ISSN 1936-5330




# Fleeting Forbearance in a World of Persistent Financial Distress

José Mustre-del-Río, Juan M. Sánchez, and Kartik Athreya

September 2026; updated September 28, 2026
RWP 26-13
https://doi.org/10.18651/RWP2026-13



# Fleeting Forbearance in a World of Persistent Financial Distress

José Mustre-del-Río Juan M. Sánchez Kartik Athreya

September 28, 2026*

**Abstract**

Relative to the persistent delinquency typically observed in consumer credit, mortgage forbearance during the COVID-19 pandemic was surprisingly short-lived. To understand why, we develop a rich structural model and estimate it on credit panel microdata. Next, using the model and survey data, we identify key roles for both selection into mortgages by relatively patient households and the failure of anticipated income losses to materialize. Even taking selection in account, had losses occurred, forbearance participation would have been persistent. Thus, the power of forbearance, a frequent macroeconomic policy, hinges on borrower selection, shock realizations, and revisions to expectations following those realizations.

**Keywords:** Delinquency, Bankruptcy, Forbearance, Heterogeneity, Impatience.
**JEL Codes:** D14, D84, E21, G51.

*The views expressed are those of the authors and do not necessarily reflect the positions of the Federal Reserve Banks of Kansas City, New York, St. Louis, or the Federal Reserve System. The authors acknowledge helpful comments from Gianluca Violante, Mark Bils, Igor Livshits, and participants at the 2022 Society for Economic Dynamics Meetings, the 2026 Midwest Macro Meetings, the Stockman Conference at the University of Rochester, and seminars at the Indian School of Business, Kansas City, Philadelphia, and St. Louis Feds. Masataka Mori and Molly Hirner provided excellent research assistance. The authors used generative artificial intelligence tools to assist with editing, improving clarity, and refining the manuscript's presentation. All scientific content, analysis, interpretation, and conclusions were developed and verified by the authors. The authors thank the Center for Advancement of Data and Research in Economics (CADRE) at the Federal Reserve Bank of Kansas City (FRB-KC) for providing essential computational resources that contributed to the results reported in this paper.

# 1 Introduction

Unsecured debt delinquency is a costly way for borrowers to delay repayment, yet nearly 8 percent of U.S. households use it in any given quarter. Delinquent debt is typically rolled over at higher interest rates, borrowers face rising risk of wage garnishment, and their credit scores deteriorate—costs that make even temporary delays in repayment consequential.[1] These costs are also reflected in delinquency's persistence: between 2018 and 2019, among borrowers who became delinquent, nearly 75 percent remained so for more than one quarter, and almost 25 percent for all eight quarters. Structural models, including our own (Athreya, Mustre-del Río and Sánchez, 2019), capture this pattern with heterogeneity in time preference: a minority of relatively impatient households alongside a majority with no discounting.

These findings matter not only for unsecured credit markets but for the far larger mortgage market, where debt relief is intended to prevent household distress from generating aggregate collateral damage. It is thus unsurprising that forbearance was offered almost immediately at the onset of COVID-19, with nearly 8 percent of mortgage borrowers participating upon its roll-out.[2] Given the persistence documented for unsecured delinquency, one might have expected a similarly sizable and long-lived response. Yet mortgage forbearance was strikingly short-lived: usage returned to near pre-pandemic levels by early 2022, with half of participants using it for only one quarter.

This contrast is puzzling: if consumer financial distress data favor models with a meaningful share of impatient households, why didn't mortgage forbearance exhibit similar persistence? This paper reconciles these facts using a structural model estimated on credit panel microdata, combined with survey data, to identify *two* forces that have received little attention in the literature. The first is *selection*. Mortgage forbearance attracted a fundamentally different population than typical unsecured debtors. Forbearance users were financially healthier homeowners and had little or no prior history of unsecured delinquency. The second is *expectations of income loss*. Using state-level variation, we document that forbearance take-up tracked households' evolving—and largely pessimistic—expectations of income loss. These were especially acute early in the pandemic but dissipated as the crisis progressed.

We establish these mechanisms using the New York Fed Consumer Credit Panel, the

[1] See, for example, Chatterjee et al. (2007), Livshits, MacGee and Tertilt (2007), Athreya, Tam and Young (2009), and Chatterjee et al. (2023), among others.

[2] As part of the Coronavirus Aid, Relief, and Economic Security (CARES) Act, loan forbearance was granted to federally insured mortgages (Section 4022) and provided protections for the credit histories of consumers in forbearance agreements (Section 4021).

Census Household Pulse Survey, and the New York Fed Survey of Consumer Expectations. These patterns inform a life-cycle model of household financial distress, building on Mustre-del Río et al. (2025), extended to incorporate mortgage forbearance and pandemic-specific income expectation shocks. We model the pandemic's onset as an unanticipated decline in expected income accompanied by the introduction of forbearance, and show that even accounting for selection, had income losses materialized as initially feared, forbearance participation would have been persistent.

Our findings carry two implications. First, the COVID-19 episode does not overturn the view that persistent financial distress reflects a chronically impatient subpopulation. Once selection and expectations are accounted for, forbearance dynamics remain consistent with such models. Second, the power of forbearance as a macroeconomic policy tool hinges critically on borrower selection, the realization of anticipated shocks, and how expectations evolve in response.

## 1.1 Related literature

This paper contributes to three strands of the literature. First, it builds on quantitative models of unsecured credit, bankruptcy, and default (Chatterjee et al., 2007; Livshits, MacGee and Tertilt, 2007; Athreya et al., 2017; Athreya, Mustre-del Río and Sánchez, 2019). We extend this framework by incorporating mortgage debt and mortgage forbearance, allowing households to manage unsecured and secured liabilities jointly. This extension is important because mortgage forbearance and unsecured delinquency are both forms of debt non-repayment, yet they need not reflect the same underlying economic forces.

Second, our paper is closely related to Herkenhoff and Ohanian (2019), which studies foreclosure delay as a form of temporary mortgage debt relief. They show that delaying foreclosure decreases employment. More broadly, our paper relates to the literature studying bankruptcy, foreclosure, and mortgage market policies (Jeske, Krueger and Mitman, 2013; Corbae and Quintin, 2015; Hatchondo, Martinez and Sánchez, 2015; Campbell and Cocco, 2015; Mitman, 2016; Kaplan, Mitman and Violante, 2020). Whereas this literature primarily evaluates the effects of debt-relief policies on mortgage default, deleveraging, labor market outcomes, and aggregate demand, we use the observed take-up and duration of mortgage forbearance during the COVID-19 pandemic to study the drivers of household debt non-repayment. We show that the temporary use of mortgage forbearance reflects differences in borrower selection and expectations of short-run income losses rather than an absence of chronically constrained households.

Finally, our paper relates to a growing literature emphasizing heterogeneity in time preferences as a source of persistent differences in household behavior. Heterogeneous discount factors have been used to account for the distribution of wealth (Krusell and Smith, 1998), the prevalence of hand-to-mouth households (Aguiar, Bils and Boar, 2025), differences in creditworthiness (Chatterjee et al., 2023), and differences in wealth accumulation over the life cycle (Calvet et al., 2026). Building on these ideas, Athreya, Mustre-del Río and Sánchez (2019) show that heterogeneous time preferences account for the high incidence and persistence of unsecured debt delinquency. Our results show that the temporary use of mortgage forbearance does not overturn this interpretation. Once differences in homeowner selection and expectations of short-run income loss are incorporated, the data remain consistent with models featuring a substantial share of chronically constrained households.

## 2 Empirical Evidence

In the first part of this section, we document that when debt non-payment in the form of mortgage forbearance was offered during the COVID-19 pandemic (i) aggregate take-up was short-lived and (ii) households who did use it did so temporarily rather than persistently. As noted in the introduction, a large literature has established that heterogeneity in time preferences is central in explaining differences in individual behavior, including the persistence of financial distress. Hence, these observations potentially challenge the view that financial distress, which, when measured as credit card delinquency, is another form of debt avoidance, is persistently used and can be explained by a group of individuals characterized as impatient.

We then demonstrate that the now-routine allowance for household heterogeneity in discounting in models of household finance offers guidance for the empirical features central to resolving this apparent tension.

In the second part of this section, we provide evidence of selection into mortgage forbearance by credit riskiness. Specifically, we find that mortgage forbearance users had little history of credit card delinquency before the pandemic, making them appear safer ex ante than individuals who enter persistent financial distress and whom we would typically characterize as impatient. Second, mortgage forbearance take-up closely tracked individual expectations of income loss rather than realized income declines.

Third, we show that as income expectations improved rapidly over the course of the pandemic, the need for mortgage payment delays waned, which helps explain the short-lived nature of aggregate mortgage forbearance usage. Though we don't offer causal ex-

planations in this section, we quantify the importance of these mechanisms in subsequent sections by estimating a life-cycle model of mortgages and unsecured debt.

These three facts suggest naturally that the relatively short-lived experience with COVID-era mortgage forbearance policy can–at this point at least *qualitatively*–be understood as the result of both positive selection into the program itself, followed by a rapid shift towards optimism in households' assessments of their income prospects as the pandemic period continued. We turn now to the details.

## 2.1 Short-lived and temporary usage of mortgage forbearance during COVID-19

***Short-lived in Aggregate Time Series*** Figure 1 plots the share of mortgage holders in forbearance by quarter since Q1-2020 using data from the NY Fed Consumer Credit Panel (CCP) and reveals our first empirical observation that take-up was short-lived.[3] As can be seen from this figure, mortgage forbearance rose sharply at the onset of the pandemic, peaking at roughly 8 percent of mortgage holders. To put the pandemic-era rise in context, at its peak, mortgage forbearance reached only 4 percent for a few months in 2018 due to natural disasters concentrated in Texas. As the COVID-19 pandemic was effectively a national natural disaster, use of mortgage forbearance was much more widespread across the country.

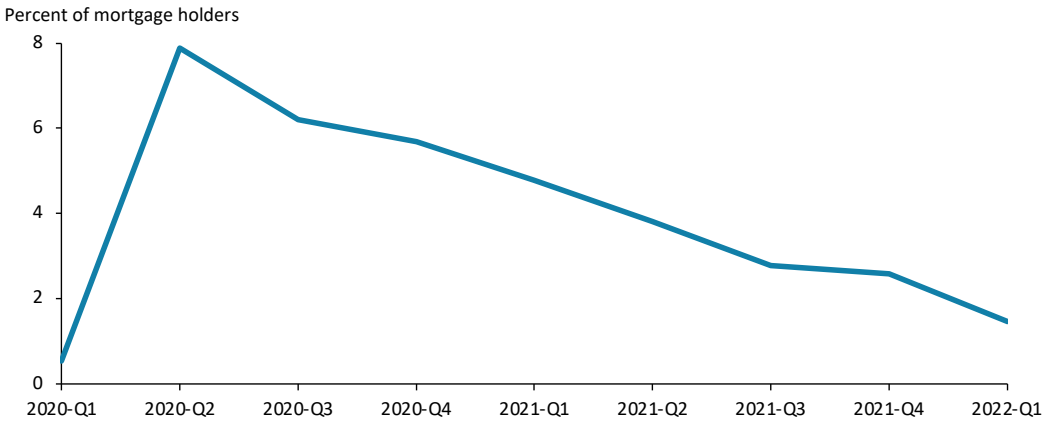



Figure 1: Incidence of forbearance

***Temporary at the Household Level*** Beyond looking at point-in-time measurements of forbearance usage, we can also use the panel dimension of the CCP to assess individual-level usage throughout the pandemic, which helps us highlight our second empirical

[3] Appendix A describes the construction of the sample and the measurement of forbearance status.

observation that among individuals who entered into forbearance, their usage was temporary. The blue bars in Figure 2 plot the distribution of duration of forbearance among those who used the program for at least one quarter. These bars reveal that despite the rapid (and geographically widespread) increase at the onset of the COVID-19 pandemic, few people used it for more than a quarter or two. Indeed, nearly half of the participants used it for only one quarter.

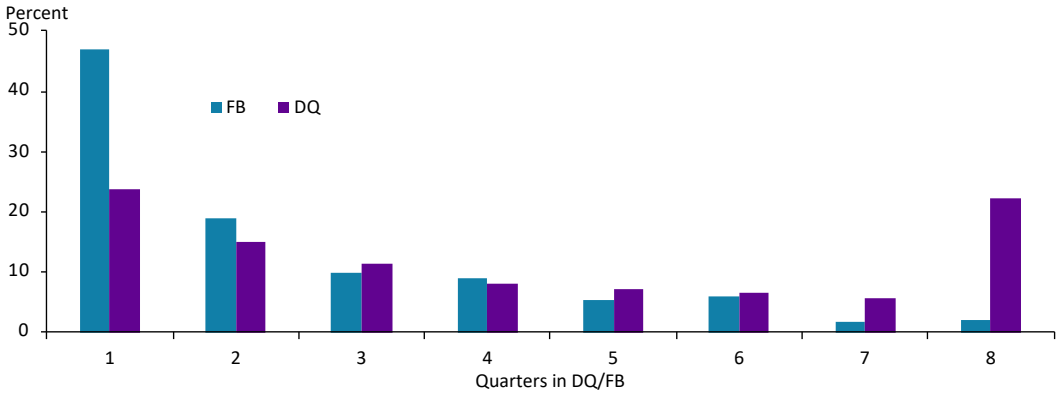



Figure 2: Duration of Forbearance and Delinquency

While interesting in and of itself, the brief use of mortgage forbearance is noteworthy when compared with usage patterns of other debt-payment delay options, such as credit card delinquency. To this point, the purple bars in Figure 2 contrast the duration distribution of credit card delinquency with that of mortgage forbearance.[4] Here, credit card delinquency is defined as being delinquent 30+ days. Comparing the two sets of bars reveals that while participation in payment delay via mortgage forbearance is short-lived, participation in payment delay via credit card delinquency is longer-lasting and highly persistent. Compared to forbearance usage, where nearly half of forbearance participants spent only one quarter in forbearance during this window, only a quarter of delinquent borrowers spent only one quarter in delinquency during this window. Rather, approximately a quarter of users remain in delinquency for all eight periods, while only 2 percent of mortgage forbearance users remain in forbearance for all eight periods.

As mentioned at the beginning of this section, we think that the comparison between

[4]To construct this distribution, we take an 8-quarter window (2018-2019 for delinquency, and the first 8 quarters of the pandemic for forbearance). We select individuals who enter the respective status at least once during the window, and count the total number of quarters they spend in that status. By construction, the minimum duration is 1 quarter, and the maximum is 8 quarters. We chose this pre-pandemic period as delinquency patterns were mechanically impacted by credit relief programs enacted during the pandemic. See, for example, https://www.cnbc.com/select/credit-card-issuers-offer-customer-assistance-amid-coronavirus-financial-hardship/

the bars in Figure 2 is relevant for at least a few reasons. First, the persistence of credit card delinquency has been widely documented (Athreya, Mustre-del Río and Sánchez, 2019; Meier and Sprenger, 2010; Gorbachev and Luengo-Prado, 2016) and thus serves as a natural baseline for gauging the persistence (or lack thereof) of mortgage forbearance as another form of debt payment avoidance. Second, since the persistence of credit card delinquency is typically reconciled in consumption/saving models by allowing for heterogeneity in preferences, a logical question is whether the same reconciliation applies to broader models that allow for mortgage forbearance. As noted in the introduction, this second reason is the primary focus of this paper.

## 2.2 Debtor Selection and Income Expectations: Evidence

Having documented the short-lived use of mortgage forbearance during the COVID-19 pandemic, we next provide reasons for this behavior and explain why it isn't necessarily at odds with the evidence and explanations for persistent financial distress. We focus on (i) selection into the program and (ii) the evolution of income expectations as two key empirical observations that shaped the dynamics of mortgage forbearance during the pandemic. We also provide evidence that mortgage refinancing, which was potentially an attractive option due to low interest rates during the pandemic, was not used as a substitute for mortgage forbearance. Hence, it is unlikely to have driven the previously documented decline in forbearance over the course of the pandemic.

***Selection into forbearance.*** Focusing first on selection, note that by construction forbearance users must be homeowners with mortgages. Thus, if mortgage holders are less risky borrowers, then this might help explain the difference in persistence of mortgage forbearance and credit card delinquency. Not surprisingly, we find that mortgage holders are less risky borrowers compared to non-mortgage holders. Over the same 2018-2019 period used to construct the purple bars in Figure 2, we find that only 10 percent of mortgage holders are ever in delinquency. By contrast, the corresponding figure for non-mortgage holders is closer to 20 percent. Thus, mortgage holders are about half as likely to be in credit card delinquency compared to non-mortgage holders over the period we analyze.

Aside from being less likely to enter credit card delinquency, mortgage holders are also less likely to remain in it persistently. Among mortgage holders who have ever entered credit card delinquency, the share with eight quarters of delinquency (again over the same 2018-2019 period previously discussed) is 17 percent. Meanwhile, the corresponding figure for non-mortgage holders is higher at nearly 24 percent. By this measure, mortgage holders are about 30 percent less likely to remain in credit card delinquency persistently.

Importantly, though, this selection only matters if the behavior of riskier and safer credit card borrowers differs when forbearance is offered. Figure 3 shows that this is the case. It splits mortgage forbearance users into those with prior credit card delinquency and those without. The figure displays a sharp contrast in the duration of forbearance usage between the two groups. Nearly half of individuals with no prior delinquencies exited mortgage forbearance within a quarter. In contrast, only 30 percent of those with prior delinquencies exited within a quarter.

