Table 2 compares the mean of change in household wealth variables between in-recession and post-recession by sub-group. When default is defined as 60 days mortgage delinquency, 486 households (5.7%) of the total sample of 8,482 households experienced non-strategic default and 104 households (1.2%) strategic default, together representing 6.9% of the share of households experiencing default. On the other hand, when captured by foreclosure starts, 235 households (2.8%) experienced non-strategic default and 25 households (0.3%) experienced strategic default followed by foreclosure starts, for a total share of 3.1 percentage points. As for changes in household financial situation, first, the rate of change in total family net worth in the post-recession period for the group of households that had never defaulted was more than twice that of households that had experienced non-strategic default, which was statistically significant in the case of 60-day mortgage delinquency. In the case of foreclosure initiation, on the other hand, the growth rate of assets of households that had never defaulted exceeded that of households that had experienced non-strategic default, but this was not statistically significant.

Whatever the definition of default, strategic defaulting households had the largest post-default growth in total net worth of all groups, but t-tests against non-defaulting households showed no statistically significant difference.

The level of the housing user cost and rent decreased substantially after the initial stage of default (60-day mortgage delinquency) without strategic motives. No such negative effect on the user cost levels was detected for defaulting households with strategic motives. In other words, early-stage strategic defaulters may have succeeded in maintaining their housing consumption levels after default. This is also the case for households in late-stage default (foreclosure start). Although not statistically significant in either definition, the average user costs of strategic defaulters were larger than those of non-defaulting households, indicating that the user costs of strategic defaulters may have rather increased after default. The variable of home ownership is not a change, but a variable of post-recession status. Essentially, regardless of the stage of default, the experience of default significantly reduces the probability of the household being owner-occupiers after the recession. However, only strategic defaulters in the early stages of default are not significantly affected by their default history. This may imply that strategic defaulters were able to quickly recover their financial situation, including their credit score, and acquire owner-occupied homes even after default, or they may have been able to continue living in properties that were underwater during the recession. There are, of course, several ways to continue living on the same property after default, such as through federal government-supported mortgage modification.

Table 2 shows changes in household wealth and other housing conditions in absolute differences, proportional differences and log first differences. The value of absolute differences indicates that households that have not experienced default during the Great Recession have a higher rate of post-default growth than households that have experienced default. This is unsurprising, but by nature of the heterogeneity among household subgroups prior to the Great Recession, the wealth of households that did not experience default or foreclosure may have been much greater than the wealth of households that did default. If so, this fundamental issue associated with the heterogenous original wealth size could result in an underestimation of the impact of the default experience leading to foreclosure on future wealth growth. To address this issue, in the model estimation, relative (proportional) changes in wealth variables or log first differences were applied to define changes in wealth.

<< **Error! Reference source not found.**Table 2 about here >>

4. Empirical Analysis

The baseline model equation (1) assesses the impact of the default experience during the recession on future household wealth growth, without taking the channel into account. In Table 3, it can be seen that in Model 1 and 2, the total net worth of households that defaulted (initial default and foreclosure start) for strategic motives improved significantly by 18.0 and 6.1 percentage points respectively after the recession. Model 3 and Model 4 show that the user cost of housing capital and rent level for non-strategic defaulters worsen by 0.25-0.4 percentage points, depending on the stage of default. Models 5 and 6 analysed the impact of default experience on households' post-default housing tenure choices and showed that, with the exception of households that experienced an initial stage of strategic default, households that defaulted were less likely to subsequently be owner-occupiers. This is consistent with the summary statistics in Table 2. As they are estimated in a probit model, The estimated coefficients against homeownership are discussed here on an average marginal effect basis.[11] The marginal effect of an early-stage non-strategic default is an 8.5% reduction in the probability of being owner-occupiers. The results also show that late-stage default reduces the probability of being a homeowner by about 15%, irrespective of the motivation for default. The balance sheets of strategic defaulters have improved overall, there is no declining trend in the housing capital user cost, and these defaulting households that stayed in early stage did not necessarily lose their owner-occupier status afterwards, suggesting that strategic defaulters were more successful in avoiding wealth loss than non-strategic defaulters. Non-strategic defaulting households, on the other hand, had low levels of housing expenditure even during the post-recession housing market expansion, suggesting that they may have continued to experience economic distress after the recession.

<< Table 3 about here >>

The equation (2) and (3) examine the channels of negative equity resolution for the growth of defaulting households after a recession. Sub-categorising defaults by setting several thresholds for the combined LTV ratio allows a direct assessment of the heterogeneous impact of default experience through the negative equity resolution channel, and the estimated results are presented in Table 4. In Models 7 and 8, strategic defaulters with severe negative equity

[11] Average marginal effect values are presented in the Appendix.

with CLTV ratios at or over 120% significantly increased their total net worth after default. Early-stage strategic defaulters with large negative equity had an increase of around 35%, and also late-stage strategic defaulters had an increase of around 8%. Late-stage non-strategic defaulters did not benefit from a significant increase in total net worth, while early-stage non-strategic defaulters showed an increase in total net worth of around 3.6%. In Models 9 and 10, only early-stage strategic defaulters with high negative equity increased their housing expenditure capacity by 33%, while other defaulting households did not increase or decrease their level of housing user costs regardless of their motives. With regard to post-default housing tenure choice in model 11 and 12, the results basically show that both non-strategic and strategic default experiences reduce the probability of being a homeowner by around 10-20 percentage points on an average marginal effect basis, while early strategic defaulters with negative equity are not strongly affected by the default experience.

