The drag of homeownership on the unemployment scar *

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Abstract

We document that homeowners suffer larger and more persistent earnings losses than renters, increasing on home equity and decreasing on housing payments. To rationalize our findings, we build an island search model, where human capital depends on workers' job status. Homeownership provides higher housing services and increases collateral, but requires a down payment and is subject to selling costs. The calibrated model delivers larger earnings losses for homeowners mainly through larger human capital decay and constrained search from lower mobility. However, homeowners' earnings recovery is optimal, as they enjoy higher housing services and home equity allows for more consumption smoothing.

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1 Introduction

There is a large literature studying the effects of unemployment spells on workers' careers—not only in the near term, as lost income, but also later on, in the form of lower wages upon reemployment. However, the interaction of the reemployment decision with other household characteristics has received less attention, even as workers often have to jointly decide how much labor to supply, where to live, and whether to own or rent a house in a given location. It is well known that on average, homeowners make larger earnings than renters. As a result, following a job separation, it is almost mechanical that they also suffer larger earnings losses than renters in the short run. Notwithstanding, in this paper we document that these larger losses are also very persistent.

Our first contribution is empirical, as we present some new stylized facts on the different size in unemployment scars between renters and homeowners, using data from the Survey of Income and Program Participation (SIPP) spanning 2004 to 2013. Among workers displaced from their job between 2009 and 2011, homeowners suffered significantly larger and more persistent earnings losses than renters. This resulted in a shrunk quarterly earnings differential between displaced homeowners and renters. Meanwhile, among workers displaced between 2004 and 2006, homeowners suffered only slightly larger earnings' scarring than renters. However, the small reduction in the quarterly earnings differential between displaced homeowners and renters of this period masks the ever present interaction between housing variables and the unemployment scar. In particular, we find that more home equity and lower housing payments significantly correlate with larger earnings losses.

This finding is at odds to the common belief that the benefits of homeownership overwhelmingly outweigh its costs, allowing families to build wealth, obtain a measure of financial security, and reduce financial risks.

Our second contribution is theoretical, as we build a simple but rich enough island search model to reconcile the empirical facts during these distinct two periods. In the model, human capital evolves endogenously during employment and unemployment episodes. The island structure aims to capture local labor markets, offering a combination of high- and low-paying jobs. Workers only receive job offers in the island where they live, and wages depend on the type of job and their human capital. Owning a house requires a down payment and is subject to selling costs, but it increases the credit limit of households by acting as collateral and provides a higher flow of housing services than renting it.

To recreate a Great Recession scenario, characterized by very low migration rates and widespread poor job prospects, we solve a two symmetric-island model with a low job-finding rate. Following an unemployment spell, homeowners are more likely than renters

to get reemployed with lower earnings relative to their previous job, as their human capital depreciates more and they face larger wage cuts from losing relatively more high-paying jobs, leading to more persistent losses compared with those of renters.

To recreate the thriving labor markets observed during the 2004-2006 period, we increase the job-finding rate in both islands, and make the job market in island 1 more appealing by increasing the likelihood of being offered a high-paying job. In this scenario, the same mechanisms explained above are still at work, but now earnings losses are less persistent for both groups, cutting the larger losses of homeowners relatively more. Moreover, homeowners make use of their larger collateral by being pickier than renters in accepting low-paying jobs and by moving in lesser numbers than renters to island 1. Overall, earnings losses for homeowners are still larger and more persistent than for renters, but the favorable differential for renters is not as large as in the Great Recession scenario, just like in the data.

However, in our model homeowners' slower earnings recovery is optimal. Unemployed homeowners continue enjoying higher housing services than renters, and homeownership provides more insurance against nondurable consumption losses due to higher home equity and lower housing payments relative to income. The optimality follows because in our model agents have perfect information about labor markets' conditions and fully internalize the human capital depreciation suffered while unemployed.

This paper contributes to several strands of literature. First, we expand the findings of the seminal papers of Davis and Wachter (2011), which focuses on the unemployment scar of the average worker during booms and recessions, and Huckfeldt (2022), which documents differences in the unemployment scar of workers by occupation over the business cycle. In addition, we find that the average unemployment scar masks significant heterogeneity when taking into account workers' housing characteristics, over and across business cycles. Other studies, such as Arulampalam (2001), Yang (2019), and Ringo (2021), have documented the effects of unemployment on the first wages upon reemployment or the reemployment decision. Our analysis is more comprehensive, as we study homeowners and renters jointly over two distinct periods and look at both short- and long-term consequences of a job separation.

A separate strand of the literature has found that low migration rates did not play a major role in the slow employment recovery after the Great Recession. For instance, Aaronson and Davis (2011) and Farber (2012) provide an empirical study of the relationship between mobility rates and housing tenure, rejecting the idea that high unemployment rates post–Great Recession were due to homeownership deterring the migration of the unemployed to better labor markets. Yagan (2019) also concludes that migration cannot fully explain the long-term consequences of local unemployment shocks, and even though human capital decay is not present in his analysis, he cites it as a possible explanation. Our modeling

approach expands the heterogeneity between homeowners and renters beyond the existence of house-lock effects, and incorporates human capital dynamics and labor market differences to understand the interaction of these channels.

The last strand of the related empirical literature has looked at the labor market and the role of home equity more broadly. Demyanyk, Hryshko, Luengo-Prado and Sørensen (2017) estimate that negative home equity was not a significant barrier to job-related mobility in different labor markets during the Great Recession, in line with the findings of Schulhofer-Wohl (2012). In contrast, Ferreira, Gyourko and Tracy (2010) find that negative equity and rising interest rates reduce the geographical mobility of owners, similar to the more recent findings of Brown and Matsa (2020). For a panel of European countries between 1994 and 1997, Barceló (2006) finds that homeowners exit unemployment less frequently than renters when the job involves a residential move, and that homeowners with outstanding mortgages leave unemployment with a higher probability and search more intensively. Additionally, Herkenhoff, Phillips and Cohen-Cole (2023) study the effects of unused credit card availability on labor market outcomes, and He and Maire (2023) look at the effects of the 1992 mortgage reform among both employed and unemployed workers on unemployment duration and wage growth. We provide complementary evidence that home equity allows workers to smooth consumption better while unemployed, although this results in more permanent earnings losses for most workers, especially when labor markets are depressed.

In summary, our empirical findings highlight the importance of looking beyond mobility and considering the role of home equity and housing payments in understanding workers' employment and earnings recoveries.

On the theory front, Bajari, Chan, Krueger and Miller (2013) try to understand the effects of housing price shocks (à la the Great Recession) on the demand for non-durable and housing consumption, and Sterk (2015) and Karahan and Rhee (2019) explore the effects of such shocks on the supply of labor and geographical mobility. Our model abstracts from housing price shocks and focuses on idiosyncratic unemployment shocks instead, jointly analyzing consumption, labor, and location decisions and their effects on the unemployment scar of workers. Glover, Heathcote, Krueger and Ríos-Rull (2020) focus on the intergenerational costs of the Great Recession. In their model, the old fare worse by selling risky assets at low prices to finance consumption, while the young accumulate wealth for life-cycle reasons. Our paper complements their findings, as in our model, homeowners are, on average, older and wealthier, and they finance consumption while staying put but, all the while, sustaining a larger human capital depreciation.

This paper is organized as follows: section 2 describes the data used and sample selection. Section 3 documents our findings. In section 4, we propose a structural model to explain

these findings, and section 5 presents a couple of calibrations with the model's predictions. Finally, section 6 concludes.

2 Data description

In this section, we describe the data sources and variables used throughout our analysis. We use micro-data from the SIPP, a longitudinal household survey that collects information on topics such as income, employment, assets, and other variables. It is administered by the Census Bureau and has been designed as a succession of household panels since its creation in 1983. In particular, we use the 2004 and 2008 panels.

The 2004 panel consists of 12 waves, containing information between February 2004 and January 2008, and the 2008 panel consists of 16 waves, with information spanning September 2008 to December 2013. Both panels contain information about 52,000 households. Within each panel, each wave contains monthly information on both "core" questions (repeated throughout waves) regarding the previous four months and "topical" questions, specific to a particular wave. For our analysis, we aggregate the data to a quarterly frequency.

Next we describe how we construct workers' labor histories using the longitudinal dimension of the panel.[1] To define workers' employment status, we use their self-reported status in week 2 of a given month, given by the variable *RWKESR2*. We define a given worker to be employed in a given month if they respond "with a job" (either "working" or "not on layoff but absent without pay") in the second week of the month; to be unemployed if they respond "on layoff or looking for a job"; and to be out of the labor force or non-employed if they respond "not looking for a job and not on layoff".[2]

We now turn to describing how we generate different income variables. We construct monthly earnings for salaried workers using the information on gross pay obtained from the primary job (*TPMSUM1*). For wage workers, we use information on hourly rates (*TPYRATE1*), usual hours worked (*RMHRSWK*) in a week, and weeks worked in the month (*RMWKWJB*). We define real earnings in 2015 dollars by deflating all earnings using the consumer price index.[3] We define the (deflated) wage per hour as the ratio of monthly real earnings and monthly hours worked.

Finally, we extract information on housing status and other demographics. The SIPP

[1] This information can be found in de Francisco, Garcia-Cabo and Powell (2020), a nontechnical note that summarizes the empirical findings in this section.

[2] Given this definition, we will not identify short-term employment and unemployment transitions, including job-to-job transitions when the worker is reemployed by week 2 of the following month.

[3] Wages come from a SIPP question on hourly wages and are corrected for top-coding comparably with the Centre for Economic Policy Research's (CEPR) wage series.

questionnaire contains the variable *ETENURE*, an indicator variable that captures workers' housing status in a given month. In this analysis, we restrict the sample to workers who respond to be either homeowners or renters. Moreover, we set a worker's housing status as the yearly mode of *ETENURE* to avoid sample inconsistencies and measurement error. Lastly, we control for workers characteristics using demographic information from the questionnaire. We use variables for age (*TAGE*) and educational attainment (*EEDUCATE*) from the first wave of interviews to define the birth year of the worker and highest degree achieved throughout the sample period. We define gender using the variable *ESEX*.

2.1 Sample selection

In choosing our sample, as it is standard in the literature, we consider prime-age workers between 25 and 55 years old to avoid entry and retirement decisions driving our results. However, according to the Survey of Consumer Finance, the biggest increase in homeownership occurs when individuals are between 30 and 40 years old. Moreover, since we want to construct a balanced panel of homeowners and renters highly attached to the labor force we restrict our sample of study to workers between 30-55 years old at the time of a separation.

We want to analyze the role of housing status and housing variables in earnings recovery after workers' separation from their main job. In particular, we define a separation in a given month as occurring when an employed worker who was working and non-absent from work in the previous month reports no employment (either unemployment or non-employment).[4] We exclude from this definition workers declaring to be employed but absent without pay to avoid including workers on temporary layoff and furloughs, who tend to have high recall rates as shown by Fujita and Moscarini (2017). A non-separated worker is one who in a given month reports to be employed and was employed in the previous month. Note that our setting considers all types of separations, exogenous and endogenous, and as such, one should not make causal conclusions from the empirical results. Instead, our analysis documents the heterogeneous co-movement of labor market outcomes with housing variables.