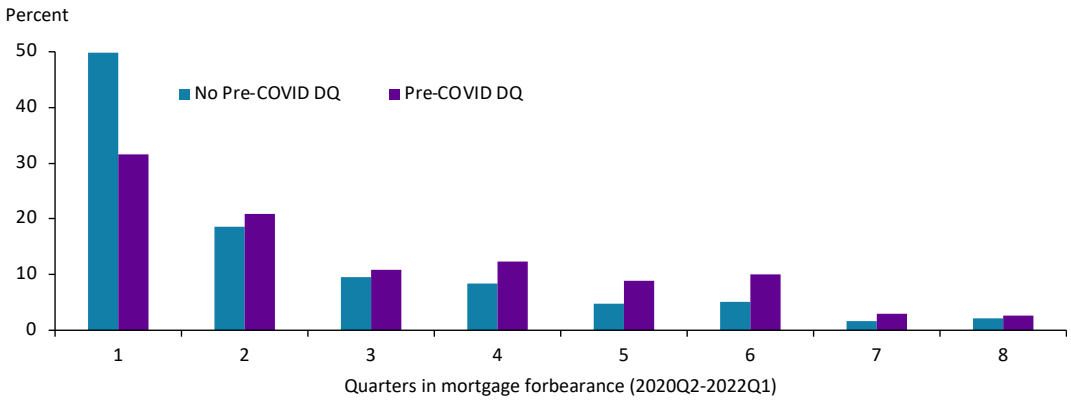



Figure 3: Duration of Forbearance by Prior Delinquency Status

***Expectations of income loss.*** While selection helps explain the low persistence of mortgage forbearance compared to credit card delinquency, it does not immediately address the gradual decline in mortgage forbearance observed in aggregate. To understand the time-series path of mortgage forbearance, we next examine the evolution of income-loss expectations over the course of the pandemic using data from the Census Household Pulse Survey.

We focus on expectations rather than actual income losses for a few reasons. First, total income increased early in the pandemic due to large, unprecedented government transfers.[5] Second, even though the Census Pulse Survey did ask respondents about actual income losses, these were in reference to March 2020.[6] This wording makes the question too retrospective in nature and therefore not useful for eliciting recent income losses. As an alternative, we look at employment status.[7] As we show below, our findings on the relationship between expected losses and mortgage forbearance are robust to the

[5]For example, real disposable personal income per capita increased by more than 15 percent year-over-year in April 2020.

[6]More specifically, the survey asked *Have you, or has anyone in your household experienced a loss of employment income since March 13, 2020?*

[7]We define individuals as being employed based on their responses to the survey question *"In the last 7 days, did you do ANY work for either pay or profit?"*

inclusion of this variable.

Focusing on the time series behavior, as seen in Figure 4, the evolution of income loss expectations appears to match that of forbearance usage. The blue line in this figure represents the share of adults who expect (or someone in their household) an income loss in the next four weeks. Expected income losses were elevated early in the pandemic, reaching nearly 40 percent in April 2020. However, they gradually declined, falling close to 10 percent in June 2021. The purple line in this figure focuses on mortgage holders and shows very similar dynamics in expected income losses.

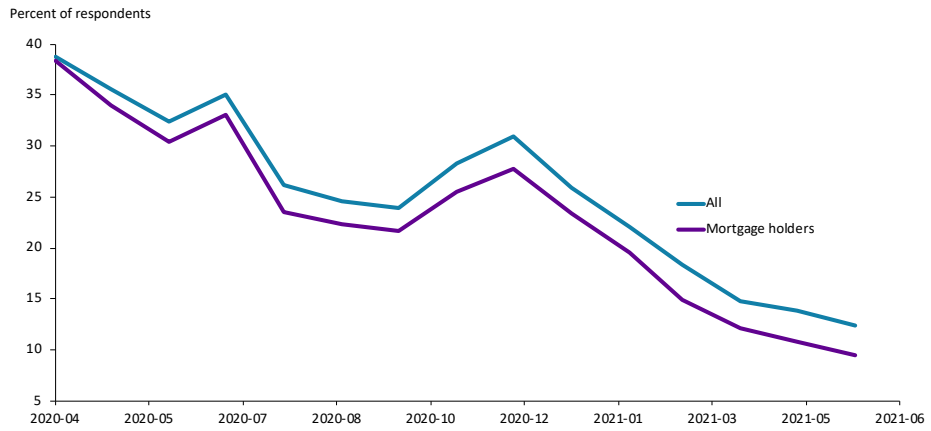



Figure 4: Expectations of Income Loss During the Pandemic

Beyond mimicking the aggregate time-series behavior of mortgage forbearance, expectations of income loss are also correlated with forbearance rates across states. Figure 5 plots the time series of the percent of people expecting income losses across states. While all states exhibit a similar time-series trend to the US (depicted in blue), this figure reveals substantial heterogeneity across states. For example, states like Hawaii and Nevada had systematically higher expectations of losses throughout the pandemic. Meanwhile, Utah and the District of Columbia had systematically lower expectations of losses. New Jersey initially had much higher expected losses than the nation, but then quickly converged with the nation's pattern. Overall, this plot highlights that the initial 40 percent and final 10 percent numbers we highlight as average expectations for the US mask substantial heterogeneity.

We can exploit this heterogeneity to examine its relationship with mortgage forbearance more directly. Figure 6 plots expectations of income loss (among mortgage holders) against the incidence of forbearance at the state level. In this scatter plot, each dot represents a state-month observation, and its size indicates the state's population. This figure suggests that income loss expectations are strongly correlated with state-level forbearance

usage during the pandemic.

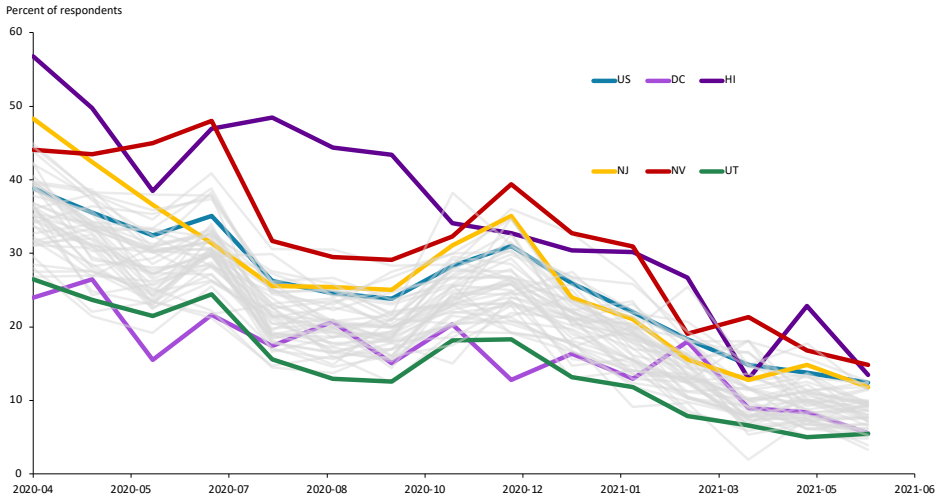



Figure 5: Expectations of Income Loss During the Pandemic by State

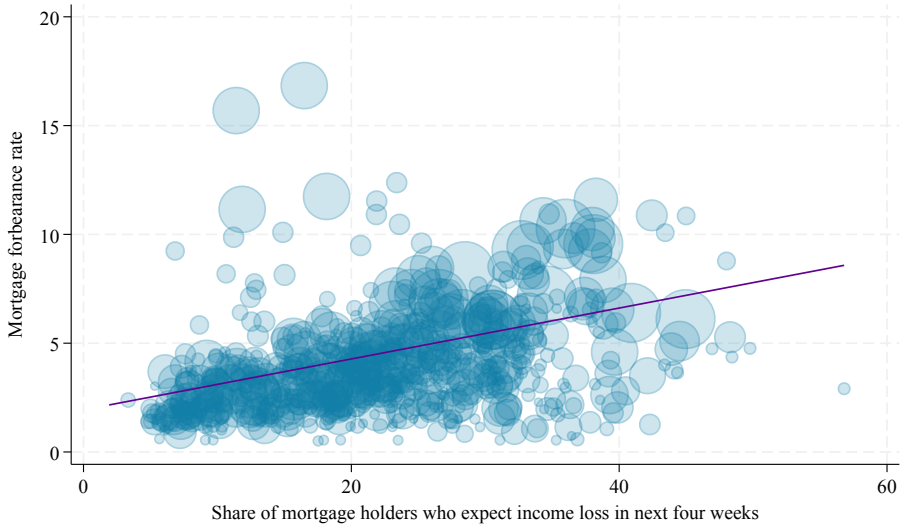



Figure 6: State-level Mortgage Forbearance and Expectations of Income Loss

We can show this relationship more formally with regression evidence. Table 1 shows the estimated coefficient from running a regression of the mortgage forbearance rate against the share of mortgage holders expecting an income loss, both measured at the state level. The first column of this table suggests that a 10-percentage-point increase in the share of mortgage holders expecting income losses is associated with roughly a 1-percentage-point increase in the state-level forbearance rate. Columns (2) through (4) of this table show that this result is robust to controlling for state and time fixed effects. Appendix B.1 shows that this finding remains robust even when comparing similar age groups across states. This is reassuring, as it suggests that no particular age group drives the relationship. Additionally, Appendix B.2 shows this finding remains robust when looking at expected income losses from the NY Fed Survey of Consumer Expectations.

| | % People in forbearance | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Expectation of income loss | 0.117*** | 0.075*** | 0.287*** | 0.087** | 0.084*** | 0.079*** | 0.252*** | 0.087** |
| | (0.015) | (0.015) | (0.027) | (0.040) | (0.016) | (0.018) | (0.044) | (0.044) |
| Constant | 1.939*** | 2.910*** | -1.985*** | 2.635*** | 9.401*** | 1.806 | 2.653 | 2.601 |
| | (0.385) | (0.378) | (0.550) | (0.908) | (2.335) | (3.113) | (3.624) | (3.856) |
| Observations | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 |
| $R^2$ | 0.179 | 0.590 | 0.368 | 0.684 | 0.206 | 0.590 | 0.376 | 0.684 |
| State FE | | ✓ | | ✓ | | ✓ | | ✓ |
| Time FE | | | ✓ | ✓ | | | ✓ | ✓ |
| Employment controls | | | | | ✓ | ✓ | ✓ | ✓ |

Note: Robust standard errors are in parentheses.

Table 1: The Relationship between Forbearance and Expectations of Income Loss at the State Level

Aside from being robust to the aforementioned tests, Columns (5) through (8) show that the positive relationship between mortgage forbearance and expectations of income loss is robust to the inclusion of the Pulse Survey measure of recent employment. Focusing on the last column of this table, even once we include the share of mortgage holders who responded that they were working in the past seven days, the statistical and economic significance of income loss expectations is identical to the corresponding estimate in Table 1. Notably, comparing the $R^2$'s of Columns (8) and (4) suggests the marginal contribution of adding employment into the regression is minimal.

Our identification of the relationship between mortgage forbearance and expectations of income loss relies on state-level variation. This is because the Census Pulse Survey includes income information but not on forbearance, whereas the CCP includes informa-

tion on forbearance but not on income. However, in a few survey waves, the Census Pulse Survey asked respondents about mortgage payments. In Appendix B.3, we use this information to show that, even at the individual level, our main findings are qualitatively the same. We view this evidence as suggestive, as the Pulse Survey does not explicitly ask about participation in mortgage forbearance.

***The limited role of refinancing.*** As noted at the onset, one possible explanation for the short-lived nature of mortgage forbearance is that households decided to exit it to refinance their mortgages. Indeed, in the two years before the pandemic, the 30-year fixed-rate mortgage was around 4 percent, but reached a low of 2.7 percent in December of 2020, making refinancing attractive. The first issue with this hypothesis is that refinancing activity increased rapidly in the last quarter of 2020 and peaked in the first quarter of 2021. By then, the percent of mortgage holders in forbearance had already declined significantly.

Second, Figure 7 displays the share of mortgage holders who refinanced after exiting forbearance. For each cohort, we computed the percentage of individuals who refinanced within 1 or 2 quarters after their last quarter in forbearance. As is evident, not many households who exited forbearance refinanced in the following quarters. Indeed, even after two quarters of exiting forbearance, at most 11 percent of individuals had refinanced their mortgages.

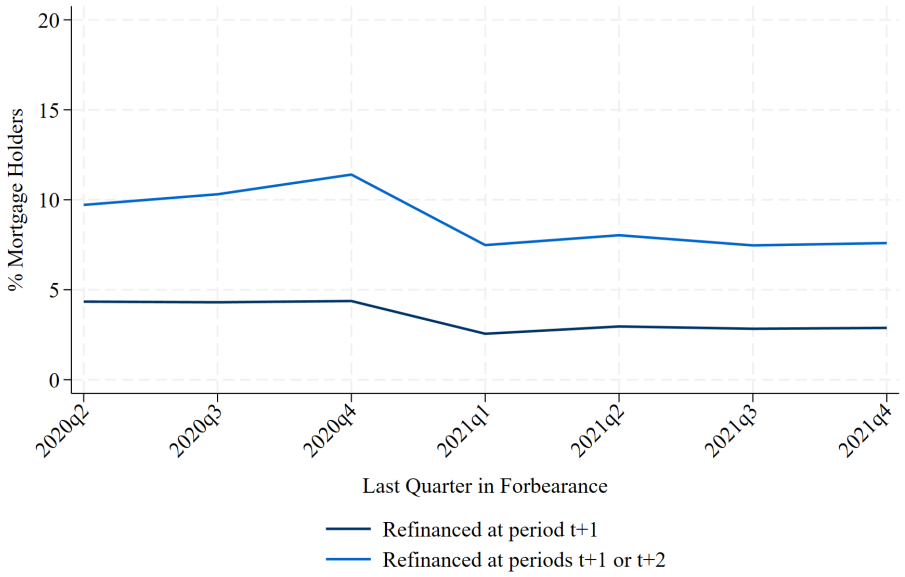



Figure 7: Transition from Forbearance to Refinancing

### 2.3 Discussion of Empirical Findings

In summary, we first document that when mortgage forbearance was offered during the COVID-19 pandemic (i) aggregate usage was short-lived and (ii) households who did use it did so only sparingly rather than persistently. These observations contrast with the persistent use of other forms of debt avoidance (such as credit card delinquency), which is typically attributed to a group of individuals characterized as impatient and regularly in financial distress.

We then provide some empirical evidence suggesting that (i) forbearance users are fundamentally different than individuals in persistent financial distress and (ii) mortgage forbearance take-up tracked expectations of income loss. The former observation helps reconcile the differing persistence patterns between forbearance usage and credit card delinquency. Meanwhile, the latter observation helps explain the abrupt spike and gradual decay of mortgage forbearance usage during the pandemic.

The question we next tackle, given the facts we have documented, is a quantitative one. How far do selection and income expectations go in making sense of observed take-up and exit from mortgage forbearance during the period of the pandemic-initiated large-scale policy offering? Our answer will be, "a great deal." We turn now to the model.

## 3 Model

This section develops a quantitative life-cycle model of housing, mortgages, and unsecured debt. This structural model serves as a laboratory for evaluating the quantitative importance of the two pieces of empirical evidence we provided in the previous section (selection and expectations of income loss) in explaining the dynamics of mortgage forbearance (which was short-lived and used only temporarily) during the pandemic. We first describe the economic environment and then present the household's decision problems.

### 3.1 Setup

Time is discrete. Households enter the economy at age 25, retire at age 65, and live up to age 85. Throughout the life cycle, they face mortality risk, which is summarized by the age-dependent survival probability $\rho_n$, where $n$ denotes age. During working years, households face idiosyncratic income risk with both persistent and transitory compo-

nents, denoted by $(z, \epsilon)$. Labor earnings at age $n$ are given by

$$e_n(z, \epsilon) = \exp(l_n + z + \epsilon),$$

where $l_n$ denotes the deterministic life-cycle profile of earnings.

Households differ in their discount factors $\beta_j$, generating heterogeneity in intertemporal behavior and financial vulnerability. In each period, households choose consumption, savings, unsecured borrowing, and housing.

Preferences are defined over non-durable consumption $c$ and housing services $h$:

$$u(c, h) = \frac{\left((1-\theta)c^{1-1/\alpha} + \theta h^{1-1/\alpha}\right)^{\frac{1-\gamma}{1-1/\alpha}}}{1-\gamma}.$$

The parameter $\theta$ governs the weight of housing in utility, $\alpha$ controls the elasticity of substitution between consumption and housing, and $\gamma$ determines risk aversion.

## 3.2 Value Functions

The household's optimization problem depends on its housing status. At each age, households choose consumption, savings, unsecured borrowing, and housing, subject to default and borrowing constraints.

### 3.2.1 Non-homeowners

The options of a non-homeowner are summarized in Figure 8. A non-homeowner chooses whether to remain a renter ($R$) or transition into homeownership by buying a house ($B$). Conditional on renting, the household also decides whether to repay unsecured debt, file for bankruptcy, or become delinquent.

The value function of a non-homeowner is

$$N_{j,n}(a, z, \epsilon) = \max\left\{R_{j,n}(a, z, \epsilon), B_{j,n}(a + e_n(z, \epsilon), z)\right\}.$$

Conditional on renting, the household solves

$$R_{j,n}(a, z, \epsilon) = \max\left\{R^P_{j,n}, R^{BK}_{j,n}, R^{DQ}_{j,n}\right\},$$

where the three value functions correspond to repayment, bankruptcy, and delinquency.