Namely, the results in Table 4 show that the more severe the degree of negative equity to be eliminated, the greater the subsequent improvement in financial position due to default, suggesting that the benefits of eliminating negative equity were very large for households. It is also important to note that this effect was more pronounced for strategic defaulting households. In the Appendix, instead of several defaults diffentiated by CLTV threshold, the Sand States dummy is employed. The negative equity reduction channel is measured indirectly, as these states experienced a sharp rise in house prices followed by a significant fall in prices during the recession. As with the LTV threshold differences, strategic defaulters in the Sand States show greater financial improvement after their default. These direct and indirect analysis results suggest that households benefited from strategic defaults through the resolution of negative equity, while households benefited less from non-strategic defaults, even though the defaults were the same.

<< Table 4 about here >>

Another channel, which is free rent from the beginning of default to the end of foreclosure, is tested incorporating the length of the foreclosure timeline as shown in equations (4) and (5). The model in Table 5 uses interactions between the default experience indicators and the Top-10 slow foreclosure states as defined by Herkenhoff and Ohanian (2019), so the interaction terms shows additional effect of the default experience on wealth growth, which is specific to households located in those slow states. As hypothesised, early and late strategic defaulters in foreclosure slow states were found to have significantly increased their net worth by 7.6%

(=23.93-16.37) and 9.6% (=0.496+9.140) respectively in Model 13 and 14.[12] No similar results were found for strategic defaulters outside the slow states and non-strategic defaulters. In Model 15 and 16, for non-strategic defaulting households, there has been a dramatic decline in housing user cost levels regardless of the speed of foreclosure process. For strategic defaulters, the initial default had no effect on post-default housing user cost levels, while the start of foreclosure process had a negative impact only on households outside the foreclosure slow states. In other words, strategic defaulters experiencing foreclosure start benefited from the slow foreclosure process, which did not reduce user cost levels even in post-default periods. With the exception of early-stage strategic defaulters, Models 17 and 18 also found that post-default households had lower owner-occupation rates, while defaulters in foreclosure slow states did not necessarily change to rental housing.

Another indicator of the free rent channel is foreclosure delay states dummy variable created by Herkenhoff and Ohanian (2019) and Table 6 displays the estimation results of equation (5). Similar to the results for foreclosure slow states, strategic defaulters showed a large increase in total net worth in foreclosure delay states (5.6% ~ 7.9%), while strategic defaulters outside these states and non-strategic defaulters overall showed no such trend in Model 19 and 20. The user cost and rent level decreased significantly for non-strategic defaulters, while this negative effect was not observed for strategic defaulters. Rather, housing user cost levels improved for early-stage strategic defaulters (Model 21 and 22). Post-default home ownership patterns were similar to those in foreclosure slow states. Non-strategic defaulters were less likely to be homeowners, while strategic defaulters did not show such a trend. In foreclosure delay states, the choice of ownership type of strategic defaulters was unrelated to their default history, whether early or late in the default and foreclosure process in Model 23 and 24. Overall, Strategic defaulters are therefore privileged to benefit from the experience of default through this longer free rent period, and this was found to be a statistically significant effect. In the Appendix, estimates were made by applying the judicial foreclosure state characteristics instead of the slowed foreclosure timeline state, but the results were not entirely consistent with the foreclosure slow state results. This may be because the judicial foreclosure characteristics may capture other background factors that are different from the foreclosure delays.

[12] Estimated values show the sum of the coefficients of the default variable and the interaction with the foreclosure slow state dummy. Significance is tested with standard errors approximated by the delta method.

<< Table 5 about here >>

<< Table 6 about here >>

The models in Table 7 distinguishes the effect of default experiences by state mortgage recourse system. In Model 25, the first non-strategic default history in the recourse state reduced total net wealth after default by 2.6%, while no such negative effect was observed in the non-recourse state, consistent with the theoretically indicated cost of recourse risk. However, when focusing on strategic default, the results were quite the opposite. While a history of early strategic defaults in the recourse state increased net worth by 25%, this positive effect was completely cancelled in the non-recourse state. In Model 26, late-stage strategic default in the recourse state had an 8% positive impact on post-default net wealth. A similar trend was observed for housing user cost and home ownership probability in Models 27 to 30. Broadly, housing user cost and the probability of homeownership for non-strategic defaulters decreased in both recourse and non-recourse states, but for strategic defaulters, these negative effects were only detected for households with the experience of foreclosure start in non-recourse states. In non-recourse states, if a household defaulted and house prices fell below the outstanding mortgage balance, it was practically impossible for lenders to claim the households' other assets. In this sense, lenders will have been sensitive to the default history of potential borrowers and will have been able to avoid the risk of default. Thus, due to these supply-side effects, it is not surprising that households with a history of default in non-recourse states would have lower housing user costs and lower homeownership rates after the default. This negative effect may partly affect households' overall net worth.

<< Table 7 about here >>

Table 8 shows models of the impact of the default experience with respect to post-default behaviour of the mortgagors: relocation and mortgage modification. In Model 31, none of the early stage defaulting households had their net worth affected by their post-default behaviour, although the subsequent loan modification itself had a positive impact on the total net worth. By contrast, in Model 32, for late defaulting households, non-strategic defaulting households showed a positive net worth growth of around 2.5% (=2.199+2.421-2.134) due to loan modification, while strategic defaulting households showed a strongly significant and positive net worth growth of around 20% (=0.328+23.08-3.315) due to relocation. Non-strategic defaulters, who did not choose to default willingly, may have been able to maintain their

financial position by loan modification. In contrast, since the strategic defaulter intentionally defaulted, the benefits of relocating would naturally be greater than those of modifying. In Model 33 and 34, housing user cost and rent had a similar trend, showing that non-strategic defaulters had reduction of the housing consumption standards by modification, but strategic defaulters had no significant effect on the user cost level. In common, a loan modification allows the borrowers to continue to make repayments by reducing the monthly repayments in exchange for an extension of the mortgage term, which ensures that the user cost is reduced as long as the borrowers remain on the same mortgage without the change in interest rate. On the other hand, relocation should require credit in acquiring or renting the next housing, but only strategic default households succeeded in increasing the level of housing consumption level through relocation, despite the fact that they should have had a disadvantage in their credit history due to the default. Next, as Models 35 and 36 show, households that experienced default, regardless of their motivation and stage, are equally less likely to be owner-occupiers after the relocation. In contrast, strategic defaulting households, perhaps supported by their ability to pay mortgage, also significantly improved their probability of being owner-occupiers afterwards through loan modification. Indeed, in our data, many of the defaulting sample took post-default measures such as loan modification, relocation or both. This resulted in differences in their subsequent financial status compared to those who did not.