To partially reduce the selection bias due to endogenous separations, we require workers to be employed full-time at the time of the separation and to report at least three years of job tenure at the beginning of the year when separations start. Moreover, we do not use separations that start at the beginning of each panel, as we require several quarters of pre-separation observations to control for differences in earnings trends occurring before the separations occur. We analyze separations between 2004:Q4 and 2006:Q2 for the 2004 wave,

[4]While our assumption would exclude unemployment spells under a month, the average number of weeks unemployed in the U.S. between 2000-2014 was never under 16 weeks according to FRED and the BLS, hence, making the occurrence of these episodes low: https://fred.stlouisfed.org/series/UEMPMEAN.

and between 2009:Q3 and 2011:Q4 for the 2008 wave.[5]

Lastly, we define homeownership status in the year of worker's separation. In particular, a separated worker is a homeowner or a renter at the time of the separation if that is the most frequent housing tenure that year. For the group of non-separators, homeowners (renters) are those reporting homeownership (renting) as their main housing status while separations occur (and exhibit no status change during this time). We do not impose additional restrictions for both separators and non-separators, so homeownership status could change after the separation year.[6] Here, it is important to clarify that SIPP reports only the workers' states and reported homeownership status within each wave. Thus, our sample of workers could still potentially include in-state and out-of-state moves, as long as moves did not entail changes in housing status.[7]

2.2 Sample characteristics

Table 1 reports the sample averages of separated and non-separated workers' main demographic and socioeconomic characteristics based on homeownership status and by SIPP panel. First, homeowners are slightly older than renters, with the age difference between between homeowners and renters being only two years in both waves. Moreover, age differences between non-separators and separator within groups are almost negligible. Regarding quarterly earnings, homeowners enjoy higher earnings than renters, and separators make on average between 15 to 25 percent less than non-separators.[8]

The average quarterly earnings differential between displaced homeowners and renters prior to unemployment was around $\$4,000$ in both waves. Moreover, homeowners have been longer at the firm, and we also observe that separators tend to have slightly shorter tenures than non-separators. Despite their similar ages and as expected, a larger proportion of homeowners are married when compared with renters. While there is a higher share of marriage households among homeowners relative to renters, the differences in total household labor income shares are very small across groups, with most income–between 75 and

[5]We have performed additional robustness analysis including further controls, such as requiring all workers to have positive earnings in at least one year following the start of separations.

[6]Since the SIPP data do not designate a household head, we look at the separations of all the workers inside a household that meet our age and job tenure criteria. We then categorize workers as homeowners if they live in a house owned by family members.

[7]Unconditional monthly migration rates are very small, as reported by Aaronson and Davis (2011). As such, our assumption simplifies the analysis and avoids dealing with potential in-sample attrition from migration across SIPP waves, especially those out of state.

[8]The average difference in quarterly earnings between employed and separated homeowners was 15,942-12,022 in the 2004 wave, and 16,260-12,579 in the 2008 wave, and between employed and separated renters, it was 10,581-8,038 in the 2004 wave, and 10,550-8,728 in the 2008 wave.

85 percent–coming from a single earner. Lastly, the average level of home equity among homeowners in the 2008 wave was between 10 and 15 percent lower than in 2004, reflecting the poorer housing wealth of most households during the Great Recession. The differences across and within groups (homeowners vs renters, separators vs non-separators) reported in Table 1 evidence the existence of selection in separations and the need to control not only for observables, but also for workers' unobserved heterogeneity when computing the different consequences of job loss for these workers. We present an econometric approach in the next subsection to potentially reduce these concerns.

Table 1: Descriptive statistics for the 2004 and 2008 panel samples

	Owners		Renters	
	Not separated	Separated	Not separated	Separated
2004 Panel				
Age	43.8	42.8	41.8	39.9
Quarterly earnings	15,942.5	12,022.9	10,581.7	8,038.4
Tenure	12.3	10.4	8.6	7.7
Female (%)	44.6	53.2	51.9	48.8
Married (%)	77.0	72.8	38.6	42.0
Household labor income	20,159.7	16,445.3	12,338.2	9,672.9
Home equity	132,518.4	116,287.0		
Number of Observations	7593	461	1116	131
2008 Panel				
Age	44.4	44.7	41.8	42.2
Quarterly earnings	16,260.9	12,579.8	10,550.3	8,728.7
Tenure	12.8	10.4	9.3	7.8
Female (%)	46.2	47.5	46.9	39.5
Married (%)	75.0	75.2	43.2	54.5
Household labor income	20,320.1	16,583.4	12,291.9	10,944.6
Home equity	110,070.2	107,251.7		
Number of Observations	4575	343	806	114

Source: SIPP 2004 and 2008, authors' calculations

2.3 Econometric model

Our empirical approach follows closely Krolikowski, Zabek and Coate (2020) and Davis and Wachter (2011), so we treat the separations as event studies. Thus, we define separated workers as the treatment group and non-separated workers as the control group. We compare the earnings recoveries of workers in the treatment group with those of workers in the control group for a maximum of 8 and 12 quarters after the separation, in the 2004 and the 2008 panel respectively. We split the sample based on homeownership status as defined earlier

and we estimate the model separately for each wave.[9]

Following Davis and Wachter (2011), we estimate the following distributed-lag model for earnings on an unbalanced panel for every quarter t:

$$e_{it} = \alpha_i + \gamma_t + X_{it}^{'}\beta + X_{it}^{'}\beta^{HO}\mathbb{1}\{HO\} + \sum_{k\geq -2}^{12} \delta_k D_{it}^k + \sum_{k\geq -2}^{12} \delta_k^{HO} D_{it}^k \mathbb{1}\{HO\} + \bar{e_i}\theta_t + \varepsilon_{it} \quad (1)$$

We regress quarterly earnings for all individuals i and periods $k \in \{-2, 12\}$ on a set of dummies D_{it}^k, where i refers to the individual, t the time of the observation and k the number of periods before or after separation. We set the baseline period as -4 (4 quarters before separations start), 0 being the quarter of separation. With this specification we can compute the change in earnings k quarters after separation by type of housing status before dismissal. For example, take the observation period to be a year, and set $k = 2010 : Q1$ as the time of separation. In 2011:Q1, the individual will have $D_{i,2011}^4 = 1$ (indicating that the measurement occurs four quarters after the separation). The indicator function $\mathbb{1}\{HO\}$ takes value 1 if the worker is a homeowner before separations start, and it takes value 0 if the worker is a renter. Hence, δ_k captures the earnings losses of separated renters relative to employed renters, while $\delta_k + \delta_k^{HO}$ captures the corresponding losses of homeowners.

Our specification includes as controls a set of person fixed effects α, year fixed effects γ, and a quadratic polynomial in age included in X, and $\bar{e_i}$, which contains the pre-separation quarterly earnings average for each worker interacted with a time effect. We cluster errors at the individual level.

3 Reduced-form evidence

3.1 Earnings losses by homeownership status: a comparison in time

Figure 1 shows the average earnings losses by homeownership status for the treatment group of displaced workers, δ_k for renters and $\delta_k + \delta_k^{HO}$ for homeowners, including those with zero earnings (not yet reemployed) in a given quarter, relative to the control group of not displaced workers. The estimates for the 2004 wave is shown in the left panel and those for the 2008 wave in the right one.

The main takeaway of Figure 1 is that the expected deeper initial earnings losses of homeowners with respect to renters are not short-lived. The hit on the $4000 pre-existing

[9] In each wave, we weight all observations in our econometric analysis using individual sample weights before separations start, in 2004:Q3 and 2009:Q2.

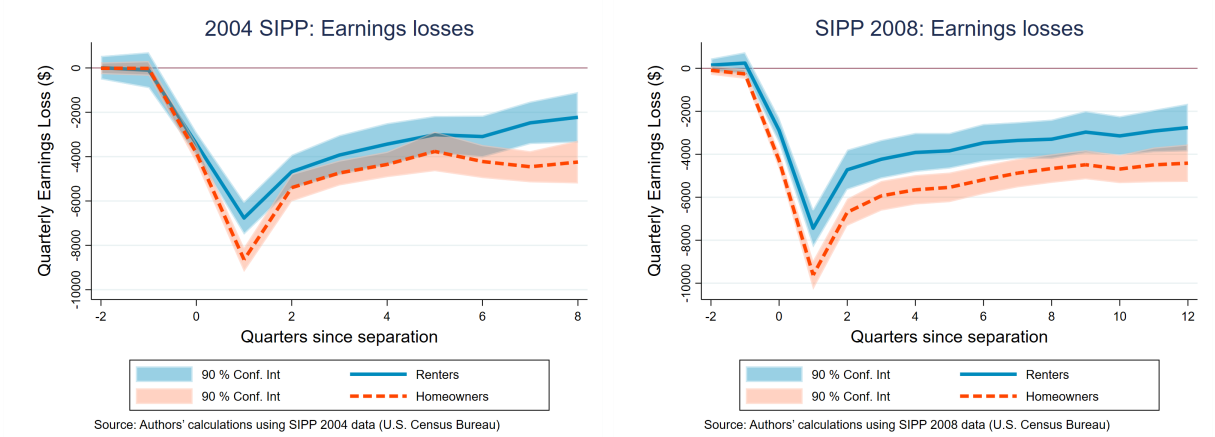


Figure 1: Average earnings losses after a dismissal

quarterly earnings differential between separated homeowners and renters (shown in Table 1) remains depressed in both SIPP waves regardless of the business cycle, implying that the annual earnings differential in favor of separated homeowners and renters shrank from $\$16,000$ to $\$12,000$ during the 2004 wave, and from $\$16,000$ to $\$8,000$ during the Great Recession. In other words, this means that after an unemployment shock, homeowners had a more difficult time finding a similar job compared to the one they held before the separation. As a result of the scarring, in the long-run, earnings of separated homeowners are more similar to non-separated renters than to non-separated homeowners.

These level losses are sizable and significant in their own right, as earnings enter the budget constraints of individuals. Moreover, the sizable magnitude of these losses in dollars also translates into a significant percentage loss of earnings relative to the group of non-separated homeowners in the Great Recession. As shown in Figure 17 in the Appendix, losses of separated homeowners are 10 percentage point larger than those of separated renters relative to non-separators in the 2008 SIPP panel. This result is in line with Davis and Wachter (2011) findings on the larger cost of job loss during recessions, Figure 1 also shows that average earnings losses for both groups of displaced workers during the 2009-11 *bust* were larger than they were for similar workers during the 2004-06 *boom*.

For the 2008 panel, where the differential recoveries by group are larger, the observed reduction in post-displacement earnings differentials between homeowners and renters is robust to a myriad of additional co-variates, like 1) spousal intra-household insurance through additional labor income, 2) total household income (i.e. including capital and non-labor income), or 3) household composition.[10] Appendix A shows earnings losses when controlling

[10]Our empirical analysis focuses on differences across groups. Given the size of our SIPP sample, we do not have a large enough sample to do a statistically significant analysis of within-group drivers of the unem-

for household labor earnings, for household total income, and separately estimating the earnings losses for married and singles. In all cases, significant differences in recoveries remain during the first two years, but for a much richer analysis between housing services and household formation, beyond the scope of our paper, see Peter, Piazzesi and Schneider (2018).

3.2 The effect of housing variables on the unemployment scar

Next, we explore more in depth what housing variables affect the unemployment scar and through which channels, specifically the roles of housing payments to income for renters and homeowners, and of home equity levels for homeowners.

For the 2004 panel in Figure 1, when classifying workers exclusively by house status, the average relative earnings recovery of renters looks only slightly better than homeowners. However, Figure 1 masks significant differences in both panels, as Figures 2 and 3 will show.

We start by analyzing the effects of housing payments relative to income in the unemployment scar. For that, we group workers based on their housing payments (monthly mortgage for homeowners and monthly rent for renters) relative to income, and then run the original regression with workers above the 8^{th} decile and below the 5^{th} decile.[11] The earnings losses of these two groups of displaced workers are shown in Figure 2, with the left panel depicting the 2004 wave and the right panel the 2008 wave.