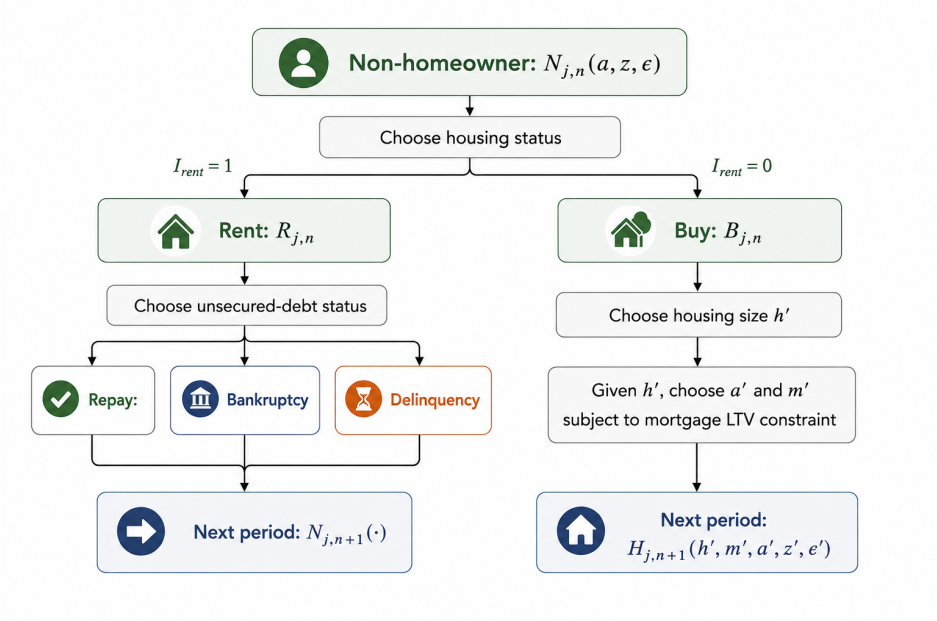



Figure 8: Non-Homeowner Choices

**Repayment:** If the household repays unsecured debt as promised, it chooses next period asset holdings $a'$:

$$R^P_{j,n}(a, z, \epsilon) = \max_{a'} \; u(c, h_R) + \rho_n \beta_j \mathbb{E}\left[N_{j,n+1}(a', z', \epsilon') \mid z\right],$$

subject to

$$c + q^a_{j,n}(h_R, 0, a', z)a' = e_n(z, \epsilon) + a.$$

The price function $q^a_{j,n}$ reflects endogenous borrowing limits and default risk.

**Bankruptcy:** If the household files for bankruptcy, unsecured debt is discharged immediately:

$$R^{BK}_{j,n}(a, z, \epsilon) = u(c, h_R) + \rho_n \beta_j \mathbb{E}\left[N_{j,n+1}(0, z', \epsilon') \mid z\right],$$

subject to

$$c = e_n(z, \epsilon) - \text{filing fee}.$$

Following bankruptcy, the household enters the next period with zero unsecured debt.

**Delinquency:** Under delinquency, the household stops repayment but remains outside formal bankruptcy:

$$R^{DQ}_{j,n}(a, z, \epsilon) = u(c, h_R) + \rho_n \beta_j \mathbb{E}\left[\varphi^a N_{j,n+1}(0, z', \epsilon') + (1 - \varphi^a) N_{j,n+1}(a(1 + r^R), z', \epsilon') \mid z\right].$$

Current consumption equals current income:

$$c = e_n(z, \epsilon).$$

With probability $\varphi^a$, delinquent debt is discharged in the following period. Otherwise, debt rolls over at the penalty interest rate $r^R$.

**Home purchase:** A renter who purchases a house chooses housing size $h'$, unsecured assets $a'$, and mortgage debt $m'$.

For a given housing choice $h'$, the value function is

$$\hat{B}_{j,n}(a, z; h') = \max_{a', m'} \; u(c, h') + \rho_n \beta_j \mathbb{E}\left[H_{j,n+1}(h', m', a', z', \epsilon') \mid z\right],$$

subject to

$$c + q^a_{j,n}(h', m', a', z)a' = a + q^m_{j,n}(h', m', a', z)m' - I_{m'>0}\xi_M - (1 + \xi_B)ph',$$

and

$$q^m_{j,n}(h', m', a', z)m' \leq \lambda p h'.$$

The parameter $\xi_M$ captures fixed mortgage origination costs, $\xi_B$ denotes housing transaction costs, $p$ is the house price, and $\lambda$ is the loan-to-value limit.

The household then optimally chooses housing size:

$$B_{j,n}(a, z) = \max_{h'} \hat{B}_{j,n}(a, z; h').$$

### 3.2.2 Homeowners

The options of a homeowner are summarized in Figure 9. A homeowner enters the period with housing $h$, mortgage debt $m$, unsecured assets $a$, and income state $(z, \epsilon)$. In the pre-COVID steady state, mortgage forbearance is not available. Starting in Q2-2020, households gain access to mortgage forbearance, which is a permanent (but previously unanticipated) option thereafter. Thus, once forbearance becomes available, the household chooses among six options: remain current on the mortgage, refinance their mortgage, enter mortgage forbearance, default on their mortgage, sell their house and buy another one, or sell their house and become a renter.

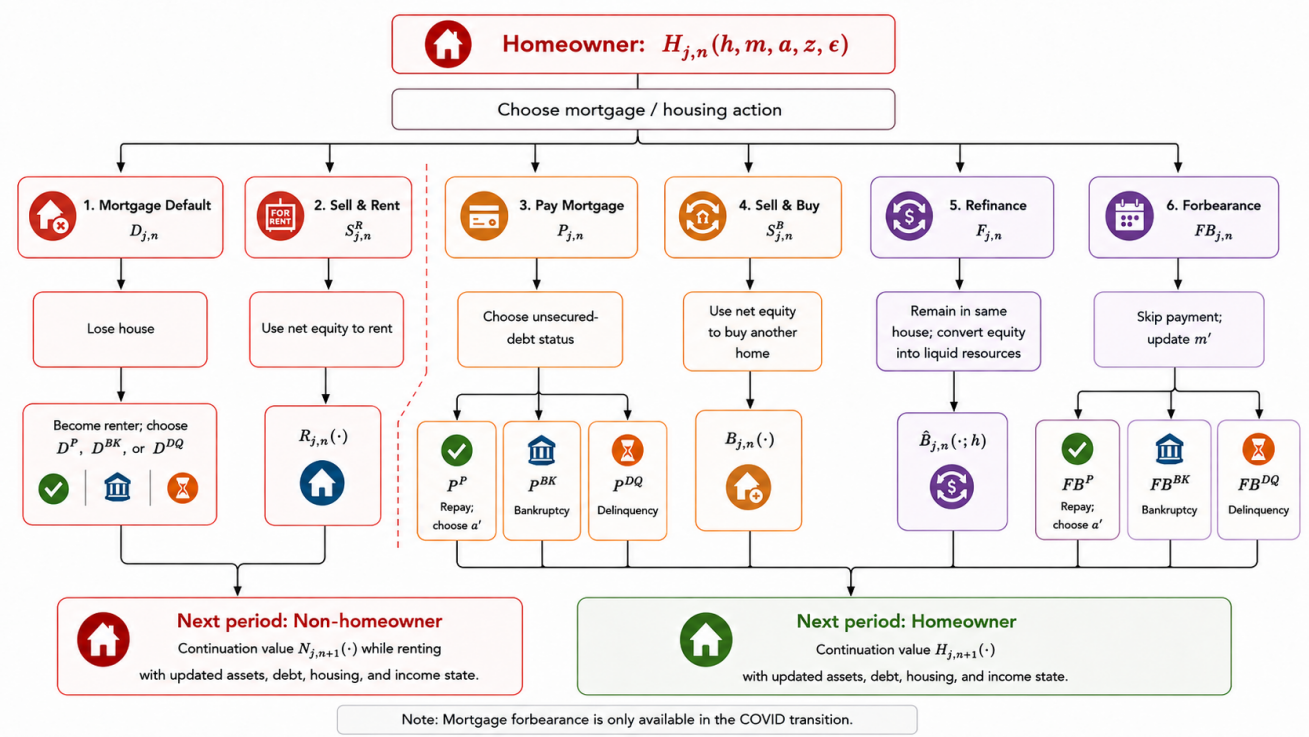



Figure 9: Homeowner Choices

The value function homeowners solve is

$$H_{j,n}(h, m, a, z, \epsilon) = \max \left\{ P_{j,n}, F_{j,n}, FB_{j,n}, D_{j,n}, S^B_{j,n}, S^R_{j,n} \right\}.$$

**Mortgage payment:** If the household remains current on its mortgage, it pays the scheduled mortgage payment and then chooses how to manage unsecured debt:

$$P_{j,n} = \max \left\{ P^P_{j,n}, P^{BK}_{j,n}, P^{DQ}_{j,n} \right\}.$$

If the household repays unsecured debt, it chooses next-period unsecured assets $a'$:

$$P^P_{j,n}(h, m, a, z, \epsilon) = \max_{a'} \; u(c, h) + \rho_n \beta_j \mathbb{E} \left[ H_{j,n+1}(h, m(1-\delta), a', z', \epsilon') \mid z \right],$$

subject to

$$c + q^a_{j,n}(h, m(1-\delta), a', z) a' = e_n(z, \epsilon) + a - m.$$

If the household files for bankruptcy, unsecured debt is discharged:

$$P^{BK}_{j,n}(h, m, a, z, \epsilon) = u(c, h) + \rho_n \beta_j \mathbb{E} \left[ H_{j,n+1}(h, m(1-\delta), 0, z', \epsilon') \mid z \right],$$

subject to

$$c = e_n(z, \epsilon) - \text{filing fee} - m.$$

Lastly, if the household becomes delinquent on unsecured debt, repayment stops temporarily and follows the same discharge process described above in the case of the renter: $P^{DQ}_{j,n}(h, m, a, z, \epsilon) =$

$$u(c, h) + \rho_n \beta_j \mathbb{E}\left[\varphi^a H_{j,n+1}(h, m(1-\delta), 0, z', \epsilon') + (1-\varphi^a) H_{j,n+1}(h, m(1-\delta), a(1+r^R), z', \epsilon') \mid z\right],$$

subject to

$$c = e_n(z, \epsilon) - m.$$

**Mortgage forbearance:** When mortgage forbearance is available, the household may skip the current mortgage payment. The missed payment is repaid over the remaining life of the loan:

$$m' = m(1-\delta) + \frac{m}{\Omega_n},$$

where $\Omega_n$ adjusts the missed payment to take into account discounting and the number of remaining mortgage payments.[8]

Conditional on using forbearance, the household again chooses whether to repay unsecured debt, file for bankruptcy, or become delinquent:

$$FB_{j,n} = \max\left\{FB^P_{j,n}, FB^{BK}_{j,n}, FB^{DQ}_{j,n}\right\}.$$

If the household repays unsecured debt, it chooses $a'$:

$$FB^P_{j,n}(h, m, a, z, \epsilon) = \max_{a'} \; u(c, h) - \vartheta + \rho_n \beta_j \mathbb{E}\left[H_{j,n+1}(h, m', a', z', \epsilon') \mid z\right],$$

subject to

$$c + q^a_{j,n}(h, m', a', z) a' = e_n(z, \epsilon) + a.$$

If the household files for bankruptcy while in forbearance, its value evolves as:

$$FB^{BK}_{j,n}(h, m, a, z, \epsilon) = u(c, h) - \vartheta + \rho_n \beta_j \mathbb{E}\left[H_{j,n+1}(h, m', 0, z', \epsilon') \mid z\right]$$

subject to

$$c = e_n(z, \epsilon) - \text{filing fee}.$$

[8] We define $\Omega_n$ formally in Appendix C.5.

Lastly, if the household becomes delinquent on unsecured debt while in forbearance, its value evolves as: $FB^{DQ}_{j,n}(h,m,a,z,\epsilon) =$

$$u(c,h) - \vartheta + \rho_n \beta_j \mathbb{E}\left[\varphi^a H_{j,n+1}(h,m',0,z',\epsilon') + (1-\varphi^a) H_{j,n+1}(h,m',a(1+r^R),z',\epsilon') \mid z\right],$$

subject to

$$c = e_n(z,\epsilon).$$

**Refinancing:** The household may refinance the mortgage and remain in the same house. Refinancing converts home equity into liquid resources, net of transaction costs:

$$F_{j,n}(h,m,a,z,\epsilon) = \hat{B}_{j,n}\left(a + ph(1+\xi_B) - q^*_n m + e_n(z,\epsilon), z; h\right).$$

Here $q^*_n$ denotes the price of mortgage pre-payment, which is formally defined in Section C.5.

**Mortgage default** The household may default on the mortgage, forcing them to leave their home and become renters. With this change of housing tenure, the household is left with choosing how to handle their unsecured debt:

$$D_{j,n} = \max\left\{D^P_{j,n}, D^{BK}_{j,n}, D^{DQ}_{j,n}\right\},$$

where

$$D^P_{j,n} = R^P_{j,n}(a,z,\epsilon),$$
$$D^{BK}_{j,n} = R^{BK}_{j,n}(a,z,\epsilon),$$

and

$$D^{DQ}_{j,n} = R^{DQ}_{j,n}(a,z,\epsilon).$$

**Selling** Finally, the household may sell their house. After paying selling costs and retiring the remaining mortgage balance, the household chooses to either rent or buy another house.

If the household sells and becomes a renter, it obtains value:

$$S^R_{j,n}(h,m,a,z,\epsilon) = R_{j,n}\left(a + ph(1-\xi_S) - q^*_n m, z, \epsilon\right).$$

Meanwhile, if the household sells and buys another house, it obtains value:

$$S^B_{j,n}(h, m, a, z, \epsilon) = B_{j,n}\left(a + ph(1 - \xi_S) - q^*_n m + e_n(z, \epsilon), z\right).$$

### 3.3 Bond prices

Debt prices are determined competitively and satisfy lender zero-profit conditions.

The price of a mortgage, $q^m_{j,n}$, for a household of type $j$ that chooses next-period housing $h'$, mortgage payment $m'$, unsecured assets $a'$, and income state $y$, is given by

$$q^m_{j,n}(h', m', a', y) = \frac{q^m_{pay,j,n} + q^m_{prepay,j,n} + q^m_{default,j,n}}{1 + r},$$

where $r$ denotes the risk-free interest rate.

This expression shows that mortgage prices depend on the probability that the mortgage is repaid, prepaid, defaulted, or enters forbearance (once this option is allowed) in the following period. Mortgage repayment can occur jointly with repayment, bankruptcy, or delinquency on unsecured debt. The model imposes no restrictions on these joint choices, allowing households substantial flexibility in managing mortgage and unsecured liabilities.

Mortgage prepayment occurs when the household refinances, sells the house and becomes a renter, or sells the house and purchases another property. In these states, mortgage debt is fully repaid. Finally, mortgage default may also occur jointly with repayment, bankruptcy, or delinquency on unsecured debt.

Under this formulation, mortgage prices fully internalize the interaction between mortgage obligations and unsecured financial positions, both current and future, when determining default risk. In the appendix, we extend this equation to account for the fact that once mortgage forbearance is permanently allowed, mortgage values also internalize the effect of this option on default risk.

Similarly, unsecured debt prices reflect repayment and delinquency outcomes:

$$q^a_{j,n}(h', m', a', z) = \frac{q^a_{pay,j,n}(h', m', a', z) + q^a_{DQ,j,n}(h', m', a', z)}{1 + r}.$$

The first component, $q^a_{pay,j,n}$, captures states in which unsecured debt is fully repaid next period. As highlighted in the decision problems, repayment is always an option regardless of housing tenure/mortgage status.

The second component, $q^a_{DQ,j,n}$, captures states in which unsecured debt enters delin-

quency next period. Recall, delinquent debt is rolled over at the penalty rate $(1 + r^R)$ with probability $(1 - \varphi^a)$. In contrast to repayment, delinquency (and bankruptcy) varies with housing tenure/mortgage status. In particular, the decision problems outlined above highlight that it is not allowed among home buyers, sellers who choose to buy another house, or mortgage refinancers. Intuitively, since households in these states are transacting in the mortgage market, good credit standing is essential.

# 4 Model Calibration and Estimation

This section describes the quantitative implementation of the model. Importantly, before using it as a laboratory for understanding mortgage forbearance during the pandemic, we want to ensure it can replicate salient features of the pre-pandemic economy. Of these, we emphasize the matching of the most relevant aspect—for our question—of household financial distress observed in pre-pandemic data: unsecured debt delinquency.

As is standard, our quantitative strategy follows two steps. First, we externally calibrate certain parameters using guidance from prior literature. Then, we estimate the remaining parameters so that the model matches key features of household balance sheets, homeownership, and financial distress before the pandemic.

## 4.1 Externally calibrated parameters

Among the subset of parameters we calibrate using external information are those involving income risk, retirement, mortality, interest rates, and the structure of housing and mortgages. A period in the model refers to one quarter. Households enter at age 25, retire at age 65, and face mortality risk up to age 85. At age 25, agents are endowed with initial conditions for earnings, homeownership, and net financial wealth, based on data from individuals aged 23 to 27 in the 2016 and 2019 Surveys of Consumer Finances (SCF). Age-specific survival probabilities are based on estimates from the Centers for Disease Control and Prevention's Vital Statistics, 2019. We will treat the economy as sufficiently open to face a world risk-free interest rate, which we set at 3%, annually.