<< Table 8 about here >>

Table 9 shows the average treatment effects of default history on the treated groups, which are strategic and non-strategic defaulting household's groups. Overall, only households in early-stage strategic default benefitted from the decision to default. The propensity score and nearest-neighbour matching and regression adjustment algorithm showed significant increase in net worth after default in Model 39, 43 and 47. For example, in model 39, this type of household had a 18% improvement in total net wealth after default compared to if they had not defaulted. The level of housing user costs varied depending on the default motivation, phase and analysis algorithm. Strategic defaulters who experienced initial stage of default received insignificant effect on housing user cost level in Model 39, 43 and 47. This type of household did not necessarily reduce their consumption levels of housing services even after defaulting on their mortgages strategically. The treatment effect of homeownership is significant in almost all models, indicating that a history of default had a negative impact on the probability of becoming a homeowner after default, regardless of motivation and phase. The results of the

treatment effect analysis are found to be partially consistent with the results of the regression analysis.

<< Table 9 about here >>

5. Conclusion

This paper discusses the post-recession change in household wealth in relation to mortgage default experiences and their motives. During the Great Recession, mortgage delinquency rates rose sharply, and the number of foreclosures reached historically high levels. This downturn in the housing market was accompanied by widespread ruthless default behaviour, leading to further turmoil in the housing market. This is an unprecedented type of default option exercised by households that were able to pay their mortgages but seek to avoid future repayments for the underwater housing. Such defaults can be explained by option theory and, if the objective is achieved, such strategic default behaviour may improve future wealth conditions. Ambrose, Buttimer and Capone (1997) theorise that the resolution of negative equity and the free rent period between the start of default and the end of foreclosure benefit the defaulter. Through both channels, households would have benefited from default behaviour and their wealth would have increased more.

We employed an identification method for strategic defaulters according to Gerardi *et al.* (2018), distinguishing the motives for mortgage default and analysing the impact of the default experience on future wealth growth, quantified as total household net worth, housing capital user costs and rent levels and post-default housing tenure choice. The results show that the post-default wealth of strategic defaulters significantly increases through the two channels, particularly when this type of defaulter is in slow foreclosure, has severe negative equity. These results indicate the effect of the channels of negative equity resolution and free rent are significantly observed. The lower housing user cost levels observed in non-strategic defaulting households were not found in the strategic defaulting households. Moreover, not only that, but the housing consumption standards improved in groups with severe negative equity and/or in states where foreclosures took longer to be processed. There has also been an overall decrease in the probability of defaulting households becoming homeowners in post-default periods, with the exception of early-stage strategic defaulters and defaulters in slow foreclosure states. The

results in this paper suggest that non-strategic defaulters did not always improve their financial position after default, while strategic defaulters were successful in improving their financial position after default through the channels of negative equity resolution and free rent.

The findings in this paper imply that strategic defaults are difficult to prevent because they provide significant benefits in post-default financial situations. Defaulting households would certainly have been in financial difficulty due to repayments for the underwater housing, while the federal and local governments would have also provided variety of support. However, as long as the benefits of negative equity resolution and free rent were significant, it was difficult to prevent strategic defaults, and the resulting contagion and spillover effects were likely to have undermined the stability of the housing and financial markets. Conversely, if public intervention is justified to mitigate those default benefits, strategic default behaviour can be reduced thereby lessening the negative externalities. For the negative equity elimination incentives, mortgage modifications that reduce principal could be effective. In addition, reduced monthly repayments could give time for the housing market to recover, thus reducing the negative equity problem in the long-run. Efficient foreclosure procedures could also reduce the problem of free rent incentives. Analysing household net worth growth in terms of post-default behaviour of defaulters, relocation and mortgage modification, we find that strategic defaulters benefitted from relocation rather than mortgage modification. Policies to encourage mortgage modification led by the federal and local governments have been noted to have inefficiencies arising from the strategic behaviour of households seeking to take advantage of the modification (Mayer *et al.*, 2014). As a result, they are considered to have been less effective in deterring strategic defaults, and more effective policy design is expected in view of the serious consequences of the negative externalities of foreclosure (e.g., contagion and spillover effects). It is hoped that what are discussed in this paper will contribute to the design of future government policies and the stable growth of housing and financial markets.

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Table 1 Survey Items on Mortgage Destress in the PSID

No.	Question	Timeframe	Property Type
A-1	Are you or anyone in the family living there, currently behind on your mortgage/loan payments?	Present	Current Main Residence
A-2	How many months are you behind?	Present	
A-3	Has your bank or lender started the process of foreclosing on your home?	Present/Retrospective	
A-4	In what month and year did the foreclosure start?	Present/Retrospective	
A-5	Have you worked with your bank or lender to restructure or modify your mortgage/loan because of missed payments?	Present/Retrospective	
A-6	How likely is it that you will continue to be behind/will fall behind on your mortgage/other loan payments in the next 12 months? Would you say very likely, somewhat likely, or not likely at all?	Present/Prospective	
B-1	Other than the foreclosure experience we just talked about*, since our last interview in [YEAR]/2001 have you or anyone in your family living there had a home on which a foreclosure was started?	Retrospective	Current/Previous Main Residence, Investment Property or Others
B-2	In what month and year did the foreclosure start?	Retrospective	
B-3	In what month and year did the foreclosure start?	Retrospective	
B-4	Was the home foreclosed upon?	Retrospective	
B-5	Did you lose your home as a result of this foreclosure?	Retrospective	
B-6	Was this home a main residence, investment property, a vacation home or what?	Retrospective	
B-7	About how much did you still owe on your mortgage or loan when the foreclosure started?	Retrospective	

This table shows the list of the survey questions about mortgage distress and foreclosure in the Panel Study Income Dynamics (PSID). * This sentence apparently indicates the questions of A-3 and A-4.