Figure 2 shows that the role that housing payments play in the earnings recovery of workers is distinctly present in both waves. We find that workers with higher housing payments relative to income tend to have a faster earnings recovery, suggesting that cash constraints are an important driver for job-seekers. Moreover, we find that renters, on average, exhibit larger housing payments than homeowners for the same decile of the distribution (about 1 percentage point higher), and thus, these constraints likely play a larger role in the search behavior of renters.[12]

These results suggest that by only focusing on housing status as the determinant of the earnings recovery, as in Figure 1, would lead to a partial picture of the determinants of the unemployment scar and underestimate the role of cash constraints. This is especially the

ployment scar, including occupational displacement. For a decomposition of within-drivers, see Huckfeldt (2022)

[11] The 8^{th} decile cutoff is 12.5 percent in the 2004 panel and 13 percent in the 2008 panel, and the 5^{th} decile cutoff are 7.1 percent and 7.4 percent in the 2004 and 2008 panels, respectively. We have assessed the sensitivity of different decile cutoffs obtaining similar results. The choice of the 8^{th} and 5^{th} aims at having enough observations while capturing variation in observed housing payments and equity, as below the median, the distribution is more compressed than above the median.

[12] These effects also hold within groups, as shown in Figure 20.

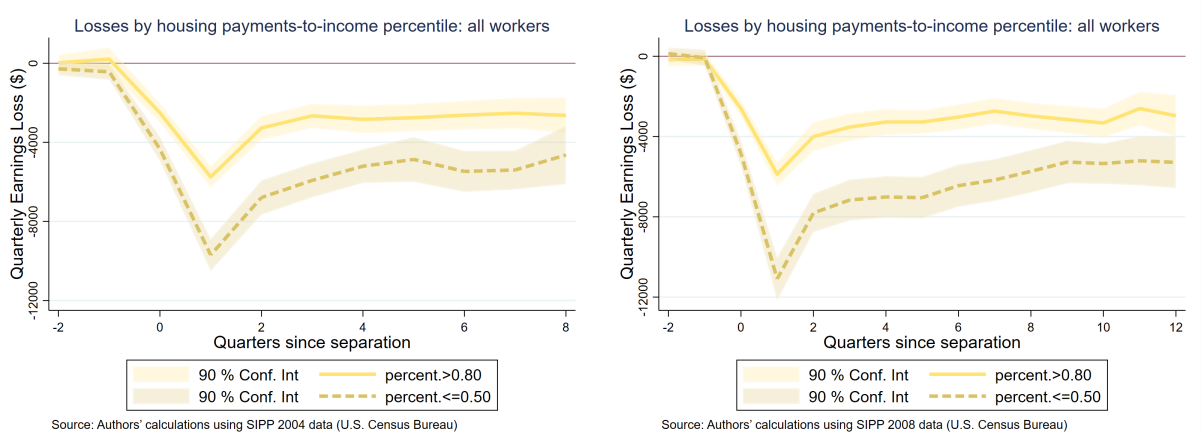


Figure 2: Workers earnings recovery by housing payments-to-income ratio

case during the 2004 wave, where the smaller gap between homeowners and renters seemed to imply similar search behavior. However, the role of housing to income payments was clearly present in 2004, suggesting cash constraints play a role throughout the business cycle.

We now turn to analyze the role of home equity in the earnings recovery of homeowners. For that, first we group homeowners based on their home equity, and then run the original regression with homeowners above the 8^{th} decile—230,000 dollars and 185,000 dollars in 2004 and 2008, respectively—and below the 5^{th} decile—97,000 and 74,000 dollars in 2004 and 2008, respectively. The earnings losses of these two groups of displaced homeowners are shown in Figure 3. Again the left panel shows the 2004 wave and the right panel, the 2008 wave.

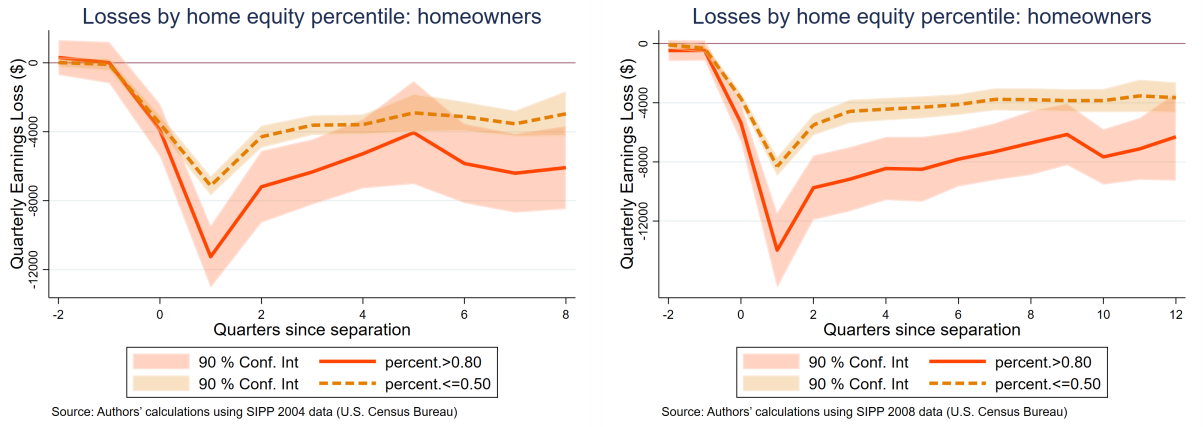


Figure 3: Homeowners earnings recovery by home equity

In both waves, it is evident that homeowners with more home equity suffer larger and more persistent earnings losses, but the differences are clearer during the Great Recession,

when average home equity levels were smaller. Theoretically, the sign and strength of the effects of home equity on the unemployment scar of displaced homeowners is not clear, and even the literature on how liquidity and available credit affect earnings is mixed. On the one hand, higher liquidity post-separation can lead to lower search effort, resulting in lower wages upon re-employment due to human capital depreciation. On the other hand, it can lead to a more thorough search, resulting in better matches and higher wages. We find that in the case of home equity, there exists a negative correlation between home equity and earnings recovery shown in both panels of Figure 3, which we put in context with alternative findings in the literature.

For example, He and Maire (2023) find that liquidity plays an important role in re-employment rates and wage recovery post-separation. Following a mortgage reform in Denmark in 1992, post-reemployment wages for unconstrained unemployed workers were lower, similar to our wealthiest homeowners, and higher for the constrained unemployed, in line with our homeowners at the 50^{th} bottom of the home equity distribution.

Similarly, Herkenhoff *et al.* (2023) find that when credit limits tighten during a downturn, employment recovers faster.[13] They estimate that individuals who have the ability to replace forgone annual earnings with credit usage take longer to find jobs, and that this results in higher wages, conditional on finding a job.

In order to reconcile our results with the literature, we estimate the following equation:

$$y_{i,t} = \alpha + \beta^{HE} E_i + \beta X_{i,t} + \epsilon_{i,t} \tag{2}$$

where $y_{i,t}$ is the ratio of the first post-unemployment wage to the average wage prior to the start of separations in the sample (replacement rate) in the first specification, and the duration of unemployment for individual i at time t in a second specification. The main variable of interest is E_i, the home equity value of individual i (standardized in 10,000 dollars). $X_{i,t}$ is a set of controls including year effects, a quadratic polynomial on age, and household's total income. We estimate these regressions via OLS separately for both SIPP panels, and differentiating between workers reporting positive and negative home equity.

We present the point estimates for β^{HE} in Figure 4. Two interesting results emerge. First, we only observe significant effects in the 2008 panel.[14] In particular, the average effect of home equity on replacement rates is negative and significant at the 90 percent level (left panel, green diamond), in line with our results in Figure 3. However, the average effect masks substantial heterogeneity when splitting the sample between homeowners with positive and

[13] Even though output and productivity are ambiguous.

[14] As such, we relegate the 2004 panel results to Figure 22 in the Appendix.

negative equity (orange and blue diamonds in Figure 4, respectively).

The marginal effect of home equity is associated with lower replacement rates and has no effect on unemployment duration for unemployed workers with positive home equity. However, providing additional lines of credit to unemployed workers with negative home equity is associated with higher reemployment rates and longer unemployment duration, as in He and Maire (2023) and Herkenhoff *et al.* (2023).

Since the group of homeowners with negative home equity only accounts for a small fraction of the observations in our data (about 10 percent), the negative effect of home equity on wages, and hence earnings dominates, as shown previously in Figure 3.

Note: Vertical lines reflect the 90 percent and 95 percent confidence intervals for the point estimates.

Figure 4: Wage replacement and unemployment duration by home equity availability

We acknowledge the limitations of our data in observing the individual use of home equity and housing in general to weather unemployment shocks. However, at the aggregate level, there is substantial evidence of a widespread usage of home equity lines in 2008, suggesting that higher home equity allows households to smooth consumption, decreasing the geographical scope of the job search and the need to accept initial job offers, similar to the effect of unemployment insurance extensions in the literature.[15]

Our results of the effects of home equity on the unemployment scar point to human capital depreciation playing a crucial role during involuntary unemployment episodes that workers do not fully internalize.[16] In conclusion, we have shown that individual home equity

[15]This was also the case during the COVID-19 recession and the high-interest rate period that followed. See https://www.corelogic.com/intelligence/blogs/home-equity-lending-rose-to-highest-level-since-2008-in-2024/.

[16]For over-optimism on job search resulting in long-term unemployment, see for instance Mueller, Spinnewijn and Topa (2021). Additionally, the observed losses contrast to "voluntary" and "short" periods out of the labor force, as reported in Sandler and Szembrot (2019), where they find that mothers taking

levels affect the unemployment scar of homeowners in significant ways, but its interactions with the health of labor markets and credit access are non linear, and are often masked when focusing on the average homeowner.

To sum up our empirical analysis, we find that ignoring the heterogeneity beyond pure homeownership, such as the role of cash constraints due to higher housing payments to income, or home equity levels, provides an incomplete picture of the determinants of the unemployment scar. We have shown that to account for the full extent of the different earnings losses among homeowners and renters found in the data, one needs to look beyond the lower mobility of homeowners caused by the classical house-lock effect, and incorporate differences in budget constraints and the overall health of the labor market through business cycles.

3.3 Heterogeneity in house price declines across states in 2008

For the Great Recession, we want to rule out that our previous results were driven by a higher proportion of homeowners being stuck in areas where the housing bust was deeper and commingled with worse local labor markets. To inspect that this channel is not driving the difference between renters and homeowners earnings recoveries, we repeat our baseline regression including five dummy variables to classify states by quartiles based on the change in house prices between the peak and trough observed during the Great Recession. The lowest quartile experienced house price drops of 31 percent or higher, whereas the top quartile experienced house price declines of "only" 10 percent or lower, and the median decline was 20 percent. The estimates for the state dummies in this regression specification, while negative for the lowest quartiles, are non-significant throughout. Accordingly, our results in Figure 5 show that the decrease in the earnings differential between displaced homeowners and renters is almost identical to the baseline specification presented in Figure 1.

3.4 What made homeowners' unemployment scar worse in 2008?

Next, we try to decompose the observed differences in earnings losses between homeowners and renters into three components: differences in reemployment rates, differences in reemployment wages, and differences in days worked. For that purpose, we start by re-estimating baseline equation (1) excluding workers with zero earnings; that is, we focus exclusively on reemployed workers.

First, we report that the incidence of non-employment for separated workers is much

up-to-a-year break from the labor force re-enter the labor market with only a temporary effect in earnings.