The parameters thus far are naturally regarded as clearly exogenous to the forces within our model. We next select parameter values that govern preferences, allowing the model to match a chosen set of targets. Specifically, we follow Athreya, Mustre-del Río and Sánchez (2019) in assuming that agents can either discount the future relatively little (i.e., be "patient") and have discount factor $\beta_H$, or discount it more significantly (i.e., be "impatient") and use discount factor $\beta_L$. This heterogeneity allows the model to cap-

ture the joint distribution of net financial wealth, delinquency (incidence and persistence), and bankruptcy. We set $\beta_H$=1.00 and $\beta_L$=0.70, which is within the range of estimates in Athreya, Mustre-del Río and Sánchez (2019) and also Aguiar, Bils and Boar (2025). As for the establishment of the share of agents with the relatively low discount rate, denoted $s_L$, this will be estimated in a process to be described shortly.

In terms of preferences for consumption and housing, we assume households experience utility with a constant elasticity of substitution:

$$u(c,h) = \frac{((1-\theta)c^{1-1/\alpha} + \theta h^{1-1/\alpha})^{(1-\gamma)/(1-1/\alpha)}}{1-\gamma},$$

where $\gamma$ denotes the risk aversion parameter, $\alpha$ governs the degree of intra-temporal substitutability between housing and nondurable consumption goods, and $\theta$ determines the expenditure share for housing. Following Hatchondo, Martinez and Sánchez (2015), we set $\gamma$ to 2 and $\alpha$ to 0.5. The value of $\alpha$ is consistent with estimates from Hanushek and Quigley (1980), Siegel (2008), and Li et al. (2015). We set $\theta$ to 0.14, which matches the share of housing in total consumption expenditures in NIPA data.[9] Lastly, the size of rental houses, $h^R$, is a parameter to be estimated below.

Turning to owner-occupied houses, we set a few more parameters using external information. As in Hatchondo, Martinez and Sánchez (2015), we assume rental houses are free so that everyone in our model can afford housing. Meanwhile, the (per-unit) price of owner-occupied houses, $p^H$, is calibrated so that the model replicates the mean home value-to-mean income ratio observed in the data. Next, we assume the mortgage payment decay rate is $\delta = 0.02$ (annually), so that mortgage payments decay at the average inflation rate. We allow for owner-occupied houses to be subject to depreciation shocks. These shocks imply that, on average, the owner-occupied housing stock depreciates at 1.5% annually, following Kaplan, Mitman and Violante (2020). Lastly, the costs of signing and refinancing a mortgage follow the estimates of Gruber and Martin (2003).

Turning to unsecured credit, following Livshits, MacGee and Tertilt (2007), the penalty rate for delinquent debt is set at 20% annually, and the bankruptcy filing costs are at 2.8% of average income, or roughly $1,000. The discharge rate of delinquent debt, $\varphi^a$, is estimated below.

In terms of the income process, we consider a restricted income profile (RIP)-type income process following Kaplan and Violante (2010). During working ages, income has

[9] A similar calibration strategy is done in Jeske, Krueger and Mitman (2013).

a life-cycle component, a persistent component, and an i.i.d. component:

$$log(y^i_{n,t}) = l(n) + z^i_{n,t} + \epsilon^i_{n,t},$$

where: $l(n)$ denotes the life-cycle component, $\epsilon^i_{n,t}$ is a transitory component, and $z^i_{n,t}$ is a persistent component as follows:

$$z^i_{n,t} = z^i_{n,t-1} + e^i_{n,t}.$$

We assume $\epsilon^i_{n,t}$ and $e^i_{n,t}$ are normally distributed with variances $\sigma^2_\epsilon$ and $\sigma^2_e$, respectively. We set $\sigma^2_\epsilon$ and $\sigma^2_e$ so that, at an annual frequency, the variance of transitory and persistent shocks matches the values from Kaplan and Violante (2010). The variance of the initial (age 25) draw of the persistent component follows Kaplan and Violante (2010). Lastly, the life-cycle component of earnings is calculated for individuals aged 25 to 65 in the SCF 1989-2019 who are employed by someone or self-employed. Similar to Kaplan and Violante (2010), this profile rises with age, peaking around age 55 at nearly twice its initial value. It then declines to roughly 90% of its peak just before retirement.

Once in retirement, pensions are modeled succinctly. The household receives a fraction of the last realization of the persistent component of its working-age income using the replacement ratio formula: $\max\{A_0 + A_1 exp(z^i_{W-1}), A_2\}$. To be consistent with replacement ratios in the United States, we calibrate $A_0$, $A_1$, and $A_2$, such that the replacement ratio declines with income, from 69% to 14%, with an average replacement rate of 47%, all at an annual level. For reference, Table 6 in Appendix D collects all the parameters set externally.

## 4.2 Estimated parameters and model fit

The remaining parameters to be determined are the share of impatient types in the population $s_L$, the size of rental houses $h^R$, and the discharge rate of the delinquent unsecured debt, $\varphi^a$. We estimate these three parameters by targeting 31 moments from the data that capture the distributions of homeownership, financial wealth, and delinquency before the pandemic.

The estimated parameter values shown in Table 2 indicate substantial heterogeneity in the population. The share of impatient households, $s_L$, is estimated to be 15%. The estimated rental house size of 1.4 is roughly a third of the average size of owner-occupied houses. Lastly, the quarterly discharge rate for delinquent debt is 4.8%, yielding an annualized rate well within the range of estimates in Athreya, Mustre-del Río and Sánchez

(2019). Although we estimate only three parameters to match 31 moments, the model demonstrates a good fit to the data, as evidenced by the chi-squared statistic of 2.89.

| Parameter | Value | SE |
|---|---|---|
| Share of $L$-type $s_L$ | 0.15 | 0.05 |
| Rental size $h^R$ | 1.36 | 0.12 |
| Discharge prob. $\varphi^a$ | 0.048 | 0.004 |
| $\chi^2 = 2.89$ | | |

Table 2: Estimated model parameters

Rather than present the model's ability to match all these moments, we focus here on the distributions of credit card delinquency and homeownership.[10] Naturally, getting the distribution of homeownership right is critical for the subsequent analysis of mortgage forbearance. Additionally, reproducing the distribution of credit card delinquency is also critical, as it helps identify the share of impatient households in the population.

Focusing first on delinquency, Figures 10 and 11 reveal that the model replicates the duration of credit card delinquency for all individuals and among mortgage holders. Figure 10 shows that the model replicates the U-shaped distribution observed in the data: most individuals either exit delinquency within a quarter or remain in it for eight quarters. Figure 11 shows that the model replicates the fact that among mortgage holders, the duration of delinquency is skewed toward shorter spells.

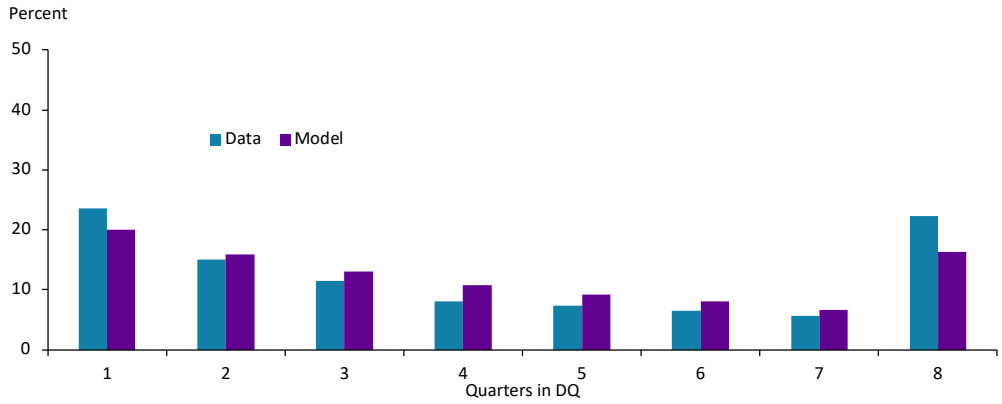



Figure 10: Distribution of delinquency durations (overall)

Turning to homeownership, the model matches the general increase in homeownership with age. As seen in Figure 12, it matches the lower rates of homeownership among

[10] Interested readers can see the model's fit of all 31 moments in Table 7 of Appendix D.

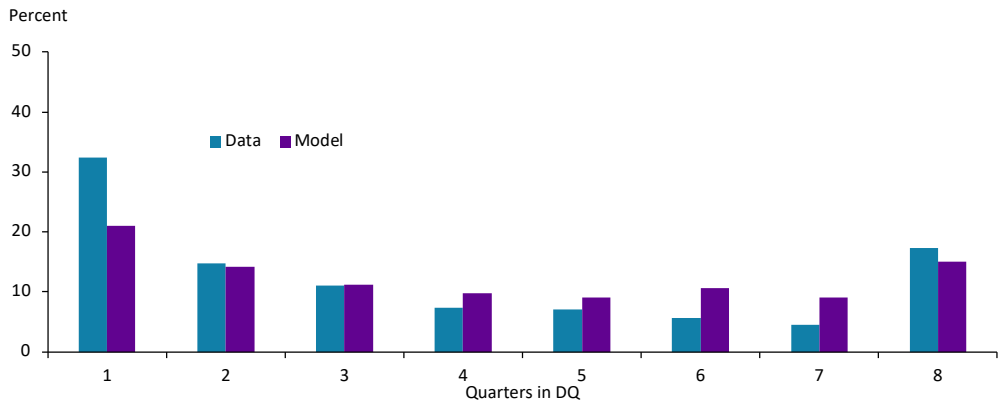



Figure 11: Distribution of delinquency durations (among mortgage holders)

30-year-olds compared to 40- and 50-year-olds. Importantly, the model does this by getting the mix of low- and high-$\beta$ individuals in homeownership right. We use the share of individuals with housing debt conditional on having at least a quarter in credit card delinquency as a proxy for homeownership among low-$\beta$ individuals. In the data and model, this figure is nearly 25 percent. Thus, the model replicates the fact that delinquent individuals (who are more likely to be impatient) are less likely to hold mortgages.

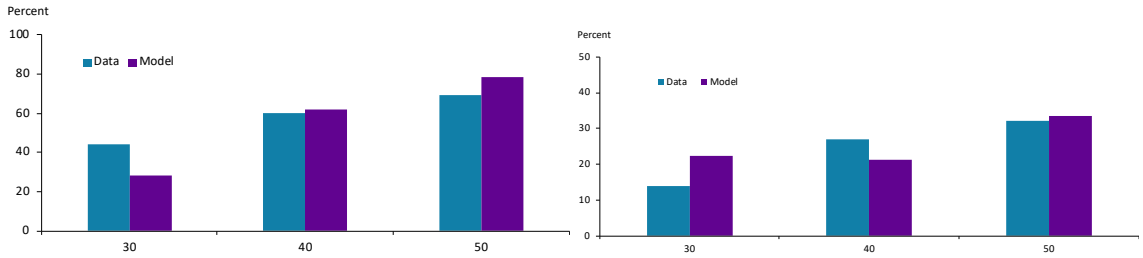



Figure 12: Homeownership (left) and share with mortgages conditional on delinquency (right) by age

# 5 The COVID-19 Transition and Mortgage Forbearance

This section uses the model to study household behavior during the COVID-19 transition. We first incorporate the mortgage forbearance program into the model and solve for the transitional dynamics from the pre-pandemic steady state. We then evaluate the model's ability to reproduce the observed dynamics of mortgage forbearance and debt over the pandemic. Finally, we use the model to isolate the mechanisms underlying its success and quantify their contribution to explaining household behavior.

## 5.1 Modeling and Calibrating Mortgage Forbearance

We now introduce mortgage forbearance into the model and study the transition dynamics it implies under shocks. We interpret the stationary equilibrium without forbearance as the U.S. economy immediately before the COVID-19 pandemic. Motivated by the empirical evidence in Section 2, the "pandemic shock" is modeled as a temporary increase in expected income risk that gradually dissipates. While this parsimonious approach abstracts from the many dimensions of the pandemic, we show that it is sufficient to account for the observed dynamics of mortgage forbearance.

We introduce three new parameters to the model that relate to the evolution of expected income risk and the costs of entering into mortgage forbearance. In terms of the temporary shock to expected income risk, we parameterize its initial magnitude, $\hat{\mu}_z$, and the speed, $\psi$, at which households revise their expectations of this risk back to normal. The third parameter, denoted by $\vartheta$, captures the utility cost of entering forbearance.

Although the three parameters are jointly determined, each primarily affects a different aspect of the transition. Utility costs determine households' long-run willingness to use forbearance once pandemic-related fears have largely subsided. Consequently, it is primarily characterized by the level of forbearance at the end of the sample period. Matching the observed forbearance rate in 2022:Q1 implies a utility cost of $\vartheta = 0.11$. For the average homeowner, this corresponds to roughly a 5 percent decrease in liquid wealth, indicating that entering forbearance carries a meaningful non-pecuniary cost.

Recall that in our baseline model, the persistent income innovation $e^i_{n,t}$ is drawn from a normal distribution with mean zero. For the households receiving the pessimistic signal, their subjective belief is that next period's innovation will instead be drawn from a distribution with mean $\hat{\mu}_z = -1.35$. Consequently, when these pessimistic households and their lenders evaluate continuation values, the standard objective expectation operator is replaced by a subjective expectation operator evaluated under this shifted distribution for $e^i_{n,t}$. The calibrated shock ($\hat{\mu}_z = -1.35$) implies that if realized, income falls by on average 28 percent, consistent with the extraordinary uncertainty surrounding income prospects at the beginning of the pandemic.

Importantly, we assume only 40 percent of households receive this pessimistic signal about the persistent component of future income, consistent with the evidence presented in Section 2. Additionally, this is purely a shock to beliefs: current and future income remains unchanged, but expectations of future income deteriorate sharply.

In addition, we assume that these pessimistic beliefs gradually disappear over time, which is also consistent with the evidence presented in Section 2. More formally, each quarter, a fraction $\psi$ of households update their expectations and return to their pre-

pandemic beliefs about the income process. As a result, aggregate expectations recover gradually rather than instantaneously. Looking at the time series path of income loss expectations presented in Figure 4 suggests that each month around 92 percent of "pessimistic" individuals remain so, while another 8 percent update their beliefs "back to normal". At a quarterly rate, this implies about 22 percent of individuals update their beliefs back to normal. Given these calculations, we set $\psi = 0.22$.

As shown in Figure 13, our calibration procedure, though simple and parsimonious, allows the model to match the forbearance rate during the pandemic very well. Importantly, while we match the beginning and end points by construction, the simple learning model about expected income shocks that we introduce appears to capture the dynamics of the mortgage forbearance take-up rate well.

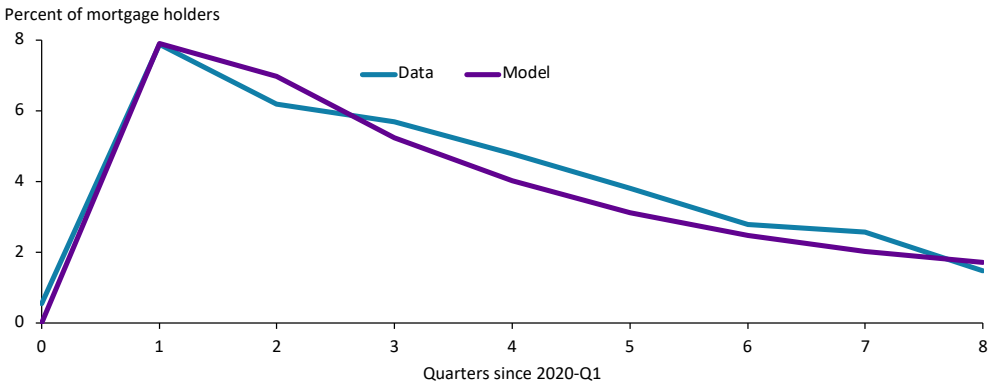



Figure 13: Mortgage forbearance: data vs model

## 5.2 Model Fit During the COVID-19 Transition

The previous section showed that the model closely matches the aggregate path of mortgage forbearance during the pandemic. In this section, we evaluate the model across several dimensions that were *not* targeted during calibration. These non-targeted moments provide additional discipline on the proposed mechanism and help explain how the model reconciles the short-lived and temporary use of mortgage forbearance with the persistence of household financial distress.

### 5.2.1 Duration of forbearance use

An important feature of the data is that among mortgage forbearance participants, usage was temporary. Although enrollment increased dramatically during the pandemic, nearly half of all households that entered forbearance exited after only one quarter, and

relatively few remained enrolled for an extended period. This pattern may seem difficult to reconcile with households suffering from persistent financial distress. While our model was estimated to match the persistence of financial distress, we now show that it replicates the sporadic usage of mortgage forbearance.

As seen in Figure 14, our model closely reproduces the distribution of forbearance duration observed in the data. The model captures both the large fraction of households exiting after one quarter and the rapid decline in the number of households remaining in forbearance for longer periods. This result is particularly noteworthy because the duration of forbearance was not targeted during calibration. Instead, it emerges naturally from the interaction between temporary pessimism about future income, the gradual recovery of household expectations, and the *selection* of households into mortgage forbearance.




Figure 14: Distribution of forbearance duration

### 5.2.2 Selection into forbearance

A key reason the model can replicate the distribution of forbearance duration is that it generates the right selection into forbearance. As documented in Section 2, the vast majority of households entering forbearance had not experienced delinquency before the pandemic. Thus, forbearance was primarily used by households that were financially healthy before COVID-19 rather than by households with a history of persistent repayment problems. Figure 15 compares the distribution of prior credit card delinquency among households entering forbearance.