Table 2 Mean Comparion of Household Wealth by Sub-group

VARIABLE		All Household (HH)	Non-Default HH	All Default HH	t-test	Non-Strategic Default HH	t-test	Strategic Default HH	t-test
Default Def.: 60 Days Mortgage Delinquency									
Total Family Net Wealth (Incl. Home Equity)	Absolute Difference ($1,000)	173.92	180.88	59.26	***	47.77	***	108.30	*
	Proportional (Relative) Difference	0.00	3.76	4.63		1.43	**	19.09	
Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)	Absolute Difference ($1,000)	-0.38	0.68	-18.09	***	-21.82	***	0.32	
	Log First Difference	0.06	0.08	-0.15	***	-0.23	***	0.18	
Home Ownership		0.88	0.89	0.73	***	0.71	***	0.82	
N		8,482	7,895	587		486		104	
Default Def.: Foreclosure Start									
Total Family Net Wealth (Incl. Home Equity)	Absolute Difference ($1,000)	173.92	176.36	83.67	**	85.86	**	61.05	
	Proportional (Relative) Difference	0.00	3.84	2.90		2.37		8.35	
Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)	Absolute Difference ($1,000)	-0.38	0.50	-33.53	**	-37.60	**	6.52	
	Log First Difference	0.06	0.07	-0.32	***	-0.40	***	0.40	
Home Ownership		0.88	0.89	0.59	***	0.60	***	0.48	***
N		8,482	8,222	260		235		25	

This table compares mean of difference in total family net wealth and housing user cost and rent values and tenure choice for households in the sub-sample, calculated by applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Units are in thousands of US dollars. T-tests compared the means of the subgroup of households that experienced default with the subgroup of households that did not experience default, with significance at *** $p<0.01$, ** $p<0.05$ and * $p<0.1$.

Table 3 Baseline Result: Impact of Default Experience on the Future Wealth Growth and Tenure Choice

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default in 2009-2013	-1.226	0.0399	-0.250***	-0.397***	-0.516***	-0.890***
	(0.781)	(1.937)	(0.0534)	(0.0915)	(0.115)	(0.153)
Dummy: Strategic Default in 2009-2013	18.00*	6.088**	0.148	0.186	-0.0188	-0.853**
	(9.990)	(2.849)	(0.0979)	(0.342)	(0.216)	(0.378)
LN (Total Family Income)	2.610***	2.726***	0.0544***	0.0566***	0.307***	0.313***
	(0.896)	(0.893)	(0.0206)	(0.0204)	(0.0483)	(0.0474)
Liquid Asset to Total Income Ratio	0.00811**	0.00846**	-3.29e-06	2.70e-06	0.00208	0.00214
	(0.00357)	(0.00357)	(7.74e-05)	(7.72e-05)	(0.00221)	(0.00220)
Total Net Wealth excl. Home Equity in 2009-2013 ($1,000)	-0.00140***	-0.00145***	-5.18e-05***	-5.25e-05***	1.02e-05	7.99e-06
	(0.000402)	(0.000400)	(1.45e-05)	(1.44e-05)	(8.49e-05)	(8.40e-05)
Liquid Asset to Total Net Wealth Ratio in 2009-2013	-0.262	-0.261	-0.00224	-0.00231	-0.0447**	-0.0468**
	(0.613)	(0.614)	(0.00893)	(0.00896)	(0.0183)	(0.0189)
Dummy: Judicial Foreclosure State	-1.770**	-1.675**	-0.0646***	-0.0609***	0.0722	0.0819
	(0.681)	(0.690)	(0.0228)	(0.0227)	(0.0705)	(0.0712)
Dummy: Non-recourse State	-2.534**	-2.469**	-0.00654	-0.00786	-0.144**	-0.147**
	(1.115)	(1.106)	(0.0226)	(0.0222)	(0.0613)	(0.0605)
Dummy: Sand State	-3.959**	-3.923**	-0.142***	-0.132***	0.0331	0.0703
	(1.532)	(1.527)	(0.0372)	(0.0372)	(0.0906)	(0.0912)
Dummy: Foreclosure Slow State	-1.711	-1.565	-0.0388	-0.0428	-0.292***	-0.303***
	(1.902)	(1.879)	(0.0308)	(0.0306)	(0.0979)	(0.0989)
S&P500 Cumulative Return since the Great Recession	0.511	0.413	0.0110	0.00680	-0.126	-0.134
	(2.021)	(2.038)	(0.0394)	(0.0391)	(0.134)	(0.136)
FHFA State HPI Cumulative Return since the Great Recession	20.43***	20.71***	0.806***	0.806***	-0.484*	-0.485*
	(5.297)	(5.281)	(0.0886)	(0.0878)	(0.283)	(0.282)
Constant	-15.21*	-15.89**	0.0253	0.0353	-3.492***	-3.473***
	(7.823)	(7.878)	(0.287)	(0.286)	(0.747)	(0.737)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00665	0.00543	0.0722	0.0732	0.163	0.169

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 4 Channel of Negative Equity Elimination Effect: Different Combined LTV Ratio Threshold