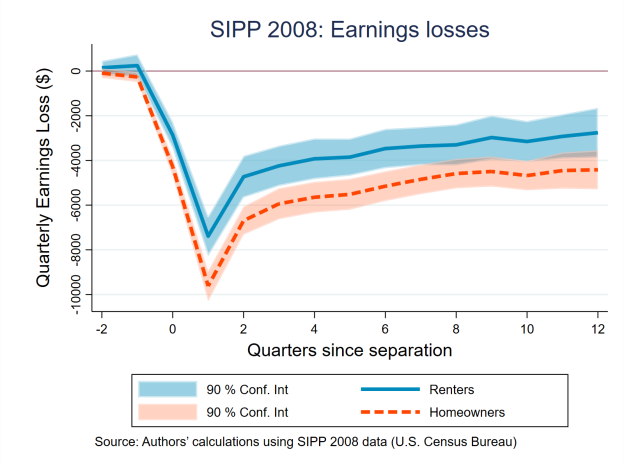


Figure 5: Earnings recovery after a displacement with a price decline dummy

smaller in 2004 than in 2008, as one would expect during an expansion. More concretely, about 50 percent of separated workers in the 2004 wave panel exhibit positive earnings only one quarter after dismissal, with renters getting reemployed slightly faster than homeowners (52 versus 46 percent respectively). However, consistent with larger average levels of home equity, a relatively larger proportion of homeowners continues to have zero labor income even after two years following the separation, suggesting a pickier attitude towards jobs.

When we look exclusively at the earnings of *reemployed* workers mainly coming from differences in match quality, Figure 6 shows that in the 2004 wave, consistent with tight labor markets, the earnings differential between reemployed homeowners and renters did not shrink and remained around $\$4,000$ per quarter. Hence, with healthy labor markets, the effect of the initial higher non-employment for wealthier homeowners on earnings was temporary, and waiting for better jobs paid-off in the long-run.

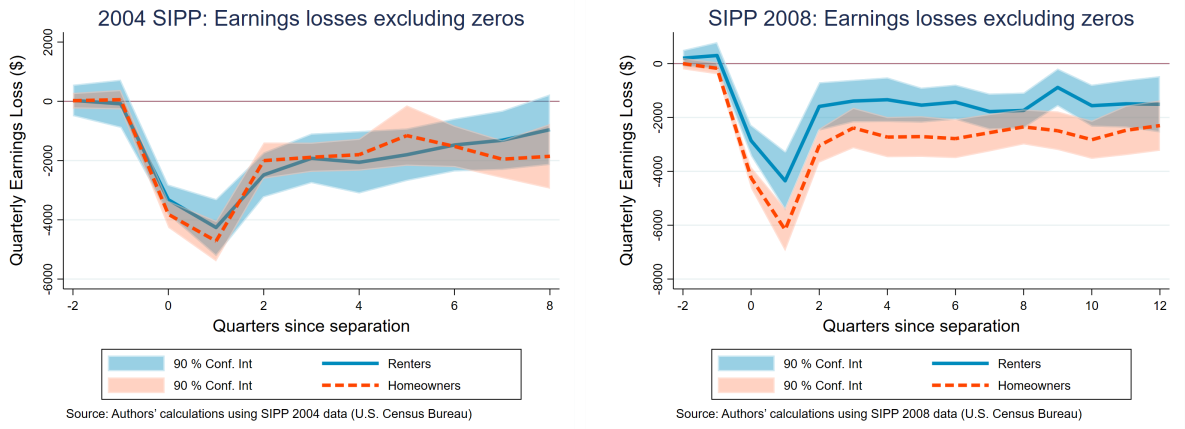


Figure 6: Average earnings after a dismissal, excluding zeros

In contrast, and consistent with depressed labor markets, in the 2008 panel the incidence of non-employment, and hence, zero earnings, was larger and almost identical for both groups, with only about 40 percent of workers exhibiting positive earnings one quarter after dismissal. Moreover, in this scenario, homeowners no longer exhibited a pickier attitude, and after two years, reemployment rates for both groups converged to about 75 percent.

Still, even after three years upon dismissal, the favorable homeowners' earnings differential for reemployed workers remained 25 percent smaller than before, around $\$3,000$ per quarter, reflecting that in the 2008 wave, reemployed homeowners, even after waiting, could not return to jobs with similar pre-displacement quality, and landed in relatively lower-paying jobs than renters.[17]

We conclude that the slightly larger losses for homeowners in 2004 were mainly driven by non-employment, while in 2008, lower match quality was the main contributor to homeowners' larger losses.

To our knowledge, this paper is the first to document the different unemployment scars between homeowners and renters, showing that housing variables affect both reemployment wages and labor supply, crucially interacting with the aggregate state of the economy.[18]

Our novel empirical analysis has shown that the interactions between the unemployment scar and housing extend beyond the usual house-lock effects studied in the literature. In particular, we have hinted at several mechanisms driving the recovery of renters and homeowners after job separations—and beyond the well-documented broad lower geographical mobility of homeowners.[19]

The first mechanism we have uncovered is how workers with higher housing payments relative to income tend to suffer smaller earnings losses. As monthly housing payments constitute a significant part of income for most households, especially for renters, this finding suggests that cash constraints are important for job search intensity or acceptance rates.

The second mechanism we have shown is that homeowners with more home equity tend to suffer larger and more persistent earnings losses. However, this effect does not always translate into lower reemployment rates or lower wages in the long-run. Instead, the extent of the home-equity effect seems to depend non-trivially on the interactions among the level

[17] In Appendix A we inspect match quality via wage losses in Figure 18 to confirm that re-employment wages are significantly lower for homeowners in the three years following the separation in the 2008 panel, but more similar in the 2004 panel for the first six quarters following the separation.

[18] Brown and Matsa (2020) examine how regional housing market distress affects job search and Yang (2019) focuses only on the effects of homeownership on post-unemployment wages, but not on total earnings. Differences in average days worked between homeowners' and renters' recoveries during the Great Recession are shown in Figure 19 in the Appendix.

[19] Aaronson and Davis (2011) also find that a house-lock effect does not seem to be an important driver of unemployment dynamics during the periods we study.

of home equity, flow of housing services, as well as local and global labor market conditions.

4 Model

Our empirical findings, while not establishing causality, reveal a significant correlation between high home equity and housing payments and lower re-employment earnings. Notably, this correlation persists even during unemployment spells previously considered short. To elucidate these findings, we propose a structural two-island random search model that integrates housing, location, and labor decisions simultaneously. This model emphasizes the crucial role of human capital dynamics in explaining the emergence of divergent unemployment scars between renters and homeowners.

4.1 Environment

There is a measure one of agents in the model, and agents can live and work in two locations $L \in \{l_i, l_j\}$, and if employed, they supply labor inelastically. Each agent is endowed with skill s, which lies on a grid with lower bound $\underline{s}$ and upper bound $\bar{s}$, and skills evolve randomly depending on the employment status of the agent. Moreover, to receive job offers from employers on an island, an agent must live on that island and be unemployed, as we do not allow for on-the-job search. In each island, firms offer two types of jobs: high-paying jobs, with associated wage per efficiency unit w_h and low-paying jobs, with associated wage w_l. There is an exogenous job distribution in each island l: the probability of being offered a high-paying job is given by $\pi_{l,h}$, independent of skill level s.[20]

Agents are rational and forward-looking, and the model has perfect information. They value non-durable consumption c and housing services c_h. There are three assets in the economy: liquid asset a, which is portable between islands, and the houses on each island. Agents can save or borrow at rate r, and they also care about their offspring, leaving a bequest for them when they die, passing away stochastically at rate ν.[21]

Agents can enjoy housing services, renting or owning a house, and for simplicity, only a one-size house is available in the model. Agents can choose to rent at price p_r or buy at price p_h. Owning a house has two additional benefits. First, and in line with the empirical literature, owning a house gives agents a higher flow of services than just renting a house of the same size. And second, owning a house provides collateral to borrow without any

[20] While dataset limitations made us abstract from occupations in our empirical analysis, we believe this assumption introduces the concept of occupation in the model via differences in jobs.

[21] Otherwise the model would converge to a degenerative distribution of infinitely lived homeowners.

additional costs.[22] However, buying a house requires a minimum down payment of γ percent of the house's value and is subject to significant selling costs.

4.2 Timing

The state variables of an agent at the beginning of every period are employment and housing status, skill, liquid asset position, and island of residence.

As mentioned earlier, there is perfect information and agents are rational and forward looking, so in every period agents simultaneously decide how much to consume and how much to save, where to live next period, and whether to rent or buy a house in that location. Meanwhile, during this period skill evolution occurs while employed or unemployed, and at the end of the period job separations occur randomly. Simultaneously, job offers and matching occurs in tomorrow's chosen location before the next period starts. Some workers remain employed in the same job, while others decide whether to accept a new job offer, or to reject it and be unemployed.

However, because location and housing decisions are discrete and because housing choices generate different endogeneous borrowing constraints, the problem each worker needs to solve is not convex. To deal with this, we artificially divide every period into two subperiods and solve it backwards.

In subperiod 1, the agent considers the possible locations and housing options for next period, and the disposable income left for consumption and savings in each option.

The diagrams in Figure 7 show the possible choices for the unemployed in subperiod 1. Without a loss of generality, we do not allow the unemployed to buy a house in the model, so non-homeowners on island i can stay as renters on island i or move also as renters to island j. Meanwhile, unemployed homeowners can stay on island i as homeowners, sell their house and become renters on island i, or sell their house and move to island j as renters.

Similarly, the diagrams in Figure 8 show the possible choices for the employed in subperiod 1. Because we do not allow on-the-job search or quits in our model, employed agents do not plan moves from one island to another, so the only location and housing choices for employed non-homeowners are whether to keep renting or buy a house in the island where they currently live to enjoy it next period.[23] Analogously, employed homeowners on island i can keep their house or sell it and become renters at the beginning of next period in the same location.

[22] While interest rates in home equity loans are higher than mortgage rates, this simplifying assumption does not affect our results qualitatively, and it is commonly used in the literature. See, for example, Peter *et al.* (2018).

[23] Ransom (2022) estimates that labor market frictions particularly inhibit the movements of the employed.

Figure 7: Location and housing options of the unemployed living in l_i in subperiod 1

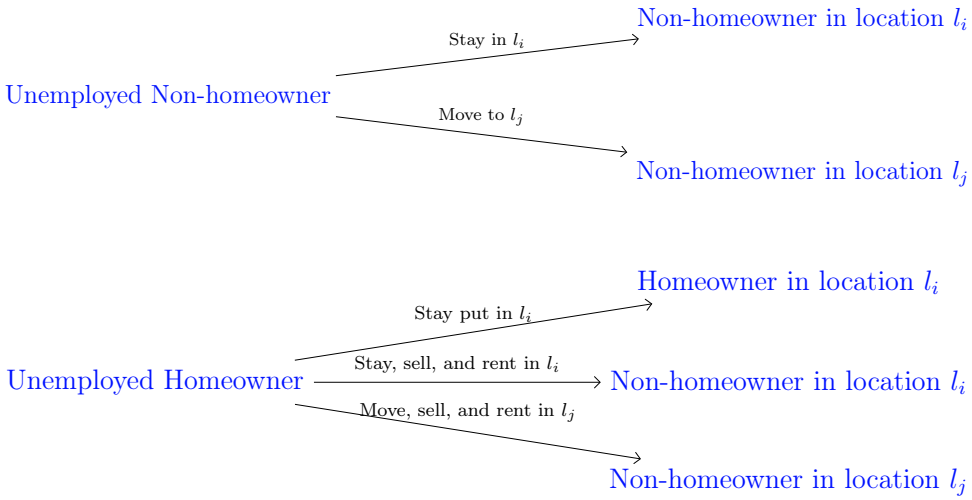
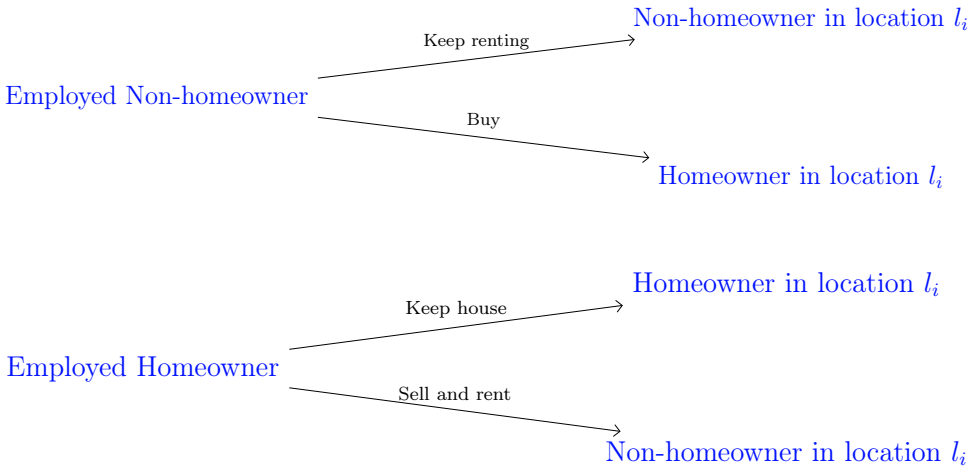


Figure 8: Housing options of the employed living in l_i in subperiod 1



In subperiod 2, agents choose the consumption and savings pair that maximizes expected utility in each possible pair of location and housing choices, given their disposable income, skill, and the jobs prospects associated with that location.