The model closely matches the data, correctly predicting that most forbearance users had no prior delinquency. This result reflects the model's selection mechanism: homeowners experiencing a temporary increase in perceived income risk choose to delay mortgage payments even though many would have continued making payments in the absence of heightened uncertainty.

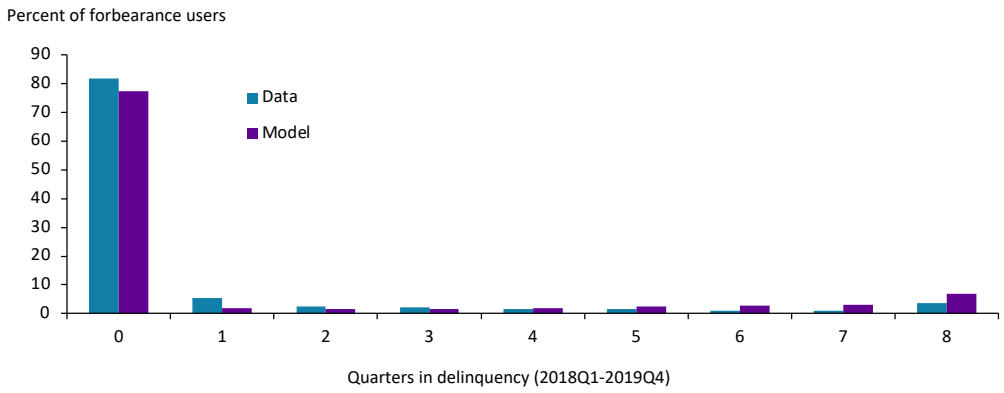



Figure 15: Prior delinquency among forbearance users

Recall that selection is important because households who entered into forbearance with a history of prior credit card delinquency remained in it substantially longer. Figure 16 restates the patterns described in Section 2 and shows the model can replicate the high duration of mortgage forbearance usage among individuals with prior credit delinquency (panel a) and the low duration of usage among individuals without prior credit delinquency (panel b). Households with weaker financial positions have lower expected future resources and therefore remain in forbearance for longer, even after expectations begin to recover. In contrast, financially healthier households exit forbearance quickly once uncertainty about future income declines.

(a) Individuals with prior delinquency

(b) Individuals without prior delinquency

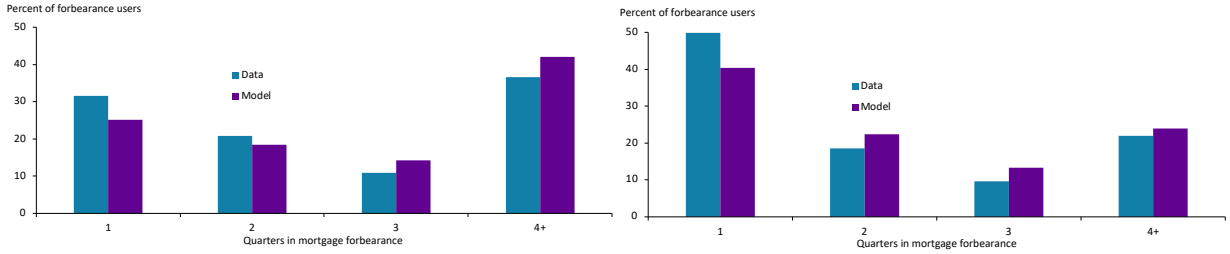


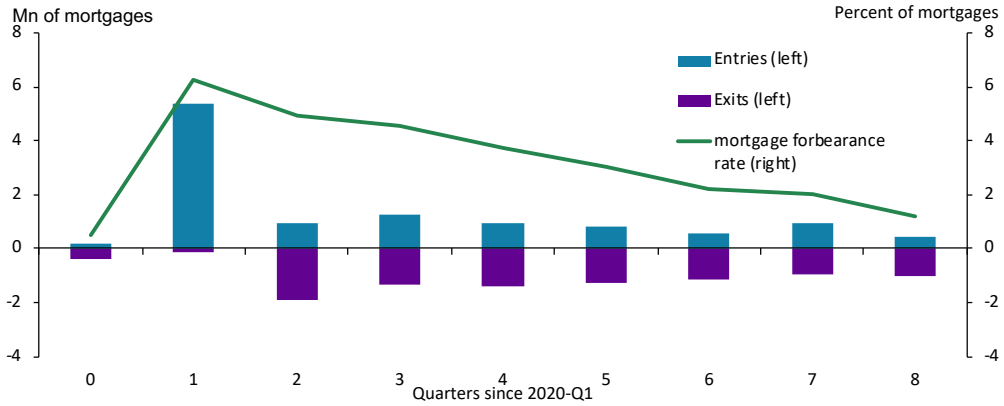

Figure 16: Forbearance duration among individuals by previous delinquency

### 5.2.3 Entry and exit dynamics

A final implication of the model concerns the flow dynamics of mortgage forbearance. The aggregate stock of households in forbearance is determined by the interaction between new entries into forbearance and exits from forbearance. Matching the stock (as our calibration delivers) does not, therefore, guarantee that the model correctly reproduces the underlying flows.

Figure 17 shows that, nevertheless, the model does relatively well along this non-targeted dimension. It compares the entry and exit flows in the data and the model.[11] Although the quantities are not exactly matched, both exhibit a sharp surge in entries immediately following the onset of the pandemic, followed by a rapid decline. At the same time, exits increase with a lag and remain elevated throughout the transition, gradually reducing the stock of households in forbearance.

(a) Data




(b) Model

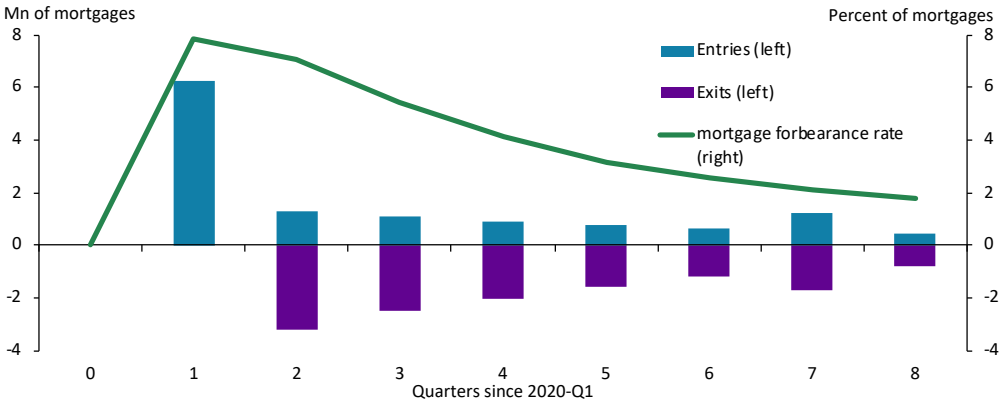



Figure 17: Flows into and out of forbearance

The model successfully captures these dynamics because of the evolution of income expectations. The initial increase in expected income risk generates a surge in entries into forbearance. Meanwhile, the gradual recovery of expectations induces households to resume mortgage payments over time. Consequently, the model matches not only the evolution of the stock of households in forbearance but also the gross flows that underlie

[11] The data-based entries and exits are similar to what is found in Haughwout et al. (2021), but extended through 2022-Q1. For the model-based graph, we assume that, in the model's steady state, there are approximately 80 million outstanding mortgages, consistent with data from the CCP for 2020-Q1.

it.

## 5.3 Understanding Why Forbearance Was Not Persistent in the Pandemic Era

The previous section showed that the model successfully reproduces several non-targeted moments of mortgage forbearance. This section explains the key ingredients behind the model's success. Three ingredients are essential. First, and as highlighted in the previous section, selection into forbearance is critical. If only impatient households enter into forbearance, then the aggregate path of forbearance is counterfactual. Second, households must gradually revise their beliefs about future income. If households revise their beliefs too quickly or too slowly, then the aggregate path of forbearance is also incorrect. Third, households make forbearance decisions based on expected, rather than realized, income. If expected income losses are realized, then aggregate forbearance is also too high and too persistent. Altogether, these mechanisms reconcile two seemingly contradictory facts: mortgage forbearance during the COVID-19 pandemic was remarkably short-lived, whereas household financial distress is highly persistent in normal times.

### 5.3.1 Selection

The first key ingredient in matching the overall mortgage forbearance rate along the transition is getting the selection into forbearance right. Figure 18 plots the forbearance rate along the transition path by discount factor type. The green line represents the forbearance rate among impatient types (low $\beta$). This path is much lower but flatter than the blue line (the model's baseline prediction). The reason this path is flat for low-$\beta$ borrowers is that the expected income loss is much less important for impatient borrowers. Thus the utility cost of forbearance determines the forbearance rate. Since this cost doesn't change over time, there is no decline in the share of impatient borrowers in forbearance. Thus, to replicate the facts about the use of forbearance during the COVID-19 pandemic, it is crucial to capture that only a small share of impatient borrowers used forbearance.

### 5.3.2 Gradual learning

The second key ingredient is that households gradually revise their beliefs about future income. Figure 19 illustrates the importance of gradual learning. If households update their beliefs too quickly (purple line), confidence about future income is restored almost immediately. As a result, households exit forbearance rapidly, and the aggregate share

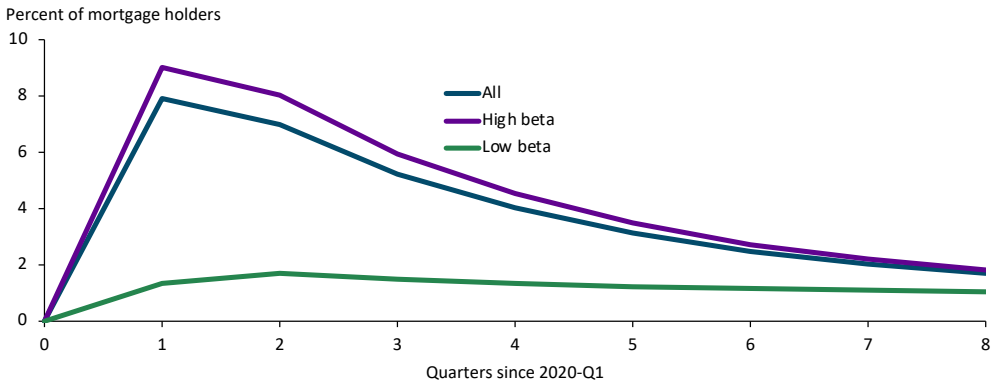



Figure 18: Forbearance dynamics by discount factor

of mortgage holders in forbearance falls much faster than observed in the data. At the opposite extreme, if households never revise their beliefs (green line), they continue to expect adverse income realizations that never materialize, remaining in forbearance for much longer than observed.

The baseline model lies between these two extremes. Gradual updating causes pessimistic beliefs to dissipate slowly across households, generating a gradual decline in aggregate forbearance while allowing individual households to exit once their expectations recover. This balance is essential for reproducing the observed dynamics of mortgage forbearance.

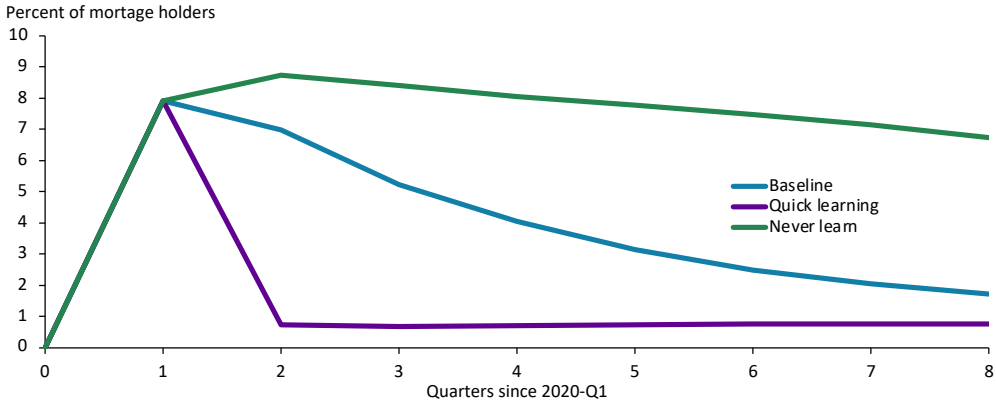



Figure 19: Forbearance dynamics under alternative learning speeds

### 5.3.3 Expected versus realized income shocks

The third key ingredient is that households make forbearance decisions based on *expected* future income rather than realized income. In the baseline economy, households become

pessimistic about future income at the onset of the pandemic, even though their current income is unchanged. As uncertainty gradually subsides, these fears prove to be largely unwarranted, and households resume making mortgage payments before experiencing substantial financial deterioration. Consequently, mortgage forbearance is widespread but temporary.

Figures 20 and 21 illustrate why this distinction is essential. These figures compare the baseline economy with two counterfactual environments in which households experience the income losses they initially fear. In the first counterfactual (green line), households correctly anticipate that the income shock will arrive in period two. In the second counterfactual (purple line), the shock arrives unexpectedly in period two. Although expectations differ across these two counterfactual exercises, the realized decline in income is identical in both cases.

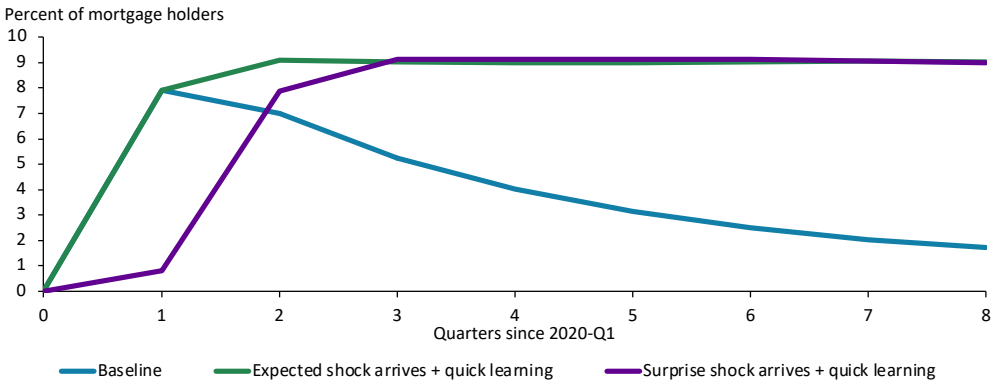
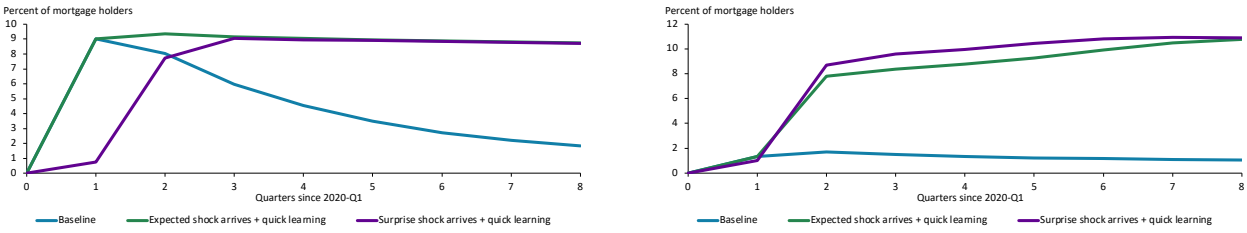



Figure 20: Forbearance dynamics under alternative expectations




(a) High beta

(b) Low beta

Figure 21: Forbearance dynamics under alternative expectations, by discount factor

This figure highlights two results. First, in aggregate, anticipation effects only matter for a few quarters. As seen in Figure 20, the path of forbearance is essentially the same by the third quarter regardless of whether or not the shock is anticipated. This figure, however, masks differences across types. Indeed, in the right panel of Figure 21 we can

see that the forbearance path for low-beta individuals is higher when the shock is unanticipated.

Second, and more importantly, once the adverse income shock actually materializes, mortgage forbearance becomes substantially more persistent regardless of whether it was anticipated. Households that experience realized income losses require considerably more time to rebuild their financial position before resuming mortgage payments. In the baseline economy, by contrast, households respond to a deterioration in expectations that is never realized. As beliefs gradually recover, they quickly exit forbearance without having experienced a persistent deterioration in their financial position.