	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
VARIABLES	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default in 2009-2013	-2.767*	0.498	-0.181***	-0.526***	-0.720***	-0.945***
CLTV Threshold: 0-80%	(1.660)	(3.723)	(0.0615)	(0.159)	(0.166)	(0.187)
Dummy: Non-strategic Default in 2009-2013	-1.208	-1.485	-0.207***	-0.296***	-0.509***	-0.821***
CLTV Threshold: 80-100%	(0.857)	(1.176)	(0.0636)	(0.0808)	(0.173)	(0.275)
Dummy: Non-strategic Default in 2009-2013	-0.0456	2.201	-0.327***	-0.450***	-0.217	-0.460
CLTV Threshold: 100-120%	(1.749)	(2.310)	(0.0900)	(0.0971)	(0.276)	(0.280)
Dummy: Non-strategic Default in 2009-2013	3.607**	-0.654	-0.244	-0.0463	-0.512*	-0.811**
CLTV Threshold: 120%-	(1.737)	(1.245)	(0.180)	(0.198)	(0.295)	(0.319)
Dummy: Strategic Default in 2009-2013	-2.172	-1.557	-0.388***	-0.376**	-0.474*	-1.322***
CLTV Threshold: 80-100%	(1.544)	(4.820)	(0.123)	(0.160)	(0.256)	(0.371)
Dummy: Strategic Default in 2009-2013	2.067	2.261	-0.0743	-0.332***	-0.0942	-1.026
CLTV Threshold: 100-120%	(2.405)	(2.098)	(0.105)	(0.116)	(0.320)	(0.723)
Dummy: Strategic Default in 2009-2013	35.00*	8.148**	0.327**	0.485	-0.0939	-0.722*
CLTV Threshold: 120%-	(19.32)	(3.274)	(0.132)	(0.441)	(0.220)	(0.398)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00711	0.00479	0.0723	0.0739	0.164	0.170

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. Non-strategic and Strategic defaults were defined according to the level of the combined loan-to-value ratio at the start of foreclosure, and the impact of each on the future wealth is analysed separately according to the CLTV threshold. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 5 Channel of Free Rent Effect: Top 10 Slowest Foreclosure State

	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
VARIABLES	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default in 2009-2013	-1.305	0.0346	-0.217***	-0.374***	-0.698***	-1.060***
	(0.970)	(2.441)	(0.0503)	(0.113)	(0.111)	(0.164)
Dummy: Non-strategic Default in 2009-2013 * Foreclosure Slow State	1.390	0.0519	-0.150	-0.0976	0.871***	0.900***
	(2.091)	(3.000)	(0.139)	(0.160)	(0.279)	(0.228)
Dummy: Strategic Default in 2009-2013	23.93	0.496	0.0917	-0.435***	-0.337	-1.491***
	(15.18)	(1.654)	(0.105)	(0.0578)	(0.234)	(0.463)
Dummy: Strategic Default in 2009-2013 * Foreclosure Slow State	-16.37	9.140**	0.183	1.012**	0.702	1.193*
	(14.99)	(4.079)	(0.205)	(0.453)	(0.454)	(0.685)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00664	0.00520	0.0723	0.0738	0.167	0.172
Linear Combination of Coefficients: Non-Strategic	0.0851	0.0865	-0.367***	-0.471***	0.0285	-0.0261
Linear Combination of Coefficients: Strategic	7.563**	9.636**	0.275	0.577	0.0601	-0.0487

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. Foreclosure Slow States are the top 10 states with slow foreclosure processes, as organised by Herkenhoff and Ohanian (2019). Linear combination of coefficients shows the sum of the coefficients of the default variable and the interaction with the foreclosure slow state dummy. Significance is tested with standard errors approximated by the delta method. The linear combination coefficients for home ownership represent average marginal effects and do not necessarily correspond to the sum of the coefficients in the upper part of the table. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 6 Channel of Free Rent Effect: Foreclosure Delay State

VARIABLES	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24
	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default in 2009-2013	-0.485	1.465	-0.207***	-0.170**	-0.479***	-0.734***
	(1.123)	(3.234)	(0.0573)	(0.0814)	(0.117)	(0.176)
Dummy: Non-strategic Default in 2009-2013 * Foreclosure Delay State	-1.009	-3.358	-0.0998	-0.496***	-0.120	-0.347
	(1.749)	(3.804)	(0.103)	(0.153)	(0.226)	(0.279)
Dummy: Strategic Default in 2009-2013	33.65	1.439	-0.00131	-0.485***	-0.429	-1.376***
	(20.50)	(1.357)	(0.112)	(0.0520)	(0.286)	(0.530)
Dummy: Strategic Default in 2009-2013 * Foreclosure Delay State	-28.08	6.480*	0.264	0.992**	0.735*	0.706
	(20.29)	(3.691)	(0.174)	(0.429)	(0.425)	(0.695)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00718	0.00527	0.0722	0.0754	0.160	0.166
Linear Combination of Coefficients: Non-Strategic	-1.494	-1.893	-0.306***	-0.666***	-0.0994***	-0.178***
Linear Combination of Coefficients: Strategic	5.567***	7.919**	0.262*	0.507	0.0509	-0.11

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. Foreclosure delay states are states where the foreclosure process was significantly delayed during the Great Recession, as organised by Herkenhoff and Ohanian (2019). Those states include California, Florida, Illinois, Indiana, Maryland, Massachusetts, New Jersey, New York, Oklahoma, Pennsylvania, and Wisconsin using RealtyTrac data. Linear combination of coefficients shows the sum of the coefficients of the default variable and the interaction with the foreclosure delay state dummy. Significance is tested with standard errors approximated by the delta method. The linear combination coefficients for home ownership represent average marginal effects and do not necessarily correspond to the sum of the coefficients in the upper part of the table. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 7 State Mortgage Recourse System Effect