After that, agents compare their maximized utility in every $\{l', h'\}$ option, and pick the quadruple $\{l', h', c, a'\}$ that maximizes their utility.

Next, we summarize the value functions that characterize the dynamic programming problem of agents.

4.3 Optimization problem

Given an agent's current employment and housing statuses, the vector of state variables is represented by initial location l, asset position a, and skill s.

4.3.1 Value functions in subperiod 2

For every possible pair of $\{l', h'\}$ for next period, given disposable income, d, agents choose the optimal level of consumption today and amount of liquid assets or debt to carry over to next period, taking into account their future job prospects.

To do so, agents need to know the job-destruction and job-finding rates on the islands in the model—$\delta_{l'}$ and $\lambda_{l'}$, respectively—the probabilities of being offered different-paying jobs if there is job heterogeneity within an island, and the law of motion for their skills while unemployed and employed. An unemployed worker is subject to random skill depreciation every period. The law of motion for s is as follows:

$$s' = \begin{cases} s - \Delta_u & \text{with prob.} \quad \pi_u \\ s & \text{with prob.} \quad 1 - \pi_u. \end{cases}$$

Analogously, employed workers accumulate skills randomly while working at the same rate across job types. In particular,

$$s' = \begin{cases} s + \Delta_e & \text{with prob.} \quad \pi_e \\ s & \text{with prob.} \quad 1 - \pi_e. \end{cases}$$

Furthermore, the borrowing constraint in the model, B, is endogenous and depends on the agent's housing and employment status and skill. In particular, the borrowing limits for employed and unemployed renters, $B_{R,U,s}$ and $B_{R,E,s}$ are a fraction of the unemployment insurance benefit of the lowest skilled worker, and the limits of the homeowners $B_{O,U,s}$ and $B_{O,E,s}$ additionally allow individuals to borrow against their house, excluding the required down payment γ.

Thus, the subperiod 2 value function of an unemployed renter is

$$
\begin{aligned}
U_R\left(l', d, s\right) = \max_{c,\ a'} u\left(c\right) + \beta\left(1-\nu\right)\mathbb{E}\left[\left(\lambda_{(l')}\max\left(E_{NH}(l', a', s'), U_{NH}(l', a', s')\right) + \right.\right. \\
\left.\left. +(1-\lambda_{(l')})U_{NH}\left(l', a', s'\right)\right] \\
s.t. \\
c + a' \leqslant d \\
a' \geqslant -B_{R,U,s}.
\end{aligned} \tag{3}
$$

Similarly, the subperiod 2 value function of an unemployed owner is

$$
\begin{aligned}
U_O\left(l', d, s\right) = \max_{c,\ a'} u\left(c\right) + \beta\left(1-\nu\right)\mathbb{E}\left[\left(\lambda_{(l')}\max\left(E_{H}(l', a', s'), U_{H}(l', a', s')\right) + \right.\right. \\
\left.\left. +(1-\lambda_{(l')})U_{H}\left(l', a', s'\right)\right] \\
s.t. \\
c + a' \leqslant d \\
a' \geqslant -B_{O,U,s}.
\end{aligned} \tag{4}
$$

The subperiod 2 value function of an employed renter is as follows:

$$
\begin{aligned}
E_R\left(l', d, s\right) = \max_{c,\ a'} u\left(c\right) + \beta\left(1-\nu\right)\mathbb{E}\left[\left(1-\delta_l\right)\left(E_{NH}\left(l', a', s'\right)\right) + \delta_l U_{NH}\left(l', a', s'\right)\right] \\
s.t. \\
c + a' \leqslant d \\
a' \geqslant -B_{R,E,s}.
\end{aligned} \tag{5}
$$

Finally, the subperiod 2 value function of an employed owner is given by

$$
\begin{aligned}
E_O\left(l', d, s\right) = \max_{c,\ a'} u\left(c\right) + \beta\left(1-\nu\right)\mathbb{E}\left[\left(1-\delta_l\right)\left(E_{H}\left(l', a', s'\right)\right) + \delta_l U_{H}\left(l', a', s'\right)\right] \\
s.t. \\
c + a' \leqslant d \\
a' \geqslant -B_{O,E,s}.
\end{aligned} \tag{6}
$$

4.3.2 Value functions in subperiod 1

Given the state variables, agents consider the possible location and housing options available for next period, and their optimal consumption and savings in each option, and choose the

pair of $\{l', h'\}$ that maximize their utility.[24]

First, an unemployed non-homeowner's only possible $\{l', h'\}$ choices for next period to consider in subperiod 1 are to decide where to live as a renter in the same island he currently lives or in the other island. His problem is given by:

$$\begin{aligned} U_{NH}(l,a,s) = u(h_r) + \max_{l'} \{U_R(l'=l,d,s), U_R(l'=l',d,s)\} \\ s.t. \\ d(l') = z(s) + (1+r)a - I_m c_m - p_r^{l'}, \end{aligned} \tag{7}$$

where $d(l')$ is disposable income available after location decisions and housing expenses, I_m is a moving indicator function that takes value 0 if $l' = l$ and 1 if $l' \neq l$, c_m is the cost of moving from one island to the other, and $z(s)$ are the unemployment benefits of the unemployed of skill s.

Second, an unemployed homeowner maximizes utility in subperiod 1 by deciding whether to continue owning the house without moving islands or to sell it and rent a house on the same or another island.

$$\begin{aligned} U_H(l,a,s) = u(h_o) + \max_{l',h'} \{U_O(l'=l,d,s), U_R(l'=l,d,s), U_R(l'=l',d,s)\} \\ s.t. \\ d(l') = z(s) + (1+r)a - I_s(p_r^{l'} - (1-c_s)p_h) - I_m c_m, \end{aligned} \tag{8}$$

where I_s is a selling indicator function that takes value 0 if $h' = h$ and 1 if $h' \neq h$, and c_s is the cost of selling a house.

Next, since there is no on-the-job search in our model, employed agents do not move, hence $l' = l$. Thus, an employed non-homeowner maximizes utility in subperiod 1 by deciding whether to continue renting or to buy a new house.

If this is the case, we impose that the prospective buyer has enough available income to provide a minimum down payment of γ percent of the value of the house, adding an additional constraint to the problem:

$$\begin{aligned} E_{NH}(l,a,s) = u(h_r) + \max_{h'} \{E_R(l'=l,d,s), E_O(l'=l,d,s)\} \\ s.t. \\ d(l) = w(s) + (1+r)a - I_b p_h - (1-I_b)p_r^l \\ w(s) + (1+r)a \geqslant \gamma I_b p_h, \end{aligned} \tag{9}$$

[24] Without loss of generality, we normalize the size of the houses available on both islands to 1.

where I_b is a buying indicator function that takes value 0 if $h' = h$ and 1 if $h' \neq h$, and $w(s)$ is the wage in the current job.

Lastly, an employed homeowner maximizes utility in subperiod 1 by deciding whether to continue owning the house or to sell it and become a renter:

$$\begin{aligned} E_H(l,a,s) = u(h_o) + \max_{h'} \{E_O(l'=l,d,s), E_R(l'=l,d,s)\} \\ s.t. \\ d(l) = w(s) + (1+r)a - I_s(p_r^l - p_h). \end{aligned} \tag{10}$$

4.4 Equilibrium

So far, we have presented a partial equilibrium model where agents optimally decide where to live, their housing, employment, and their consumption and savings decisions. As a result, and taking house prices p_h, rental prices p_r, the interest rate r, the exogenous law of motions for skills s, and arrival rates for job offers λ and separations δ as given, a partial equilibrium in this setting consists of:

(a) a set of value functions $\{U_{NH}(l,a,s), U_H(l,a,s)\ E_{NH}(l,a,s), E_H(l,a,s)\}$ describing the expected lifetime utility of the possible four types of agents in each of the two locations in the economy, as a function of the state variables, that satisfy the system of equations from (2) to (9); and

(b) a set of policy functions about the optimal employment, housing, location, and saving choices for next period $\{e' = E(e,h,l,a,s), h' = H(e,h,l,a,s), l' = L(e,h,l,a,s), c = C(e,h,l,a,s), a' = A(e,h,l,a,s)\}$ that maximize the value functions in (a).

5 Calibration

One of the main contributions of this paper is to show how labor choices are intertwined with housing decisions, with a special emphasis on highlighting how different housing characteristics lead workers with similar skills to take different job offers in different locations, with significant and persistent consequences. Thus, in this section, we calibrate our stylized the model for two numerical exercises to recreate the main features in both the Great Recession and the thriving labor market that preceded it. Our calibration is quarterly, and all parameters are externally calibrated to match standard data moments in the literature. The data moments targeted and the key parameters associated with them are summarized in Table 2. We describe the calibration sources for the common parameters across numerical exercises

next. While the combination of the parameters above is not meant to match endogenous moments generated by our simple model, such as homeownership rates by age, we aim to generate reasonable trade-offs between buying versus renting a house.

The annual interest rate of the economy is 3 percent, and we choose a logarithmic utility function in nondurable consumption and housing, with a relative weight of nondurable to housing consumption of 2.7 (as in Greenwood and Hercowitz (1991)). On average, individuals stochastically retire from the labor market after 40 years. The house price to median income ratio for the United States in 2006-2008 was around 7, as such, we set a house price $p_h = 7.5$ in the model simulation to match that number.[25] In terms of annual depreciation of owner-occupied housing, there exists a wide range of estimates in the literature, from 1.6 percent as in Davis and Heathcote (2005), to $2.5 - 3$ percent in Sommer, Sullivan and Verbrugge (2013). We set this depreciation rate to be 2 percent, a mid-point in the literature range. Given the values for the interest and depreciation rates, and the house price, we set rental price p_r such that the house-price-to-rent ratio is about 20.[26] The minimum required down payment is 20 percent, which is standard in the literature.

Regarding the labor market structure, to calibrate the salary differential between the high-paying and low-paying job, we follow Huckfeldt (2022), who estimates the wage loss differential for occupational switchers to be about 30 percent, and a roughly 25 percent wage premium at skill-intensive jobs for new entrants. As a result, we believe setting the premium in the high-paying job to 25 percent is a sensible choice and aims to bring the notion of occupation closer to our modelling assumptions. Following Shimer (2005), we set the destruction rate so jobs last on average two and a half years. The average replacement rate agents receive during unemployment is about 40 percent of their working wages, varying some, based on the worker's skill level, but within the usual U.S. labor market replacement rates. Finally, we set the human capital appreciation technology to deliver an average cumulative return to experience of about 25 percent after 5 years of continuous employment, as in Buchinsky, Fougère, Kramarz and Tchernis (2010).[27] We set π_u, the probability of skill depreciation

[25] This ratio is obtained from dividing the Case-Shiller Home Price Index from the St Louis Fed FRED database by the median income from the same database. While this ratio produces a higher estimate than (Hatchondo, Martinez and Sánchez (2015)), where a house is three-times the annual income, it is closer to the figures produced by the Joint Center for Housing Studies (https://www.jchs.harvard.edu/blog/home-price-income-ratio-reaches-record-high-0), and more relevant for the period of study, as house prices peaked before the Great Recession.