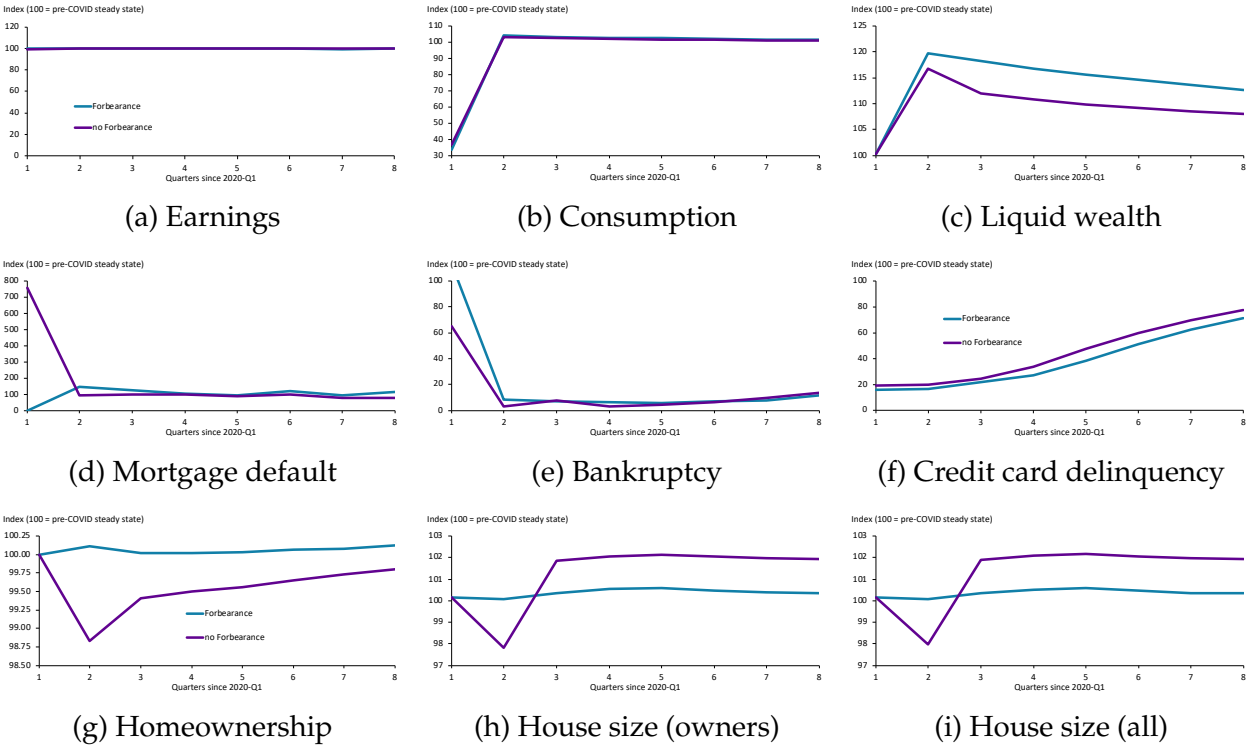
Taken together, these results explain why mortgage forbearance during the COVID-19 pandemic was remarkably short-lived despite the persistence of household financial distress documented during normal times. During the pandemic, households primarily responded to temporary fears about future income that gradually dissipated.

## 5.4 How Did Forbearance Matter for Forbearance Users?

In this section, we analyze the impact of forbearance by constructing counterfactual scenarios in which it isn't offered. To cleanly isolate the effect of forbearance, we focus on the cohort of households that entered into forbearance in the first quarter it became available and track their behavior throughout the transition. We track the dynamics of several variables, including consumption, liquid wealth, and housing. For each variable, Figure 22 plots its behavior with (baseline) and without (counterfactual) forbearance relative to the evolution of the same variable if the economy remains in the steady state.

Figure 22a shows the evolution of labor earnings. Because the anticipated shock never materializes, earnings remain at their steady-state level throughout the eight quarters. Figure 22b presents the corresponding path of consumption. Households that choose forbearance in period 1 of the baseline transition sharply reduce their consumption—to approximately 40 percent of its steady-state level—in anticipation of lower labor earnings. However, this consumption path differs only slightly compared to the case without forbearance. The effect of forbearance is more pronounced for liquid wealth, as shown in Figure 22c. Households receiving forbearance suspend their mortgage payments and instead accumulate those funds as liquid wealth.

The second row shows the evolution of financial distress. Figure 22d presents the mortgage default (foreclosure) rate. With forbearance, the mortgage default rate is zero in the first period for these agents by construction (since we are focusing on agents who use forbearance in period 1). Then it returns to a level close to its steady-state level in




(a) Earnings (b) Consumption (c) Liquid wealth

(d) Mortgage default (e) Bankruptcy (f) Credit card delinquency

(g) Homeownership (h) House size (owners) (i) House size (all)

Figure 22: Dynamics among forbearance users

subsequent quarters. Without forbearance, by contrast, the same anticipated shock would raise the mortgage default rate for these households to roughly eight times its steady-state level. Thus, in the model, a central role of forbearance is to prevent mortgage default.

Figures 22f and 22e show distress associated with credit card debt. Both delinquency and bankruptcy rates remain well below their steady-state levels after the first period. In the case with forbearance, the mechanism is straightforward. By construction, all households in this group use forbearance in the first period, allowing them to suspend their mortgage payments without missing payments on their credit card debt. The result without forbearance is less immediate. In that case, the sharp increase in mortgage default frees resources that households can use to remain current on their credit card debt. Thus, these households substitute nonpayment of mortgage debt for nonpayment of credit card debt, much as mortgage forbearance allows them to do without entering foreclosure.

The bottom row presents the evolution of housing decisions. Figure 22g shows that the homeownership rate changes very little when forbearance is available. Without forbearance, however, homeownership among this group of households declines modestly, partly due to increased foreclosures. Figures 22h and 22i show the evolution of housing demand among homeowners and among all households, including renters, respectively. For this group—the households most affected by forbearance—housing demand changes

only minimally when forbearance is available. Although the fluctuations remain relatively small without forbearance, they become more pronounced. These results reinforce the conclusion that, in our model, forbearance helps stabilize the housing market.[12]

# 6 Conclusion

Mortgage forbearance is a policy frequently used in times when large-scale household mortgage default might otherwise amplify macroeconomic shocks—as it did during the Global Financial Crisis. Given the costs of such programs, it is important to understand the forces that govern their attractiveness, especially those that determine overall take-up and subsequent persistence in use.

As we documented, take-up of pandemic-era forbearance was widespread, but persistence was remarkably low: the program was short-lived. At first glance, this is hard to reconcile with extensive evidence that household financial distress, as measured through unsecured debt delinquency, is highly persistent. Prior work, including (Athreya, Mustre-del Río and Sánchez, 2019), shows that these patterns can be well understood by extending single-agent models to incorporate a simple form of preference heterogeneity that distinguishes "impatient" households with urgent consumption needs from "patient" households. Given this, one might have expected households to remain in forbearance program for as long as it was available. Instead, most borrowers exited after only one quarter.

This paper shows that these facts are not contradictory. We develop a quantitative life-cycle model that includes mortgages, unsecured debt, default, and mortgage forbearance. We model the pandemic as a temporary increase in expected income risk at the onset of the pandemic. Two mechanisms are essential. First, mortgage forbearance is a program for homeowners, a group of households that is financially healthier than those who typically experience persistent financial distress. Second, households respond to changes in expected future income rather than realized income. As pessimistic expectations dissipated without being fully realized, borrowers quickly resumed making mortgage payments. Together, these mechanisms reconcile the temporary use of mortgage forbearance during COVID-19 with the persistence of household financial distress in normal times.

Our findings suggest that credit card delinquency and pandemic-era mortgage forbearance are fundamentally different, as they attracted different populations and were

[12] If house prices were allowed to adjust to clear the housing market, the fluctuations in quantities would be smaller, and house prices would also respond. For example, the decline in housing demand in the counterfactual without forbearance would put downward pressure on house prices. This effect would likely be modest, however, because the affected households account for less than 10 percent of homeowners and their housing demand declines by only about 2 percent.

driven by distinct shocks. This distinction, however, may be specific to the nature of the COVID-19 shock itself: an abrupt, highly uncertain disruption to expected income that ultimately proved far less persistent than initially feared. Forbearance programs introduced in response to shocks with different persistence properties—for example, a prolonged house-price bust rather than a sharp but transitory income shock—could generate very different take-up and exit dynamics. Indeed, related work shows that the transmission of macroeconomic shocks into household financial distress and consumption depends importantly on the type of shock involved (Mustre-del Río et al., 2025). Taken together, our results underscore that distinguishing between chronic financial distress and shock-specific, temporary precautionary responses is essential both for interpreting repayment behavior and for designing debt relief policies suited to the particular macroeconomic circumstances that prompt them.

# References


Aguiar, Mark, Mark Bils and Corina Boar. 2025. "Who Are the Hand-to-Mouth?" *Review of Economic Studies* 92:1293–1340.

Athreya, Kartik, José Mustre-del Río and Juan M. Sánchez. 2019. "The Persistence of Financial Distress." *The Review of Financial Studies* 32(10):3851–3883.

Athreya, Kartik, Juan M. Sánchez, Xuan S. Tam and Eric R. Young. 2017. "Bankruptcy and delinquency in a model of unsecured debt." *International Economic Review* 59(2):593–623.

Athreya, Kartik, Xuan S. Tam and Eric R. Young. 2009. Are Harsh Penalties for Default Really Better? Working Paper 09-11 Federal Reserve Bank of Richmond.

Calvet, Laurent E., John Y. Campbell, Francisco J. Gomes and Paolo Sodini. 2026. "The Cross-Section of Household Preferences." *Journal of Finance* .

Campbell, John Y. and Joao F. Cocco. 2015. "A Model of Mortgage Default." *The Journal of Finance* 70(4):1495–1554.

Chatterjee, Satyajit, Dean Corbae, Kyle Dempsey and José-Victor Ríos-Rull. 2023. "A Quantitative Theory of the Credit Score." *Econometrica* 91(5):1803–1840.

Chatterjee, Satyajit, Dean Corbae, Makoto Nakajima and José-Víctor Ríos-Rull. 2007. "A Quantitative Theory of Unsecured Consumer Credit with Risk of Default." *Econometrica* 75(6):1525–1591.

Corbae, Dean and Erwan Quintin. 2015. "Leverage and the Foreclosure Crisis." *Journal of Political Economy* 123(1):1–65.

Gorbachev, Olga and María José Luengo-Prado. 2016. The Credit Card Debt Puzzle: The Role of Preferences, Credit Risk, and Financial Literacy. Technical report Federal Reserve Bank of Boston. Research Department Working Paper 16-6.

Gruber, Joseph and Robert Martin. 2003. "Precautionary Savings and the Wealth Distribution with Illiquid Durables." *International Finance Discussion Papers* (773).

Hanushek, Eric A. and John M. Quigley. 1980. "What is the Price Elasticity of Housing Demand?" *Review of Economics and Statistics*, 62(3):449–454.

Hatchondo, Juan Carlos, Leonardo Martinez and Juan M. Sánchez. 2015. "Mortgage Defaults." *Journal of Monetary Economics* 76:173–190.

Haughwout, Andrew, Donghoon Lee, Joelle Scally and Wilbert van der Klaauw. 2021. Forbearance Participation Declines as Programs' End Nears. Liberty street economics Federal Reserve Bank of New York.

Herkenhoff, Kyle F. and Lee E. Ohanian. 2019. "The Impact of Foreclosure Delay on U.S. Employment." *Review of Economic Dynamics* 31:63–83.

Jeske, Karsten, Dirk Krueger and Kurt Mitman. 2013. "Housing, mortgage bailout guarantees and the macro economy." *Journal of Monetary Economics* 60(8):917–935.

Kaplan, Greg and Giovanni L. Violante. 2010. "How Much Consumption Insurance beyond Self-Insurance?" *American Economic Journal: Macroeconomics* 2(4):53–87.

Kaplan, Greg, Kurt Mitman and Giovanni L. Violante. 2020. "The Housing Boom and Bust: Model Meets Evidence." *Journal of Political Economy* 128(9):3286–3345.

Krusell, Per and Anthony A. Smith. 1998. "Income and Wealth Heterogeneity in the Macroeconomy." *Journal of Political Economy* 106(5):867–896.

Li, Wenli, Haiyong Liu, Fang Yang and Rui Yao. 2015. Housing over Time and over the Life Cycle: A Structural Estimation. Working paper no. 15-04 Federal Reserve Bank of Philadelphia.

Livshits, Igor, James MacGee and Michèle Tertilt. 2007. "Consumer Bankruptcy: A Fresh Start." *American Economic Review* 97(1):402–18.

Meier, Stephan and Charles Sprenger. 2010. "Present-Biased Preferences and Credit Card Borrowing." *American Economic Journal: Applied Economics* 2(1):193–210.

Mitman, Kurt. 2016. "Macroeconomic Effects of Bankruptcy and Foreclosure Policies." *American Economic Review* 106(8):2219–2255.

Mustre-del Río, José, Juan M. Sánchez, Ryan Mather and Kartik Athreya. 2025. "The Effects of Macroeconomic Shocks: Household Financial Distress Matters." *Review of Financial Studies* 38(2):564–604.

Siegel, Stephan. 2008. Consumption-Based Asset Pricing: Durable Goods, Adjustment Costs, and Aggregation. Working paper University of Washington.

# APPENDIX

## A Construction of Forbearance Measures

This appendix describes how we construct measures of mortgage forbearance using the NY Fed Consumer Credit Panel (CCP)/Equifax data.

The dataset does not contain a direct, consistently reported indicator of forbearance. We therefore rely on two complementary approaches.

**Narrative-code-based measure.** Equifax provides narrative codes for each loan that describe the account status. We classify a loan as being in forbearance if at least one of these codes indicates either that the account is "affected by a natural disaster" or that the "account is in forbearance."

A limitation of this approach is that reporting these codes is not mandatory for lenders. As a result, the narrative-code measure may understate the true extent of forbearance.

**Scheduled-payment-based measure.** The CARES Act requires credit reporting agencies to report zero scheduled payments when accommodations are granted. Based on this, we infer that a loan is in forbearance when the outstanding balance is positive, and the scheduled payment is reported as zero.

This approach captures a broader set of accounts but may introduce measurement noise if zero payments occur for reasons other than formal forbearance.

**Comparison of measures.**

Figure 23 compares the evolution of forbearance rates across these measures.

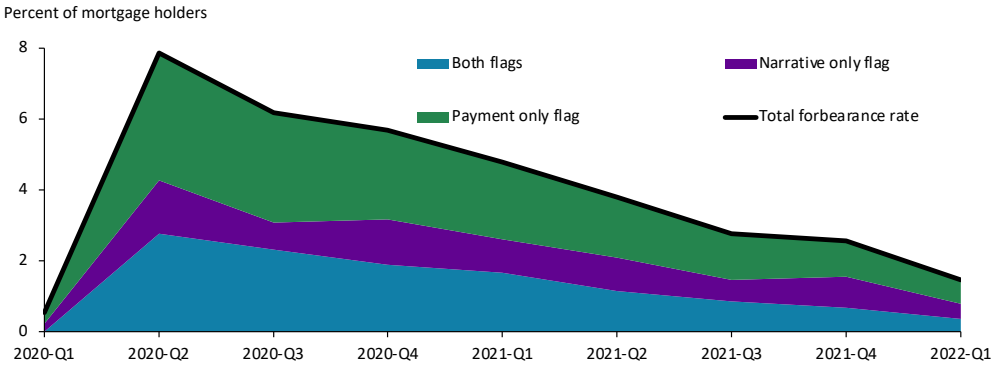



Figure 23: Forbearance rate decomposition by measurement approach

Both measures display similar time-series patterns, with a sharp increase at the onset

of the pandemic followed by a rapid decline. This consistency provides reassurance that a particular measurement approach does not drive our results.

In the main text, we define mortgage holders as in forbearance if either of these two measures indicates they are.

# B Additional Empirical Evidence

This appendix provides additional evidence on the relationship between expected income losses and mortgage forbearance. The goal is to document the robustness of the expectations channel across datasets, levels of aggregation, and empirical specifications.

## B.1 Evidence by age group

First, we combine variation across states and age groups in Figure 24, leveraging a larger number of observations (periods times states times age buckets) to document a clear positive association.

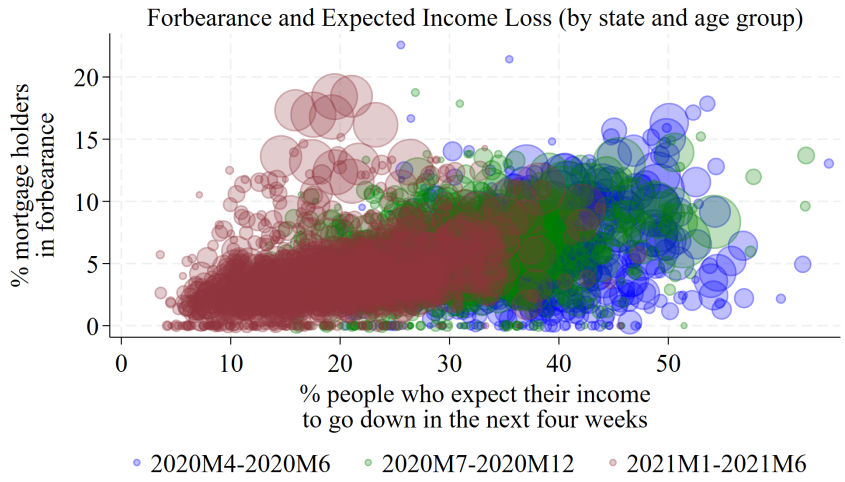



Figure 24: Expected income losses and forbearance: state-by-age group variation

Then, in Figure 25, we show that this positive aggregate association is visibly present within each age bucket, indicating that a particular age group does not drive the expectations channel. Taken together, the evidence in this appendix reinforces the central role of expectations in driving forbearance behavior during the pandemic.