	Model 25	Model 26	Model 27	Model 28	Model 29	Model 30
VARIABLES	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
.						
Dummy: Non-strategic Default in 2009-2013	-2.659**	0.427	-0.204***	-0.190*	-0.288**	-0.650***
	(1.113)	(2.907)	(0.0708)	(0.100)	(0.142)	(0.188)
Dummy: Non-strategic Default in 2009-2013 * Non-recourse State	3.852**	-1.059	-0.144	-0.554***	-0.655***	-0.623**
	(1.738)	(3.045)	(0.0998)	(0.165)	(0.191)	(0.265)
Dummy: Strategic Default in 2009-2013	25.46*	8.192**	0.164	0.442	0.0929	-0.290
	(13.81)	(3.651)	(0.119)	(0.414)	(0.261)	(0.434)
Dummy: Strategic Default in 2009-2013 * Non-recourse State	-24.16*	-7.231*	-0.0707	-0.873**	-0.446	-1.702**
	(13.71)	(4.330)	(0.191)	(0.422)	(0.432)	(0.711)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00693	0.00519	0.0723	0.0758	0.166	0.172
Linear Combination of Coefficients: Non-Strategic	1.192	-0.632	-0.348***	-0.745***	-0.155***	-0.208***
Linear Combination of Coefficients: Strategic	1.293	0.962	0.0931	-0.431***	-0.0581	-0.326***

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. Recourse and Non-recourse state is classified following to Ghent and Kudlyak (2011). Linear combination of coefficients shows the sum of the coefficients of the default variable and the interaction with the non-recourse state dummy. Significance is tested with standard errors approximated by the delta method. The linear combination coefficients for home ownership represent average marginal effects and do not necessarily correspond to the sum of the coefficients in the upper part of the table. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 8 Post-default Household Reactions Effect

	Model 31	Model 32	Model 33	Model 34	Model 35	Model 36
VARIABLES	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Subsequent Relocation Experience	0.273	0.328	0.139***	0.136***	-1.257***	-1.262***
	(1.053)	(1.057)	(0.0275)	(0.0268)	(0.0780)	(0.0777)
Dummy: Subsequent Modification Experience	2.907*	2.199	-0.167***	-0.172***	0.0241	0.0597
	(1.682)	(1.568)	(0.0275)	(0.0267)	(0.0595)	(0.0597)
Dummy: Non-strategic Default in 2009-2013	5.050**	2.421	0.125	-0.834***	0.232	2.003***
	(2.038)	(3.065)	(0.0905)	(0.178)	(0.298)	(0.410)
Dummy: Non-strategic Default in 2009-2013 * Subsequent Relocation	-2.593*	-2.475	-0.312***	-0.203	-0.978***	-1.216***
	(1.533)	(2.910)	(0.0962)	(0.144)	(0.271)	(0.304)
Dummy: Non-strategic Default in 2009-2013 * Subsequent Modification	-7.448***	-2.134	-0.150	0.727***	-0.241	-1.918***
	(2.292)	(3.232)	(0.105)	(0.169)	(0.236)	(0.303)
Dummy: Strategic Default in 2009-2013	107.3	23.08***	0.921**	1.929**	4.620***	5.094***
	(68.28)	(5.566)	(0.438)	(0.811)	(0.613)	(0.845)
Dummy: Strategic Default in 2009-2013 * Subsequent Relocation	4.350	-3.315	-0.244	-0.542***	-5.069***	-5.236***
	(5.826)	(2.518)	(0.149)	(0.197)	(0.340)	(0.467)
Dummy: Strategic Default in 2009-2013 * Subsequent Modification	-108.8	-21.16***	-0.696	-1.779**	-0.360	-1.213
	(69.59)	(4.995)	(0.443)	(0.826)	(0.604)	(0.820)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared	0.0124	0.00507	0.0864	0.0885	0.266	0.260
Linear Combination of Coefficients: Non-Strategic & Relocation	2.73	0.274	-0.0475	-0.901***	-0.293***	-0.0702*
Linear Combination of Coefficients: Non-Strategic & Modification	0.51	2.486*	-0.192***	-0.279**	0.00219	0.0215
Linear Combination of Coefficients: Strategic & Relocation	111.9	20.09***	0.816*	1.523*	-0.25***	-0.207*
Linear Combination of Coefficients: Strategic & Modification	1.393	4.122	0.058	-0.0222	0.627***	0.582***

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. Default experience dummies interact with households' post-default reactions (relocation and mortgage modification). These are set to 1 if the household relocated to another residence or agreed to a mortgage modification in the post-default period, respectively. Linear combination of coefficients shows the sum of the coefficients of the default variable and the interaction with the non-recourse state dummy. Significance is tested with standard errors approximated by the delta method. The linear combination coefficients for home ownership represent average marginal effects and do not necessarily correspond to the sum of the coefficients in the upper part of the table. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015,

2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.

Table 9 Average Treatment Effect of Default Experience on the Treated Group (ATET)

Treatment Variable Default Definition	Non-Strategic Default 60 Days Delq.	Non-Strategic Default Foreclosure Start	Strategic Default 60 Days Delq.	Strategic Default Foreclosure Start
Propensity Score Matching	Model 37	Model 38	Model 39	Model 40
Total Net Wealth	-2.615	1.450	18.433***	-4.107
	(3.520)	(1.571)	(6.873)	(3.624)
Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)	-0.181***	-0.212**	-0.009	-0.127
	(0.066)	(0.107)	(0.101)	(0.223)
Home Ownership	-0.139***	-0.248***	-0.104*	-0.348***
	(0.029)	(0.040)	(0.054)	(0.050)
Nearest-Neighbour Matching	Model 41	Model 42	Model 43	Model 44
Total Net Wealth	-2.480	3.077*	22.472*	1.926
	(3.460)	(1.640)	(13.557)	(1.782)
Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)	-0.046	0.055	0.121	-0.531**
	(0.066)	(0.113)	(0.128)	(0.241)
Home Ownership	-0.181***	-0.315***	-0.156***	-0.391***
	(0.027)	(0.040)	(0.050)	(0.102)
Regression Adjustment	Model 45	Model 46	Model 47	Model 48
Total Net Wealth	-0.978	0.087	37.850**	14.000
	(0.750)	(1.879)	(14.841)	(9.496)
Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)	-0.254***	-0.413***	-0.031	-2.613***
	(0.058)	(0.088)	(0.184)	(0.886)
Home Ownership	-0.132***	-0.253***	-0.501***	-0.180***
	(0.028)	(0.041)	(0.034)	(0.046)