[26] From Census Bureau data, the national U.S. ratio of median house prices to annual rental payments rose from 22.7 in 2005 to 24.50 in 2007, and decreased below 20 in 2011, making a target of 20 sensible for our time frame. See https://smartasset.com/mortgage/price-to-rent-ratio-in-us-cities for additional details on this computation.

[27] They estimate 24 percent cumulative returns for high-school drop-outs, 28 percent for high-school grads, and 43 percent for college grads.

while unemployed, such that human capital depreciates on average about 16 percent per quarter of unemployment.[28]

For our numerical solution, we discretize the skill grid into three points and the asset grid into 100 unevenly distributed points.[29] Lastly, we use Fella (2014) and de Francisco (2023) to transform the liquid asset grid in combination with the endogenous borrowing constraints associated with housing choices, into an ability-to-borrow measure, $b \geqslant 0$, where $b = 0$ implies the individual is credit constrained, and $b > 0$ indicates how far the individual is from hitting the relevant borrowing limit. This calibration highlights the tractability of our model by capturing salient features of the data.

5.1 A Great Recession scenario with symmetric islands

The Great Recession, as other papers have documented, exhibited very low migration rates and widespread poor geographical job prospects. As a result, we simplify the possible reallocation channels in the full model by computing a steady-state economy composed of two symmetric islands, where optimally nobody moves. This lack of mobility makes mechanisms cleaner and mutes house-lock effects.

We set job-finding and job-destruction rates to be the same across islands, and, in particular, we target a 15 percent monthly job-finding rate λ_l on each island, in line with the rates observed in the United States during the Great Recession between 2008 and 2010. We set the selling cost c_s to 6 percent of the house price. The job distribution in terms of wage prospects on both islands are the same—that is, the probability of being offered a high-paying job $\pi_{l,h}$ is set to 45 percent for $l = 1, 2$.

We next simulate the economy for 60,000 workers over a long period until the economy is in a steady state. As expected, given the symmetry in labor markets across islands, about 50 percent of the population lives in each location, and there is no migration. The homeownership rate is 52 percent in each location, with the average homeowner being older and having more years of labor market experience than the average renter.

This result also aligns with the fact that homeowners are more skilled and employed in high-paying jobs than renters. Thus, on average, renters earn 20 percent less than homeowners and have less net assets.

[28] Huckfeldt (2022) estimates a 4 percent human capital depreciation over a continuous quarter of unemployment. However, his model features an additional obsolescence human capital shock that is absent in our model, increasing the human capital loss.

[29] The lower bound for skill is set to $\underline{s} = 0.5$ and the upper bound is $\bar{s} = 1$. We have solved the model using a finer skill grid with 10 points, achieving similar results, which are available upon request.

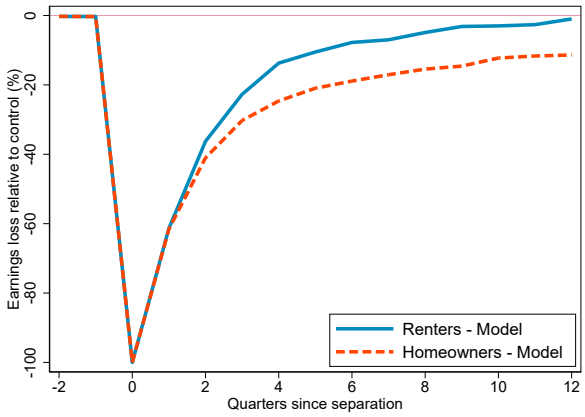
Table 2: Parameters for the symmetric case

Parameter	Description	Value	Target
β	Discount factor	0.9924	3% annual interest rate
ν	Death probability	0.0062	40 years of working life
p_h	House price	7.5	See text
p_r	Rental price	0.095	House-price-to-rental = 20
δ_h	Depreciation rate of owner-occupied housing	0.02	See text
γ	Down payment	20%	Standard
c_m	Moving cost	$2 * p_r$	Two months' rent
$\frac{w_h}{w_l}$	High-paying job job salary premium	1.25	25%, see text
δ_l	Job-destruction rate	10%	2.5 years of tenure, see text
z	Replacement rate	$38 - 48\%$	Standard
π_e	Prob. of skill appreciation	0.05	25% 5-year experience premium
π_u	Prob. of skill depreciation	0.50	16 percent average loss per quarter

5.1.1 The unemployment scar between homeowners and renters: Model results

Here, we show the unemployment scars that the model generates for homeowners and renters. We focus on separated workers who are unemployed in period t but were employed in $t-1$ and $t-2$. We classify them as homeowners or renters given their housing tenure in the period before the separation, and we use that period to define the island location pre-separation. We similarly define a control group as those workers employed in $t-1$ and $t-2$ who do not separate in t (but could separate thereafter). Next, we follow these workers up to $t+12$ quarters and compare the labor market outcomes of separators with those of the control group in Figure 9, focusing on the evolution of earnings and employment.

Figure 9: Earnings losses in the symmetric economy



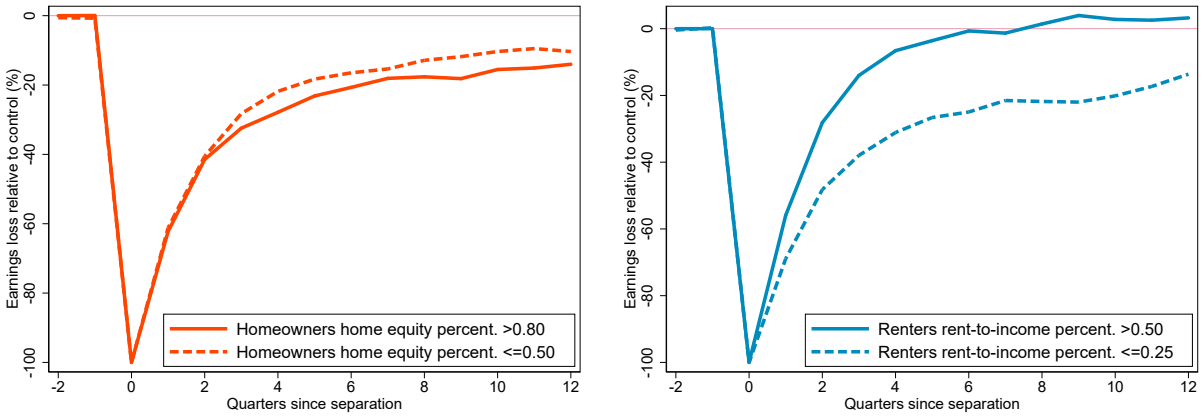
The symmetric calibration of the model in a low job-finding rate environment captures

very well the empirical estimates in Section 3 during 2009-11. Earnings losses relative to the control group are prominently persistent for homeowners, whose losses remain 15 percent lower even after three years following the separation. Renters, however, experience an almost full recovery three years after the separation.

Next, we explore if the housing variables present in the model are consistent with our empirical estimates in explaining the different unemployment scar between homeowners and renters.

The left panel of Figure 10 shows that homeowners with less home equity (dashed line) recover faster than others. Moreover, in the right panel, one can see that renters with higher house payments-to-income (solid line) recover faster than other renters.[30] In summary, the calibrated model successfully captures not only the difference in earnings recovery by homeownership group, but also by home equity and housing payments documented in the empirical part.

Figure 10: Earnings losses by home equity percentile and rent-to-income



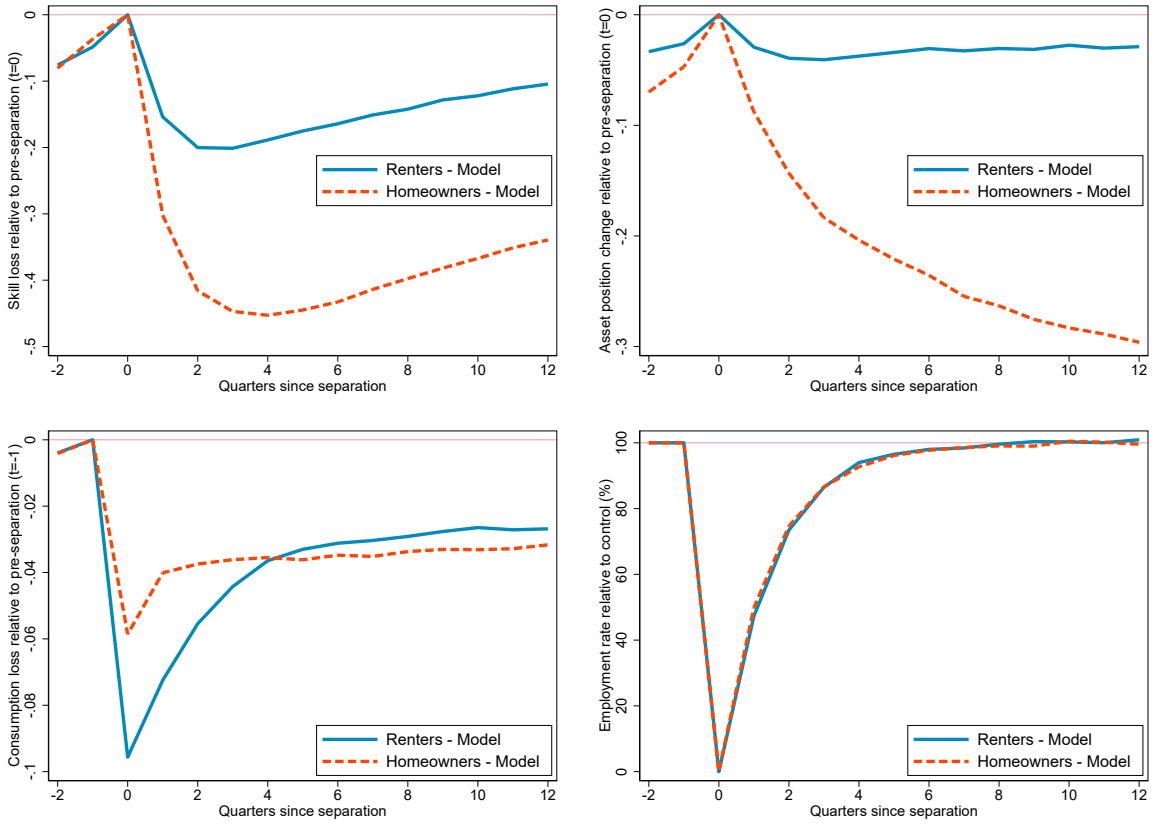
We turn to explore the channels driving the differential earnings losses across groups by studying the impulse response of separators' skills, net assets, consumption, and employment decisions relative to their control. We present these results in Figure 11.

The earnings-loss differential arises mainly from two sources: first, as depicted in the top-left panel, on average homeowners lose more skills than renters, since more of the latter are at the bottom of the skills distribution pre-separation, and these losses are persistent because, upon reemployment, human capital accumulation is slow. Second, there is a composition effect, as, on average, more homeowners were employed in higher-paying jobs than renters before the separation, leading to larger wage cuts. Interestingly, both renters and

[30] In the model, we depict the percentiles of rent-to-income payments only for renters, who have clearly defined rent payments per period, even though the empirical observation holds for renters and homeowners.

homeowners accept jobs at the same rate (bottom-right panel), so employment alone does not explain the differences in earnings recovery in this low job-finding rate environment.

Figure 11: Skills, assets, consumption, and employment in the symmetric economy



Notwithstanding, homeowners weather unemployment shocks better than renters by using housing as collateral (top-right panel) to smooth consumption. Note how homeowners can borrow up to a fraction $(1-\gamma)$ of the housing value in the model (via borrowing limits $B_{O,U}$ and $B_{O,E}$). Renters, however, with basically no room to borrow, experience a smaller change in their net asset position but suffer larger consumption losses (bottom-left panel). For both groups, post-separation consumption does not fully recover even three years later, signaling that the unemployment scar also leaves permanent marks on consumption and assets.