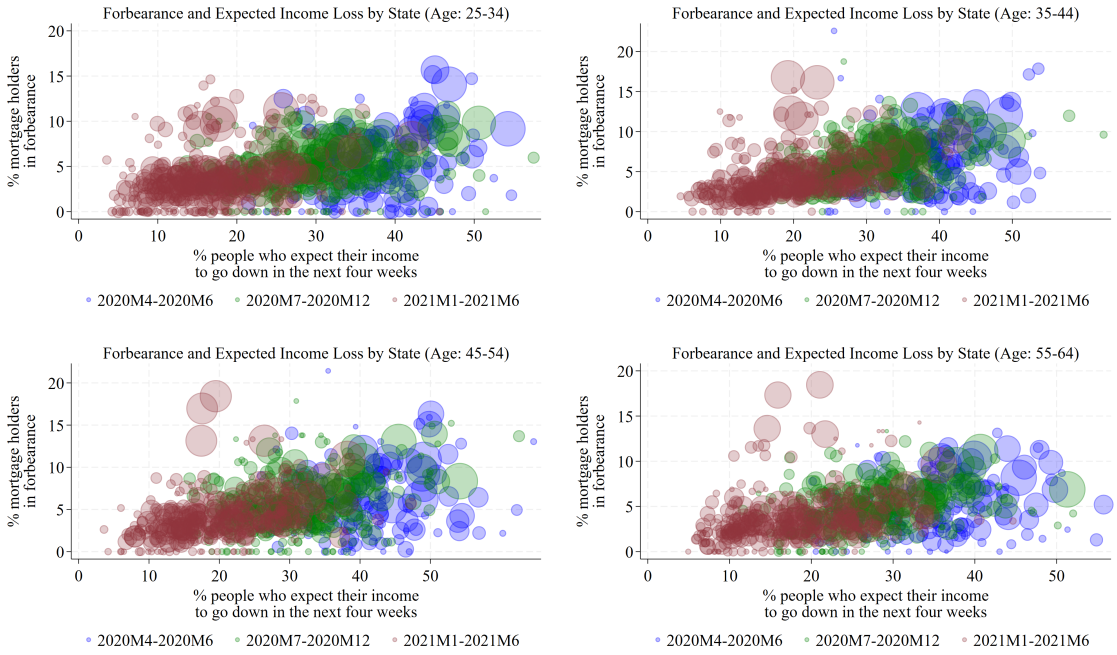



Figure 25: Expected income losses and forbearance by age group

## B.2 Evidence from the Survey of Consumer Expectations (SCE)

The NY Fed Survey of Consumer Expectations (SCE) asks survey participants what they expect their earnings to be if they were working in the same job at the same place they currently work, and working the same number of hours. Here, we aggregate the responses to this question at the state and commuting zone level and compare them with the incidence of forbearance.

Figure 26 shows a strong positive relationship between expected income losses and the incidence of mortgage forbearance at the state level. This pattern is consistent with the evidence from the Household Pulse Survey and supports the role of expectations in driving forbearance decisions. Table 3 formally quantifies the relationship between expected income losses and the incidence of forbearance using a state-quarterly panel. The relationship remains robust when controlling for state or time fixed effects. Figure 27 shows the robustness of the positive relationship at the commuting zone level. Table 4 quantifies this relationship and shows that it remains robust when controlling for the commuting zone or time fixed effects. In both cases, the coefficient remains positive but becomes insignificant when state and time fixed effects are added, which may be due to the small number of observations.

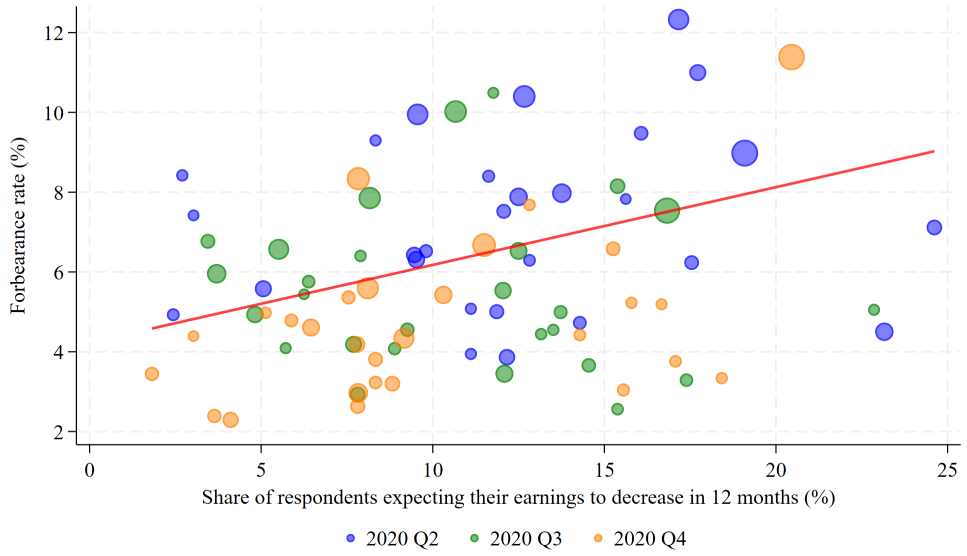



Figure 26: Expected income losses and forbearance at the state level: SCE evidence

Notes: We keep only samples with more than 30 state-quarter observations and expected earnings loss above zero. Each scatter size represents the number of respondents at the state-quarter level in the Survey of Consumer Expectations. The fitted line is weighted by the number of respondents in the SCE. The result remained robust even when the sample restriction was relaxed, with a limit on the number of observations at the state-quarter level exceeding 11.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | % People in Forbearance | | | |
| Expected Earnings Loss | 0.195*** | 0.139*** | 0.152* | 0.038 |
| | (0.066) | (0.042) | (0.083) | (0.042) |
| Constant | 4.229*** | 4.859*** | 4.725*** | 6.016*** |
| | (0.694) | (0.478) | (0.835) | (0.438) |
| Observations | 83 | 82 | 83 | 82 |
| R-squared | 0.155 | 0.757 | 0.243 | 0.876 |
| State FE | No | Yes | No | Yes |
| Time FE | No | No | Yes | Yes |

Table 3: Relationship between Expected Earnings Loss and Forbearance at the state level: SCE evidence

## B.3 Individual-level Evidence from the Census Pulse Survey

For a few survey waves, the Census Pulse Survey did ask respondents about mortgage payments. In particular, it asked whether respondents were able to pay last month's

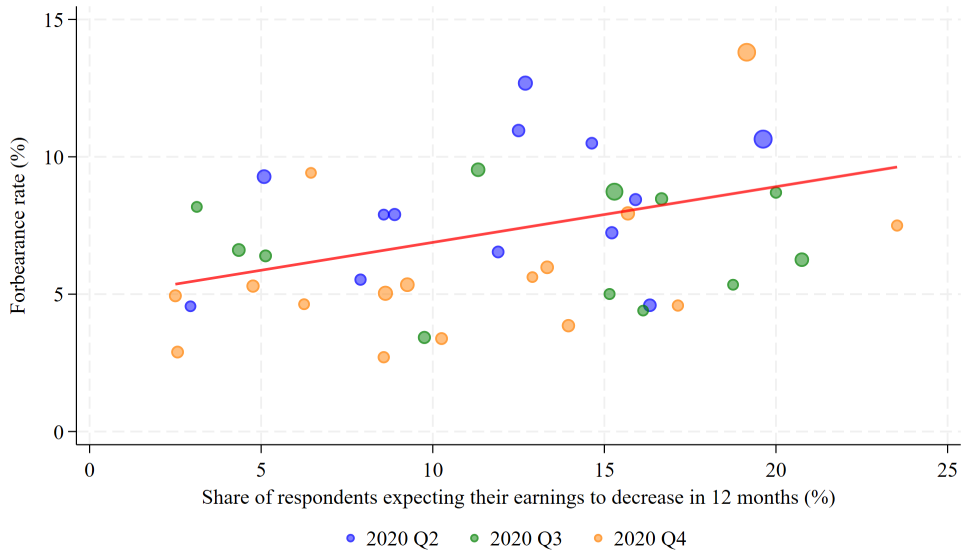



Figure 27: Expected income losses and forbearance at the commuting zone level: SCE evidence

Notes: We keep only samples with more than 30 observations at the commuting zone-quarter level and expected earnings loss above zero. Each scatter size represents the number of respondents at the commuting zone-quarter level in the Survey of Consumer Expectations. The fitted line is weighted by the number of respondents in the SCE. The result remained robust even when the sample restriction was relaxed, with the sample limited to those with more than 11 observations at the commuting zone-quarter level.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | % People in Forbearance | | | |
| Expected Earnings Loss | 0.203** | 0.128 | 0.195** | 0.092 |
| | (0.083) | (0.093) | (0.093) | (0.092) |
| Constant | 4.859*** | 5.853*** | 4.952*** | 6.317*** |
| | (0.924) | (1.243) | (0.970) | (1.045) |
| Observations | 41 | 36 | 41 | 36 |
| R-squared | 0.154 | 0.710 | 0.258 | 0.817 |
| Commuting Zone FE | No | Yes | No | Yes |
| Time FE | No | No | Yes | Yes |

Table 4: Relationship between Expected Earnings Loss and Forbearance at the commuting zone level: SCE evidence

mortgage on time and how confident they were in making their next payment on time. For the latter question, survey respondents had to choose between five answers: no confidence, slight confidence, moderate confidence, high confidence, and payment is/will be

deferred. The last option is potentially a proxy for mortgage forbearance, though it does not explicitly mention the program. This caveat notwithstanding, we can use these questions to examine the relationship between expected income losses and individual-level entry into mortgage forbearance, all within the same dataset.

The results of Table 5 suggest that even at the individual level, there is strong evidence that expected income losses were associated with higher participation in mortgage forbearance. Because the responses to the question regarding confidence in making the next payment are categorical, we estimate a multinomial logit model. For expositional simplicity, we report the coefficients for the outcome of interest (payment is/will be deferred) as relative risk ratios, with the baseline outcome being high confidence in payment. The first column shows that expected income losses significantly increase the likelihood of reporting a mortgage payment deferral relative to high confidence in making payments. Since we are leveraging individual-level data for this estimation, these regressions control for standard demographic characteristics such as age, race, and education. However, because of survey design, we cannot track individuals over time and thus control for individual fixed effects.

| | Relative risk of payment deferral | |
|---|---|---|
| | (1) | (2) |
| Expected income loss | 3.872*** | 3.746*** |
| | (0.059) | (0.057) |
| Constant | 0.112*** | 0.165*** |
| | (0.016) | (0.023) |
| Demographic Controls | ✓ | ✓ |
| Employment Controls | | ✓ |
| Observations | 1090581 | 1090021 |
| Pseudo $R^2$ | 0.147 | 0.148 |

Table 5: The Relationship between Forbearance Expected Income Loss at the Individual Level

Importantly, this finding is true even after controlling for employment status. The second column shows that, even after controlling for employment status, expected income losses still meaningfully increase the likelihood of reporting a mortgage payment deferral.

# C Debt prices

## C.1 Mortgage prices

Debt prices are determined competitively and satisfy lender zero-profit conditions.

The price of a mortgage, $q^m_{j,n}$, for a household of type $j$ that chooses next-period housing $h'$, mortgage debt $m'$, unsecured assets $a'$, and income state $y$, is given by

$$q^m_{j,n}(h', m', a', y) = \frac{q^m_{pay,j,n} + q^m_{prepay,j,n} + q^m_{default,j,n}}{1+r}, \tag{1}$$

where $r$ denotes the risk-free interest rate.

This expression shows that mortgage prices depend on the probability that the mortgage is repaid, prepaid, or defaulted on in the following period. Mortgage repayment can occur jointly with repayment, bankruptcy, or delinquency on unsecured debt. The model imposes no restrictions on these joint choices, allowing households substantial flexibility in managing mortgage and unsecured liabilities.

Mortgage prepayment occurs when the household refinances, sells the house and becomes a renter, or sells the house and purchases another property. In these states, mortgage debt is fully repaid. Finally, mortgage default may also occur jointly with repayment, bankruptcy, or delinquency on unsecured debt.

Under this formulation, mortgage prices fully internalize the interaction between mortgage obligations and unsecured financial positions, both current and future, when determining default risk. Importantly, mortgage prices in the pre-COVID steady state do not account for the possibility of mortgage forbearance, since forbearance became unexpectedly available only during the transition beginning in Q2-2020.

When a household uses a mortgage that promises repayment of $m'$ next period, the amount borrowed is

$$m' q^m_{j,n}(h', m', a', z).$$

The first component of the mortgage price, $q^m_{pay,j,n}$, captures states in which the household remains current on the mortgage next period:

$$q^m_{pay,j,n}(h', m', a', z) = \rho_n \mathbb{E}\Big[ \quad \text{mort pay, no def} + \text{mort pay, BK} + \text{mort pay, DQ} \Big| z \Big], \tag{2}$$

where

$$\text{mort pay, no def} \;=\; \mathbb{I}_{P^P_{j,n+1}(h', m', a', z', \epsilon')} \Big[ 1 + (1-\delta) q^m_{j,n+1}(h', m'', a'', z') \Big], \tag{3}$$

$$a'' = \hat{a}^{P,P}_{j,n+1}(h', m', a', z', \epsilon'),$$

$$\text{mort pay, BK} = \mathbb{I}_{P^{BK}_{j,n+1}(h',m',a',z',\epsilon')}\Big[1 + (1-\delta)q^m_{j,n+1}(h', m'', 0, z')\Big], \tag{4}$$

and

$$\begin{aligned}\text{mort pay, DQ} = \mathbb{I}_{P^{DQ}_{j,n+1}(h',m',a',z',\epsilon')}\Bigg[1 + (1-\delta)\Big(&\varphi^a q^m_{j,n+1}(h', m'', 0, z') \\ &+(1-\varphi^a)q^m_{j,n+1}(h', m'', a'', z')\Big)\Bigg],\end{aligned} \tag{5}$$

$$a'' = (1 + r^R)a', \qquad m'' = m'(1-\delta).$$

Here, $\rho_n$ denotes the age-specific survival probability and $\mathbb{I}$ equals one whenever the corresponding value function is optimal.

The second component, $q^m_{prepay,j,n}$, captures states in which the mortgage is prepaid. This occurs whenever the household refinances or sells the current house:

$$\begin{aligned}q^m_{prepay,j,n}(h', m', a', z) = \rho_n \mathbb{E}\Big[ \quad &\Big(\mathbb{I}_{F_{j,n+1}(h',m',a',z',\epsilon')} \\ &+\mathbb{I}_{S^R_{j,n+1}(h',m',a',z',\epsilon')} + \mathbb{I}_{S^B_{j,n+1}(h',m',a',z',\epsilon')}\Big) q^*_{j,n+1}\Big| z\Big].\end{aligned} \tag{6}$$

In all prepayment states, lenders recover the market value of the mortgage, denoted by $q^*_{j,n+1}$.

Finally, the component $q^m_{default,j,n}$ captures mortgage default states. In these cases, lenders recover the collateral value net of foreclosure costs:

$$q^m_{default,j,n}(h', m', a', z) = \rho_n \mathbb{E}\left[\frac{\mathbb{I}_{D_{j,n+1}(h',m',a',z',\epsilon')} p h'(1-\bar{\xi}_S)}{m'}\middle| z\right]. \tag{7}$$

## C.2 Mortgage prices when forbearance is allowed

When forbearance is allowed, mortgage prices follow a similar formula to Equation 1, but now we must add an additional term $q^m_{FB,j,n}$, which accounts for this possibility.

This term is very similar to $q^m_{pay,j,n}$ except that now creditors take into account that next period they do not receive a mortgage payment and therefore, $m''$ evolves as $m'' = m'(1-\delta) + m/\Omega_{n+1}$. More formally,

$$q^m_{FB,j,n}(h',m',a',z) = \rho_n \mathbb{E}\Big[ \quad \text{mort FB, no def} + \text{mort FB, BK} + \text{mort FB, DQ} \Big| z \Big], \quad (8)$$

where

$$\begin{aligned} \text{mort FB, no def} &= \mathbb{I}_{FB^P_{j,n+1}(h',m',a',z',\epsilon')} \Big[ 0 + (1-\delta) q^m_{j,n+1}(h',m'',a'',z') \Big], \quad (9) \\ a'' &= \hat{a}^{FB,P}_{j,n+1}(h',m',a',z',\epsilon'), \end{aligned}$$

$$\text{mort pay, BK} = \mathbb{I}_{FB^{BK}_{j,n+1}(h',m',a',z',\epsilon')} \Big[ 0 + (1-\delta) q^m_{j,n+1}(h',m'',0,z') \Big], \quad (10)$$

and

$$\begin{aligned} \text{mort FB, DQ} &= \mathbb{I}_{FB^{DQ}_{j,n+1}(h',m',a',z',\epsilon')} \Bigg[ 0 + (1-\delta) \Big( \varphi^a q^m_{j,n+1}(h',m'',0,z') \\ &\quad + (1-\varphi^a) q^m_{j,n+1}(h',m'',a'',z') \Big) \Bigg], \quad (11) \\ a'' &= (1+r^R)a', \qquad m'' = m'(1-\delta) + m'/\Omega_{n+1}. \end{aligned}$$

## C.3 Unsecured debt prices

When a household issues unsecured debt promising repayment of $a'$ next period, the amount borrowed is given by

$$-a' q^a_{j,n}(h',m',a',z),$$

where the price of unsecured debt satisfies

$$q^a_{j,n}(h',m',a',z) = \frac{q^a_{pay,j,n} + q^a_{DQ,j,n}}{1+r}. \quad (12)$$

Thus, unsecured debt prices depend on whether the household repays the debt or enters delinquency in the following period.