This table presents the results of treatment-effects analysis on post-default household wealth growth and tenure choice. There are two treatment groups: households with non-strategic default experience and households with strategic default experience. The control group is households with no default experience. Three matching algorithms were applied to estimate treatment effects: propensity score matching, nearest neighbour matching and regression adjustment. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if owner-occupier. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Robust Standard Errors are reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Appendix 1 Classification of Recourse and Non-Recourse State

Recourse	Non-Recourse
Alabama	Alaska
Arkansas	Arizona
Colorado	California
Connecticut	Iowa
Delaware	Minnesota
District of Columbia	Montana
Florida	North Carolina
Georgia	North Dakota
Idaho	Oregon
Illinois	Washington
Indiana	Wisconsin
Kansas	
Kentucky	
Louisiana	
Maine	
Maryland	
Massachusetts	
Michigan	
Mississippi	
Missouri	
Nebraska	
Nevada	
New Hampshire	
New Jersey	
New Mexico	
New York	
Ohio	
Oklahoma	
Pennsylvania	
Rhode Island	
South Carolina	
South Dakota	
Tennessee	
Texas	
Utah	
Vermont	
Virginia	
West Virginia	
Wyoming	

We follow the classification between recourse and non-recourse state status following Gerardi *et al.* (2018). Also, this classification is equivalent to Ghent and Kudlyak (2011).

Var	Mean	Std. Dev.	Min	Max
Log Total Household Income	11.42	0.82	0.69	15.47
Liquid Assets to Income Ratio	1.05	45.92	-0.01	3,500.00
Dummy (Judicial Foreclosure State)	0.40	0.49	0	1
Dummy (Non-recourse States)	0.24	0.43	0	1
Dummy (Sand States: CA, FL, AZ, NV)	0.16	0.37	0	1
Dummy (Top 10 Foreclosure Slow States)	0.18	0.38	0	1
Dummy (Top 10 Foreclosure Fast States)	0.21	0.41	0	1
Dummy (Delayed Foreclosure States)	0.40	0.49	0	1
Number of Household Members	2.63	1.40	1	10
Age of Household Head	52.30	11.43	18	91
Gender of Household Head	0.82	0.39	0	1
Marital Status of Household Head	0.67	0.47	0	1
Dummy (Race/Ethnicity: Hispanic)	0.99	0.08	0	1
Dummy (Race/Ethnicity: Black & African-America)	0.10	0.29	0	1
Dummy (Race/Ethnicity: American Native)	0.00	0.07	0	1
Dummy (Race/Ethnicity: Asian)	0.02	0.13	0	1
Dummy (Race/Ethnicity: Pacific Islander)	0.00	0.03	0	1
Dummy (Race/Ethnicity: Other)	0.03	0.17	0	1
Dummy (Race/Ethnicity: Missing)	0.01	0.08	0	1
Dummy (Educational Background: Less than High School)	0.04	0.19	0	1
Dummy (Educational Background: High School)	0.93	0.26	0	1
Dummy (Educational Background: Some College)	0.08	0.28	0	1
Dummy (Educational Background: College and More)	0.41	0.49	0	1
Dummy (Employment Status: Unemployed)	0.02	0.15	0	1
Dummy (Employment Status: Self-employed)	0.13	0.33	0	1
Dummy (Industry: Agriculture, Forestry, Fishing, and Hunting)	0.02	0.15	0	1
Dummy (Industry: Mining, Quarrying, and Oil and Gas Extraction)	0.01	0.08	0	1
Dummy (Industry: Utilities)	0.01	0.12	0	1
Dummy (Industry: Construction)	0.95	0.21	0	1
Dummy (Industry: Manufacturing)	0.12	0.33	0	1
Dummy (Industry: Wholesale Trade)	0.04	0.19	0	1
Dummy (Industry: Retail Trade)	0.06	0.23	0	1
Dummy (Industry: Transportation and Warehousing)	0.05	0.21	0	1
Dummy (Industry: Information)	0.02	0.14	0	1
Dummy (Industry: Finance and Insurance)	0.05	0.21	0	1
Dummy (Industry: Real Estate and Rental and Leasing)	0.02	0.13	0	1
Dummy (Industry: Professional, Scientific, and Technical Services)	0.07	0.26	0	1
Dummy (Industry: Management, Administrative and Support Services)	0.03	0.17	0	1
Dummy (Industry: Educational Services)	0.06	0.24	0	1
Dummy (Industry: Health Care and Social Assistance)	0.07	0.26	0	1
Dummy (Industry: Arts, Entertainment, and Recreation)	0.01	0.11	0	1
Dummy (Industry: Accommodations and Food Services)	0.02	0.15	0	1
Dummy (Industry: Other Services (Except Public Administration))	0.04	0.19	0	1
Dummy (Industry: Public Administration and Active-Duty Military)	0.08	0.28	0	1
Dummy (Industry: Missing)	0.13	0.33	0	1
State Unemployment Rate Change	-0.10	0.06	-0.25	0.10
S&P500 Cumulative Return since the Great Recession	1.70	0.40	1.25	2.21
FHFA State HPI Cumulative Return since the Great Recession	0.21	0.18	-0.06	0.68
N	8,482			

This table presents the control variables used to estimate the model. For the variables of Total Net Worth excluding Home Equity in 2009-2013 and Liquid Assets to Total Net Wealth Tatio in 2009-2013, the values for those who did not default were the mean

of the total net worth and liquid assets to total net worth ratios for 2009-2013, respectively. For those who defaulted, the value for the year of default was taken as the value for this variable.