All in all, through our model's lens, homeowners' slower earnings recovery is optimal. Unemployed homeowners continue enjoying higher housing services than renters, and homeownership provides more insurance against nondurable consumption losses due to higher home equity and lower housing payments relative to income.

5.2 A thriving labor market with asymmetric islands

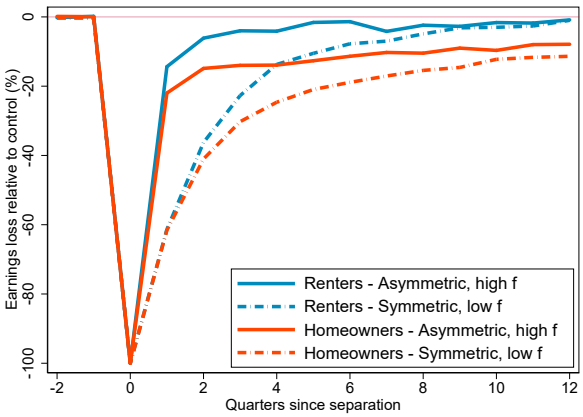
Our second exercise attempts to recreate the labor market dynamics and labor reallocation pre-Great Recession. Thus, this calibration differs from the previous one in three important dimensions: first, we reflect the hot labor market by setting the monthly job-finding rate λ_l on both islands to 45 percent, that is, we make it easier to find jobs, both high and low paying, everywhere. Second, we introduce a reason to move from island 2 to island 1 and to make the wait for high-paying jobs worth in island 1, by increasing the probability of being offered a high-paying job on island 1 is to $\pi_{1,hp} = 0.55$; meanwhile, on island 2, this probability remains unchanged, with $\pi_{2,hp} = 0.45$, as before. And third, to capture the healthier financial position of homeowners, reflected in their larger average levels of home equity shown in Table 1, we lower selling costs c_s to 3 percent of the house price.

In the new steady state for this economy, 69 percent of agents live on island 1 and 31 percent on island 2, with agents on island 1 being slightly older. Now the homeownership rate is 64 percent on island 1 and only 41 percent on island 2. However, on average, agents on island 1 have more assets because of the improved wage distribution. Overall, the option to move in this economy amplifies the regional heterogeneity between the two islands, especially in housing tenure and age.

5.2.1 The unemployment scar between homeowners and renters: Model results

As in the previous section, Figure 12 depicts the earnings losses of homeowners and renters after a job separation in the asymmetric economy, compared with those shown in Figure 9.

Figure 12: Earnings losses: Asymmetric vs Symmetric economy

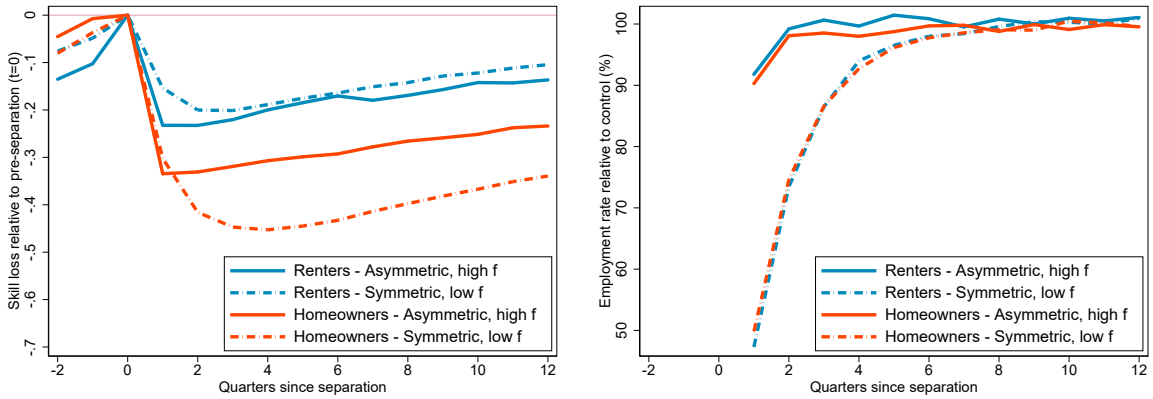


The panel shows that earnings losses are less persistent for both groups compared with the symmetric case (as solid lines are above dashed lines throughout). It is also notable that

the difference in the earnings scar between homeowners and renters is not as wide as in the symmetric case, in line with the empirical findings from the 2004 SIPP panel, due to the thriving job market conditions. So, in the aggregate, the model exercises capture well the differential recovery between homeowners and renters between booms and recessions.[31]

However, the channels driving the different unemployment scars between renters and homeowners are more nuanced and richer.

Figure 13: Skills and employment in both economies



Consistent with the empirical findings of the 2004 SIPP panel shown in the empirical section, the earnings recovery differential between renters and homeowners in this exercise is smaller than in the Great Recession scenario.

The reduced recovery differential in earnings is due to the combination of a couple of additional factors. First, even though the larger skill depreciation and wage cuts from losing relatively more high-paying jobs continue to be larger for homeowners, higher job-finding rates lead to higher reemployment rates and smaller skill depreciation especially for homeowners, as seen in the left panel of Figure 13.[32] Working in the opposite direction we have two new channels. Now, homeowners make use of their larger collateral by being pickier than renters in accepting low-paying jobs (right panel of Figure 13), and moving in lesser numbers than renters to island 1—the usual house-lock effect—, where the job distribution is better.[33]

[31] As in the Great Recession scenario, home equity and housing payments also help explain the different unemployment scar between homeowners and renters during booms. See Figure 23 in Appendix B.

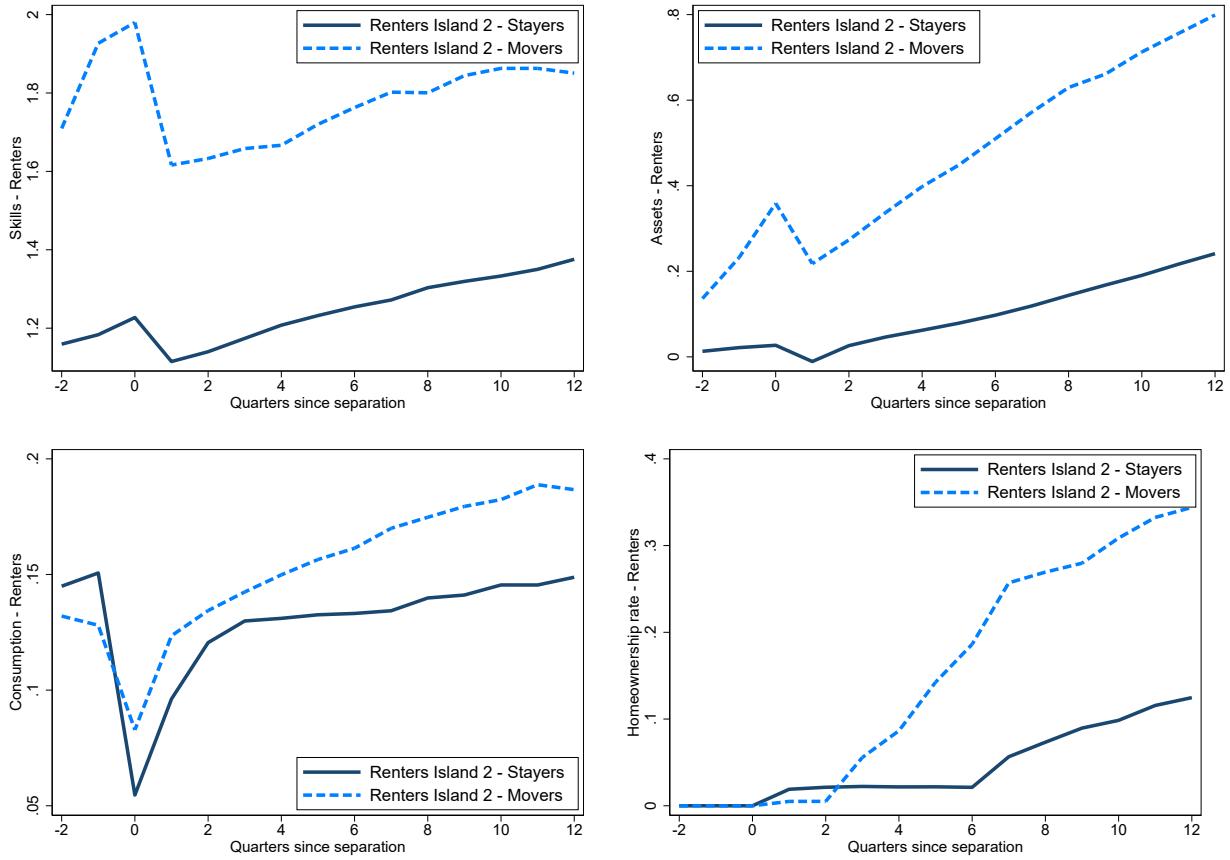
[32] This mechanism is not new, as Huckfeldt (2022) reconciles the lower earnings losses found during expansions due to smaller occupational displacement.

[33] Moving rates and the assets evolution for this exercise are available upon request.

5.2.2 The role of wealth and skills in labor reallocation across islands

To conclude our analysis, we explore how geographical reallocation affects the recoveries after a job loss within groups and show that the average effects mask substantial heterogeneity. We start with the most mobile group: renters.

Figure 14: Reallocation among renters: Movers versus stayers



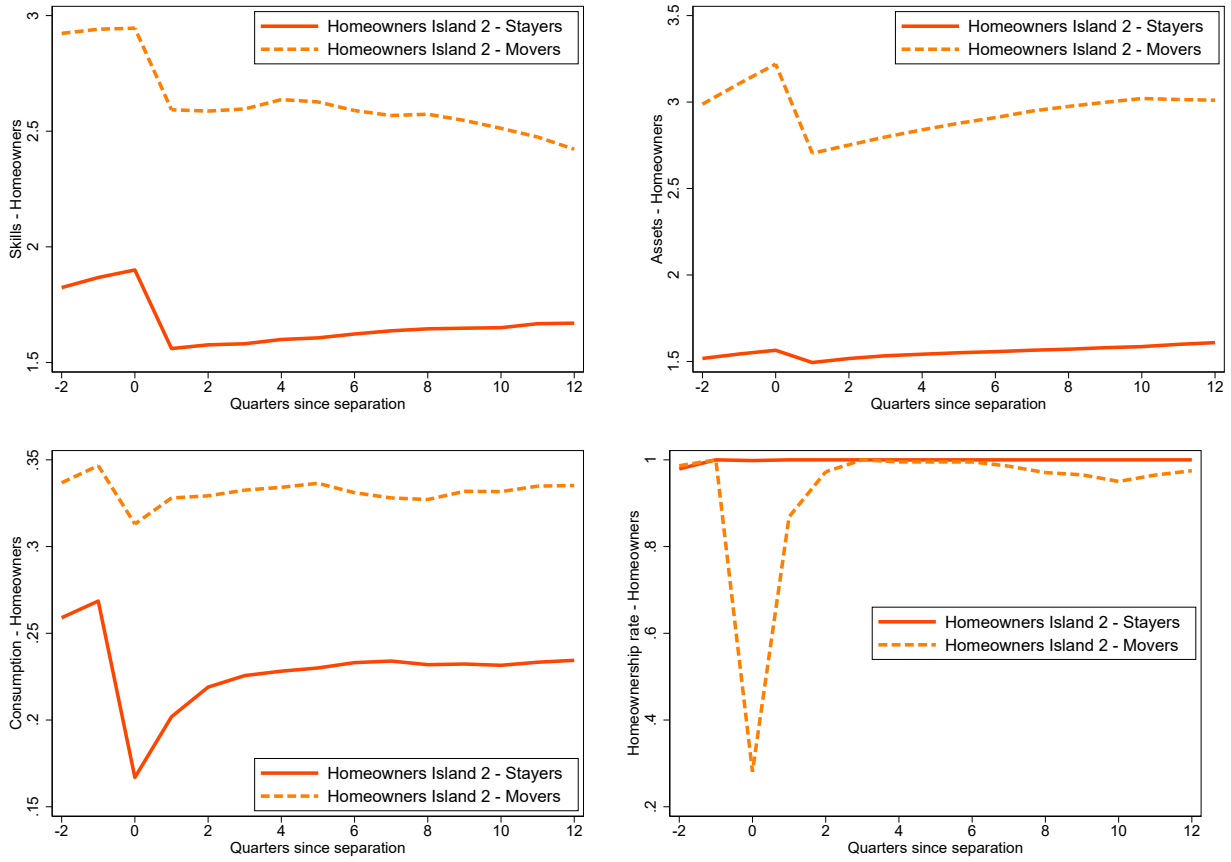
The top panels of Figure 14 show that, on average, more skilled and wealthier separated renters are more likely to reallocate. Higher skills give them a better opportunity to extract the benefits of moving to island 1, where more high-paying jobs are available. Besides skills, wealth still plays an important role, as all renters would like to move to island 1, but the poorest ones cannot. A quarter after a job loss, these poor renters borrow against future income and exhibit marginal propensities to consume larger than one, as shown by their average negative net assets in the top-right panel of Figure 14.