**Repayment** The first component, $q^a_{pay,j,n}$, captures states in which unsecured debt is fully repaid next period. Repayment may occur in several situations: renter with repayment, homebuyer with repayment, mortgage payer with repayment, mortgage refinancer with repayment, mortgage defaulter with repayment, seller-to-renter with repayment,

and seller-to-buyer with repayment. In all these cases, lenders receive full repayment per unit of debt issued:

$$q^a_{pay,j,n}(h',m',a',z) = \rho_n \mathbb{E}\Bigg[ \quad \mathbb{I}_{R^P_{j,n+1}(a',z',\epsilon')} + \mathbb{I}_{B_{j,n+1}(a'+e_{n+1}(z',\epsilon'),z')} \\ + \mathbb{I}_{P^P_{j,n+1}(h',m',a',z',\epsilon')} + \mathbb{I}_{F_{j,n+1}(h',m',a',z',\epsilon')} \\ + \mathbb{I}_{D^P_{j,n+1}(h',m',a',z',\epsilon')} \\ + \mathbb{I}_{S^R_{j,n+1}(h',m',a',z',\epsilon')} + \mathbb{I}_{S^B_{j,n+1}(h',m',a',z',\epsilon')} \Bigg| z \Bigg]. \tag{13}$$

The first two terms arise only when the household remains a renter ($h' = h_R$), whereas the remaining terms correspond to homeowner states.

**Delinquency** The second component, $q^a_{DQ,j,n}$, captures states in which unsecured debt enters delinquency next period. Delinquency may occur in three situations: renter delinquency, mortgage payer delinquency, and mortgage defaulter delinquency.

In all delinquency states, debt is rolled over at the penalty interest rate $(1 + r^R)$ with probability $(1 - \varphi^a)$. However, the continuation value of delinquent debt depends on the household's future housing and mortgage position:

$$q^a_{DQ,j,n}(h',m',a',z) = (1-\varphi^a)(1+r^R)\rho_n \mathbb{E}\Bigg[ \quad \mathbb{I}_{R^{DQ}_{j,n+1}(a',z',\epsilon')} \times q^a_{j,n+1}(h_R, 0, a'', z') \\ + \mathbb{I}_{D^{DQ}_{j,n+1}(h',m',a',z',\epsilon')} \times q^a_{j,n+1}(h_R, 0, a'', z') \\ + \mathbb{I}_{P^{DQ}_{j,n+1}(h',m',a',z',\epsilon')} \times q^a_{j,n+1}(h', m'', a'', z') \Bigg| z \Bigg], \tag{14}$$

where

$$a'' = (1+r^R)a', \qquad m'' = m'(1-\delta).$$

The first term applies only when the household remains a renter, whereas the latter two correspond to homeowner states.

Under this formulation, unsecured debt prices fully internalize the interaction between unsecured repayment incentives, mortgage obligations, and future delinquency risk.

## C.4 Unsecured debt prices when mortgage forbearance is allowed

Since households who enter into forbearance can pay, become delinquent, or file for bankruptcy, unsecured debt prices change slightly when forbearance is offered.

First, the repayment formula takes into account the case of unsecured debt repayment when also choosing forbearance:

$$\begin{aligned} q^a_{pay,j,n}(h',m',a',z) = \rho_n \mathbb{E}\Bigg[ \quad & \mathbb{I}_{R^P_{j,n+1}(a',z',\epsilon')} + \mathbb{I}_{B_{j,n+1}(a'+e_{n+1}(z',\epsilon'),z')} \\ & + \mathbb{I}_{P^P_{j,n+1}(h',m',a',z',\epsilon')} + \mathbb{I}_{F_{j,n+1}(h',m',a',z',\epsilon')} \\ & + \mathbb{I}_{D^P_{j,n+1}(h',m',a',z',\epsilon')} + \mathbb{I}_{FB^P_{j,n+1}(h',m',a',z',\epsilon')} \\ & + \mathbb{I}_{S^R_{j,n+1}(h',m',a',z',\epsilon')} + \mathbb{I}_{S^B_{j,n+1}(h',m',a',z',\epsilon')} \Bigg| z \Bigg]. \end{aligned} \tag{15}$$

Second, the delinquency formula takes into account the case of unsecured debt delinquency when also choosing forbearance:

$$\begin{aligned} q^a_{DQ,j,n}(h',m',a',z) = (1-\varphi^a)(1+r^R)\rho_n \mathbb{E}\Bigg[ \quad & \mathbb{I}_{R^{DQ}_{j,n+1}(a',z',\epsilon')} \times q^a_{j,n+1}(h_R,0,a'',z') \\ & + \mathbb{I}_{D^{DQ}_{j,n+1}(h',m',a',z',\epsilon')} \times q^a_{j,n+1}(h_R,0,a'',z') \\ & + \mathbb{I}_{P^{DQ}_{j,n+1}(h',m',a',z',\epsilon')} \times q^a_{j,n+1}(h',m'',a'',z') \\ & + \mathbb{I}_{FB^{DQ}_{j,n+1}(h',m',a',z',\epsilon')} \times q^a_{j,n+1}(h',\tilde{m}'',a'',z') \Bigg| z \Bigg], \end{aligned} \tag{16}$$

where

$$a'' = (1+r^R)a', \qquad m'' = m'(1-\delta) \qquad \tilde{m}'' = m'(1-\delta) + m'/\Omega_n.$$

## C.5 Defining $q^*_n$ and $\Omega_n$

Here we provide a formal definition of $q^*_n$ and $\Omega_n$.

### C.5.1 A formula for $q^*_n$

Focusing on $q^*_n$, note that this price of pre-payment must take into account the age-dependent survival probability $\rho_n$, discounting via the real interest rate $r$, and the decay of mortgage payments over time $\delta$. Given these primitives, $q^*_n$ follows the following

recursion:

$$q_n^* = \left(1 + \rho_n \frac{(1-\delta)}{(1+r)} q_{n+1}^*\right) \tag{17}$$

This formula can be derived as follows. First, note that in the last period of life $n = T$, $\rho_T = 0$ and so $q_T^* = 1$. In other words, in the last period of life "pre-payment" is just payment.

In the second to last period of life (e.g. $n = T - 1$), the value of pre-payment requires paying $m$ today for sure and then $m(1-\delta)$ discounted with probability $\rho_{T-1}$ tomorrow. Thus, the present discounted value of these two payments is:

$$b + \rho_{T-1} \frac{b(1-\delta)}{(1+r)} = b\left(1 + \rho_{T-1} \frac{(1-\delta)}{(1+r)}\right)$$

Thus,

$$q_{T-1}^* = 1 + \rho_{T-1} \frac{(1-\delta)}{(1+r)} = 1 + \rho_{T-1} \frac{(1-\delta)}{(1+r)} q_T^*.$$

From this last expression it is easy to see the recurrence relation implied by Equation 17.

### C.5.2 A formula for $\Omega_n$

Suppose an individual skips a payment of size $x$ at age $n$ in forbearance.

Forbearance implies that the individual will spread the repayment of $x$ by adding a payment to all future streams of mortgage payments. The payments decline geometrically over time: if the original scheduled payment at age $n+1$ is $m(1-\delta)$, then subsequent original payments would be $m(1-\delta)^t$ at age $n+t$.

By increasing the payment at age $n+1$ by an amount $\varepsilon$, the modified payment becomes $m(1-\delta) + \varepsilon$. Subsequent payments follow the declining schedule from this new base: $(m(1-\delta) + \varepsilon)(1-\delta)$ at age $n+2$, $(m(1-\delta) + \varepsilon)(1-\delta)^2$ at age $n+3$, and so on.

This implies the additional amount to each future payment at age $n+s$ is:

$$\varepsilon_s = \varepsilon \cdot (1-\delta)^{s-1} \quad \text{for } s = 1, 2, \ldots, T-n$$

The probability of being alive at age $n+s$ to make the payment is the product of surviving

each intervening year:

$$p_s = \prod_{j=n}^{n+s-1} \rho_j$$

where $\rho_j$ is the one-year survival probability at age $j$, and for $s = 1$, this is $\rho_n$ (product from $j = n$ to $n$).

The present value (at age $n$) of the added stream of payments is:

$$\text{PV} = \sum_{s=1}^{T-n} p_s \cdot \frac{\varepsilon_s}{(1+r)^s} = \sum_{s=1}^{T-n} \left( \prod_{j=n}^{n+s-1} \rho_j \right) \cdot \frac{\varepsilon \cdot (1-\delta)^{s-1}}{(1+r)^s}$$

We set this present value to exactly offset the missed payment $x$:

$$x = \sum_{s=1}^{T-n} \left( \prod_{j=n}^{n+s-1} \rho_j \right) \cdot \frac{\varepsilon \cdot (1-\delta)^{s-1}}{(1+r)^s}$$

Solving for $\varepsilon$, we obtain:

$$\varepsilon = \frac{x}{\sum_{s=1}^{T-n} \left( \prod_{j=n}^{n+s-1} \rho_j \right) \cdot \frac{(1-\delta)^{s-1}}{(1+r)^s}}$$

We define $\Omega_n$ as the denominator of this expression. This ensures the present value of the increased future payments exactly equals the value of the skipped payment $x$, accounting for discounting, survival probabilities, and the declining payment structure. Note that the upper limit is $T - n$, as the last possible payment is at age $T$, and mortality is certain upon reaching age $T$ (but the payment at $T$ can still be made if alive at $T$).

A little algebra reveals that: $\Omega_n = \frac{q^*_{n+1}\rho_n}{1+r}$. As an example, suppose that $n = T - 1$. Then:

$$\begin{aligned} \Omega_{T-1} &= \sum_{s=1}^{T-(T-1)} \left( \prod_{j=T-1}^{T-1+s-1} \rho_j \right) \cdot \frac{(1-\delta)^{s-1}}{(1+r)^s} = \sum_{s=1}^{1} \left( \prod_{j=T-1}^{T-1+s-1} \rho_j \right) \cdot \frac{(1-\delta)^{s-1}}{(1+r)^s} \\ &= \rho_{T-1} \cdot \frac{1}{(1+r)} = q^*_T \frac{\rho_{T-1}}{1+r}. \end{aligned}$$

| Parameter | Value | Definition | Basis |
|---|---|---|---|
| $l_n$ | — | Life-cycle component of income | SCF 1989-2019 |
| $W$ | 65 | Retirement age | U.S. Social Security |
| $\rho_n$ | — | Mortality age profile | CDC Vital Statistics 2019 |
| $a_0$ | — | Initial net financial asset distribution | SCF 2016-2019 |
| $e_0$ | — | Initial earnings distribution | SCF 2016-2019 |
| $h_0$ | — | Initial homeownership distribution | SCF 2016-2019 |
| $\sigma_\epsilon^2$ | 0.05 | Variance of $\epsilon$ (annualized) | Kaplan and Violante 2010 |
| $\sigma_e^2$ | 0.01 | Variance of $e$ (annualized) | Kaplan and Violante 2010 |
| $r$ | 0.03 | Risk-free rate (annualized) | Hatchondo, Martinez and Sánchez 2015 |
| $\gamma$ | 2 | Risk aversion | Hatchondo, Martinez and Sánchez 2015 |
| $\alpha$ | 0.5 | Elasticity of substitution | Hatchondo, Martinez and Sánchez 2015 |
| $\theta$ | 0.14 | Consumption weight of housing | NIPA consumption weight of housing |
| $\xi_B$ | 0.03 | Cost of buying a house, households | Gruber and Martin 2003 |
| $\xi_S$ | 0.03 | Cost of selling a house, households | Gruber and Martin 2003 |
| $\xi_M$ | 0.026 | Cost of signing a mortgage, as a percentage of average income | Federal Reserve |
| $\delta$ | 0.02 | Mortgage payment decay | Average inflation |
| $A_0$ | 0.9 | Replacement ratio | U.S. Social Security |
| $A_1$ | 0.1 | Replacement ratio | U.S. Social Security |
| $A_2$ | 0.14 | Replacement ratio | U.S. Social Security |
| $\lambda$ | 0.8 | LTV limit | Positive down payment |
| $f$ | 0.028 | Cost of filing for bankruptcy, as a percentage of average income | Livshits, MacGee and Tertilt 2007 |
| $r_R$ | 0.2 | Rollover rate on delinquent debt (annualized) | Livshits, MacGee and Tertilt 2007 |
| $\beta_H$ | 1.00 | Discount factor of patient types (annualized) | Athreya, Mustre-del Río and Sánchez 2019 |
| $\beta_L$ | 0.70 | Discount factor of impatient types (annualized) | Athreya, Mustre-del Río and Sánchez 2019 |
| $p^H$ | 23.44 | Price of owner-occupied houses (per-unit) | Mean home value/mean income in SCF 2019 |

Table 6: Externally set parameters

# D More details on the calibration

Table 7 presents the model's fit of all the moments we target. Because the moments differ in scale, we define the objective function as the sum of weighted squared percentage deviations:

$$\chi^2 = \sum_i w_i \left( \frac{M_i - D_i}{D_i} \right)^2,$$

where $M_i$ and $D_i$ denote the model and data moments, respectively. As noted in the main text, not all moments are weighted equally. To capture the persistence profile of credit delinquency without over-weighting the intermediate distribution, we assign a weight of $w_i = 1/6$ to bins 2–7 of the duration histogram, while bins 1 and 8 and all other targeted moments receive a weight of $w_i = 1$. Standard errors reported in Table 2 are computed using the standard asymptotic variance formula for minimum-distance estimators, which involves computing the Jacobian matrix of the moment conditions:

$$\text{avar}(\hat{b}) \equiv \left(1 + \frac{1}{S}\right) \left[ \frac{\partial g_n(b)}{\partial b} W \frac{\partial g_n(b)}{\partial b'} \right]^{-1}.$$

Here $S$ is the simulation size (set to 100,000 individuals in our case), $W$ follows the above definition, and $g_n(b) = \frac{M_i(b) - D_i}{D_i}$.

| Target | Data | Model | Source |
|---|---|---|---|
| Mean liquid assets / Mean income | 1.51 | 2.29 | SCF 2019 |
| Homeownership rate | 59.20 | 57.88 | SCF 2019 |
| Mean home value/ Mean income | 3.31 | 3.25 | SCF 2019 |
| Percent of ppl with mortgage | 37.20 | 33.65 | CCP/Equifax† |
| Mean housing debt/ Mean income | 1.97 | 0.90 | SCF 2019 |
| Mortgage default rate (ever been foreclosed in past 5 years) | 1.85 | 0.49 | SCF 2019 |
| BK rate (ever filed for bankruptcy in past 5 years) | 2.41 | 2.81 | SCF 2019 |
| DQ 30 rate | 7.83 | 9.68 | CCP/Equifax⋆ |
| Share of mortgage holders conditional on having at least one quarter of credit card DQ (%) | 24.50 | 25.77 | CCP/Equifax‡ |
| Share of mortgage holders conditional on having at least one quarter of credit card DQ (%), age 30 | 14.27 | 22.20 | CCP/Equifax‡ |
| Share of mortgage holders conditional on having at least one quarter of credit card DQ (%), age 40 | 27.41 | 21.35 | CCP/Equifax‡ |
| Share of mortgage holders conditional on having at least one quarter of credit card DQ (%), age 50 | 32.34 | 33.42 | CCP/Equifax ‡ |
| Homeownership rate, age 30 | 44.00 | 28.34 | SCF 2019 |
| Homeownership rate, age 40 | 59.79 | 61.78 | SCF 2019 |
| Homeownership rate, age 50 | 69.10 | 78.59 | SCF 2019 |
| Percent DQ30, 1 quarter duration | 23.62 | 20.00 | CCP/Equifax† |
| Percent DQ30, 2 quarters duration | 15.02 | 15.78 | CCP/Equifax† |
| Percent DQ30, 3 quarters duration | 11.45 | 13.00 | CCP/Equifax† |
| Percent DQ30, 4 quarters duration | 8.12 | 10.82 | CCP/Equifax† |
| Percent DQ30, 5 quarters duration | 7.31 | 9.18 | CCP/Equifax† |
| Percent DQ30, 6 quarters duration | 6.53 | 8.09 | CCP/Equifax† |
| Percent DQ30, 7 quarters duration | 5.69 | 6.80 | CCP/Equifax† |
| Percent DQ30, 8 quarters duration | 22.27 | 16.49 | CCP/Equifax† |
| Percent DQ30, 1 quarter duration, mortgage holders | 32.36 | 20.89 | CCP/Equifax‡ |
| Percent DQ30, 2 quarters duration, mortgage holders | 14.76 | 14.08 | CCP/Equifax‡ |
| Percent DQ30, 3 quarters duration, mortgage holders | 11.09 | 11.15 | CCP/Equifax‡ |
| Percent DQ30, 4 quarters duration, mortgage holders | 7.32 | 9.81 | CCP/Equifax‡ |
| Percent DQ30, 5 quarters duration, mortgage holders | 7.07 | 9.03 | CCP/Equifax‡ |
| Percent DQ30, 6 quarters duration, mortgage holders | 5.62 | 10.65 | CCP/Equifax‡ |
| Percent DQ30, 7 quarters duration, mortgage holders | 4.49 | 8.97 | CCP/Equifax‡ |
| Percent DQ30, 8 quarters duration, mortgage holders | 17.29 | 15.41 | CCP/Equifax‡ |

Table 7: Model fit

Notes: (†) Ages 25-64, balanced sample between 2018Q1-2019Q4. (‡) Ages 25-64, balanced sample between 2018Q1-2019Q4; mortgage holders are defined as those with a positive mortgage balance for at least one quarter during the sample period. (⋆) Time series average from balanced sample between 2018Q1-2019Q4. Moments in bold are weighted by 1/6.