Appendix 3 Average Marginal Effect of Home Ownership Probit Estimation

VARIABLES	Model 13	Model 14	Model 15	Model 16
	Home Ownership			
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default in 2009-2013	-0.0853***	-0.146***		
Dummy: Non-strategic Default in 2009-2013 CLTV Threshold: 0-80%			-0.119***	-0.155***
Dummy: Non-strategic Default in 2009-2013 CLTV Threshold: 80-100%			-0.0841***	-0.135***
Dummy: Non-strategic Default in 2009-2013 CLTV Threshold: 100-120%			-0.0358	-0.0755
Dummy: Non-strategic Default in 2009-2013 CLTV Threshold: 120%-			-0.0845*	-0.133**
Dummy: Strategic Default in 2009-2013	-0.00312	-0.140**		
Dummy: Strategic Default in 2009-2013 CLTV Threshold: 80-100%			-0.0783*	-0.217***
Dummy: Strategic Default in 2009-2013 CLTV Threshold: 100-120%			-0.0156	-0.168
Dummy: Strategic Default in 2009-2013 CLTV Threshold: 120%-			-0.0155	-0.118*

This table presents the average marginal effects of coefficients, estimated by a weighted probit regression of tenure choice, applying PSID sample weights. Homeownership is a binary variable, equal to 1 if homeownership. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default in 2009-2013	-1.834*	0.117	-0.136***	-0.140*	-0.471***	-0.931***
	(1.005)	(2.951)	(0.0502)	(0.0729)	(0.122)	(0.174)
Dummy: Non-strategic Default in 2009-2013 * Sand State	1.482	-0.201	-0.422***	-0.698***	-0.185	0.118
	(1.261)	(3.154)	(0.0923)	(0.153)	(0.283)	(0.328)
Dummy: Strategic Default in 2009-2013	24.10*	1.504	0.00185	-0.377***	0.0654	-0.829
	(14.09)	(2.191)	(0.0893)	(0.0955)	(0.289)	(0.578)
Dummy: Strategic Default in 2009-2013 * Sand State	-18.93	8.695**	0.400*	1.052**	-0.298	-0.0485
	(14.02)	(3.880)	(0.206)	(0.488)	(0.394)	(0.779)
Observations	8,132	8,132	7,990	7,990	8,132	8,132
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00671	0.00520	0.0746	0.0775	0.163	0.169
Linear Combination of Coefficients: Non-Strategic	-0.352	-0.0839	-0.559***	-0.838***	-0.109**	-0.133***
Linear Combination of Coefficients: Strategic	5.162***	10.2***	0.402**	0.675	-0.0385	-0.144*

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if homeownership. The Sand States include Arizona, California, Florida and Nevada and this dummy is interacted with the default experience indicators. Linear combination of coefficients shows the sum of the coefficients of the default variable and the interaction with the sand state dummy. Significance is tested with standard errors approximated by the delta method. The linear combination coefficients for home ownership represent average marginal effects and do not necessarily correspond to the sum of the coefficients in the upper part of the table. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Appendix 5 Channel of Free Rent Effect: Judicial Foreclosure States

VARIABLES	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	Total Net Wealth		Housing User Cost & Rent (Incl. Tax, Insurance & Home Repair)		Home Ownership	
Default Def.	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start	60 Days Delq.	Foreclosure Start
Dummy: Non-strategic Default (Foreclosure Start) in 2009-2013	-0.536	1.177	-0.322***	-0.503***	-0.540***	-0.976***
	(0.867)	(2.741)	(0.0674)	(0.124)	(0.138)	(0.187)
Dummy: Non-strategic Default (Foreclosure Start) in 2009-2013 * Judicial Foreclosure State	-3.547	-3.041	0.204**	0.289*	-0.00918	0.233
	(2.219)	(3.652)	(0.0994)	(0.152)	(0.255)	(0.309)
Dummy: Strategic Default (Foreclosure Start) in 2009-2013	2.448	6.965**	0.206	0.228	-0.457**	-1.120***
	(1.735)	(2.798)	(0.140)	(0.386)	(0.232)	(0.396)
Dummy: Strategic Default (Foreclosure Start) in 2009-2013 * Judicial Foreclosure State	35.96*	-5.986	-0.170	-0.331	2.334***	(omitted)
	(20.38)	(5.137)	(0.177)	(0.383)	(0.395)	
Observations	8,132	8,132	7,990	7,990	8,132	8,129
Controls & Constant?	Y	Y	Y	Y	Y	Y
Adj.R-squared / Pseudo R-squared	0.00764	0.00520	0.0726	0.0737	0.165	0.170
Linear Combination of Coefficients: Non-Strategic	-4.084**	-1.865	-0.118*	-0.213**	-0.0906***	-0.122***
Linear Combination of Coefficients: Strategic	38.4*	0.978	0.0365	-0.103*	0.309***	-0.184***

This table presents the results of a weighted linear regression of household wealth growth and a weighted probit regression of tenure choice, applying PSID sample weights. Changes in total net worth is defined as relative (proportional) differences, while changes in housing user cost and rent as log first differences. Homeownership is a binary variable, equal to 1 if homeownership. Judicial Foreclosure State is classified following to (Ghent and Kudlyak, 2011). Linear combination of coefficients shows the sum of the coefficients of the default variable and the interaction with the judicial foreclosure state dummy. Significance is tested with standard errors approximated by the delta method. The linear combination coefficients for home ownership represent average marginal effects and do not necessarily correspond to the sum of the coefficients in the upper part of the table. The sample is limited to household heads with mortgages, aged 24-65 years, participating in the labour market and with a total LTV ratio of less than 250% in the PSID first three waves of 2009, 2011 and 2013, and the status of the same household heads in the subsequent three waves, 2015, 2017 and 2019 is tracked. Disabled households are also included. Standard Errors are clustered at year and state level and reported in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.