Indeed, we compute marginal propensities to consume for these two groups of renters following the separation. We calculate the ratio between percent changes in consumption in the period following the separation relative to percent changes in income. Movers' ratio is 0.62, suggesting that while they reduce consumption, they do less than one to one relative

to the loss in income. Meanwhile, stayers have a ratio of 1.15, and using the nomenclature pioneered by Kaplan, Violante and Weidner (2014), we call this group hand-to-mouth renters.

Moreover, in our model, as in the data, migration rates for renters are higher than for homeowners. We observe that some of the renters that move were in the brink of buying a house in island 2, and moving to island 1 delays homeownership, but only briefly. As shown in the bottom-right panel of Figure 14, homeownership rates of movers surpass those of stayers within the first year after the job loss.

Figure 15: Reallocation for homeowners: Movers versus stayers



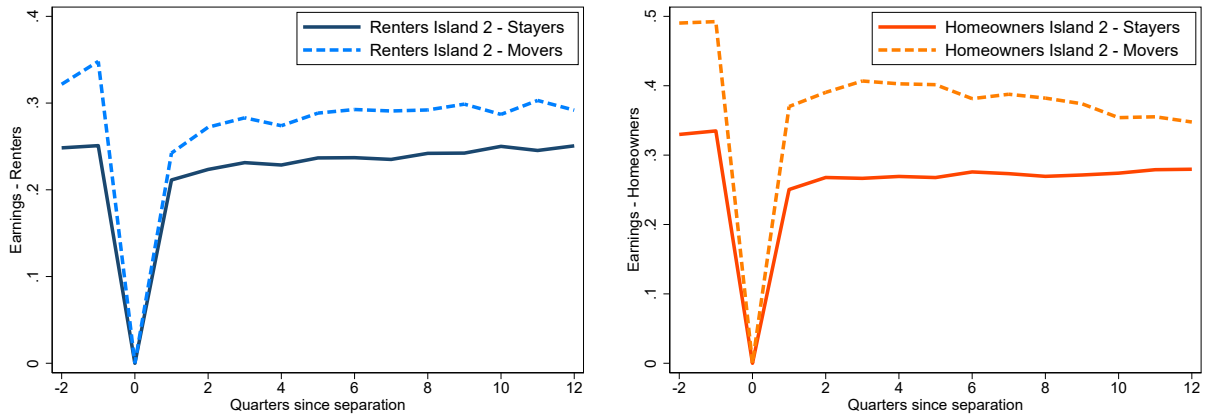
Next, we focus on homeowners in island 2, highlighting some interesting similarities between movers and stayers. For example, the top panels of Figure 15 show that homeowners who move are also more skilled and wealthier than stayers before a job loss. However, for all homeowners, the initial loss of skills is similar and significant, and although stayers are less wealthy than movers, they are not poor. Indeed, they are what Kaplan *et al.* (2014) defined as the "wealthy hand-to-mouth", with most of their wealth tied up in the down payment on their house.

Upon separation, this group of stayers exhibits marginal propensities to consume that

are much higher than those of the wealthier homeowners who move to island 1 and similar to those of the renters who also manage to move.

Lastly, Figure 16 shows that both, within renters and homeowners, movers' earnings recovery is faster and stronger than that of stayers. Thus, the unemployment scar in our model depends not only on the combination of skills and wealth, but also on the composition of wealth (liquid vs. illiquid). For homeowners, our results align with Brown and Matsa (2020), who find that job seekers with low home equity in areas with depressed housing markets apply for fewer jobs that require relocation, but within their constrained geographical location, look for jobs more intensively by expanding their search for lower-level positions. Our model succeeds in generating this effect, as homeowners with lower equity migrate less and get employed in relatively more low-paying jobs compared to pre-separation, resulting in larger earnings losses.

Figure 16: Earnings recovery: movers versus stayers



All in all, our model generates a considerable amount of heterogeneity consistent with our data findings, and our results add to the growing literature recently summarized by Krueger, Mitman and Perri (2016) on how wealth and skill heterogeneity can amplify and propagate macroeconomic shocks.

6 Conclusion

We have documented the importance of housing characteristics to reconcile the observed unemployment scar of homeowners and renters in the data. Recently unemployed homeowners experience a larger drop in earnings than renters, but more surprisingly, the earnings recovery of homeowners is also slower and weaker. Moreover, our novel empirical analysis has shown that the interactions between the unemployment scar and housing extend beyond the

usual house-lock effects studied in the literature. In particular, we find that high mortgage and rent payments before unemployment and low levels of home equity result in a faster earnings recovery across workers, suggesting that cash and credit constraints are important for job search intensity and acceptance rates.

We propose a simple structural island search model that captures the most salient trade-offs that homeowners and renters face after a job loss. We show that accounting for workers' housing characteristics and local job market conditions is key to understanding the different unemployment scars between homeowners and renters.

The model does a good job reconciling the different earnings recoveries of separated homeowners and renters between 2004–06 and 2009–11, and our paper suggests that the loss of human capital while unemployed, even for previously believed short periods such as a year, is significant and not fully internalized by workers.

More research needs to be done to determine to what extent workers are overly optimistic about their skills or about the prospects of the economy and the labor market. However, our findings call for unemployment policies to tie unemployment insurance to unemployment duration and the retention or acquisition of new skills. Moreover, to the extent that the government can more easily spot what industries and occupations are steadily shrinking in the economy and which ones are growing, policies subsidizing the acquisition of highly demanded skills can be optimal.

Lastly, this paper offers a good starting framework for future research, as the COVID-19 crisis and the subsequent spread of teleworking arrangements have loosened the links between housing decisions and local job markets for many workers.

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A Appendix A: Additional empirical results

A.1 Additional results from 2004 and 2008 SIPP panel

In this section we describe additional results and robustness analysis to the main findings in Section 3, by re-estimating equation 1 including additional sets of controls and alternative dependent variables. We summarize these findings as follows:

- In 2004, the earnings loss differential in percentages relative to the control group are not significant between homeowners and renters, with the percentage loss of the former being slightly smaller. In 2008, homeowners also lose more in percentage terms compared to renters, with the differential accounting about 10 percentage points, as shown in Figure 17.

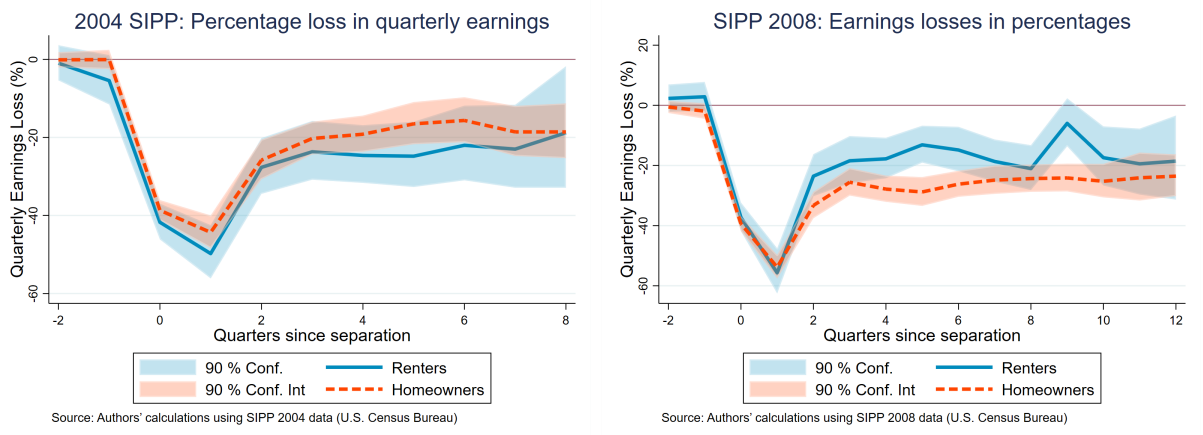

Figure 17: Percentage earnings losses in the 2004 and 2008 panels

- Match quality upon re-employment, measured via hourly wage losses, is significantly lower for homeowners relative to renters in the 2008 panel, but more similar in the 2004 panel. These results are presented in Figure 18.

- We do not find significant differences in labor supply, measured as days worked in a quarter, between homeowners and renters in either the 2004 or the 2008 panel, although renters seem to perform better three years post-dismissal (Figure 19).

- Larger housing payments-to-income ratios also result in smaller losses within groups, both the 2004 panel and in the 2008 panel. Moreover, losses are larger in the 2008 panel for those separators below the median housing-to-income payments. These findings are shown in Figure 20.

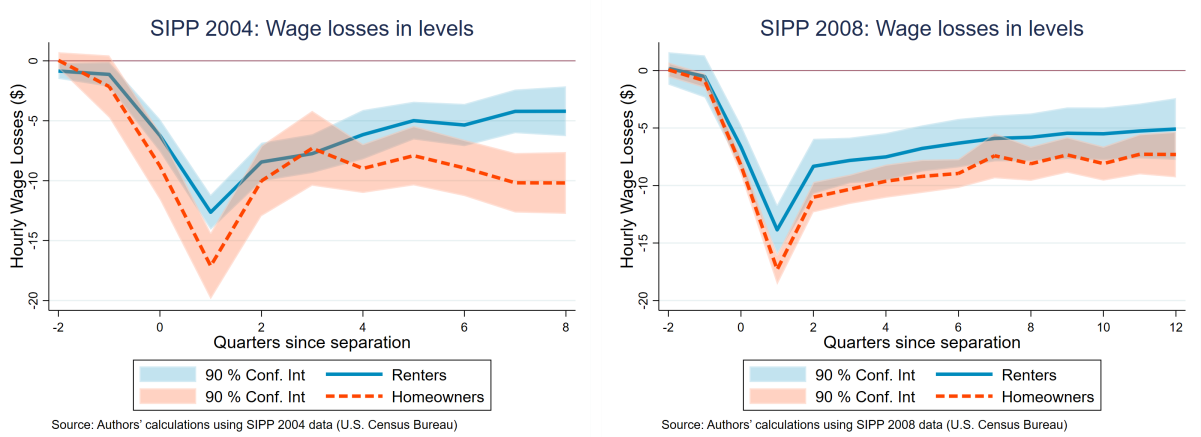

Figure 18: Wage losses in the 2004 and 2008 panels

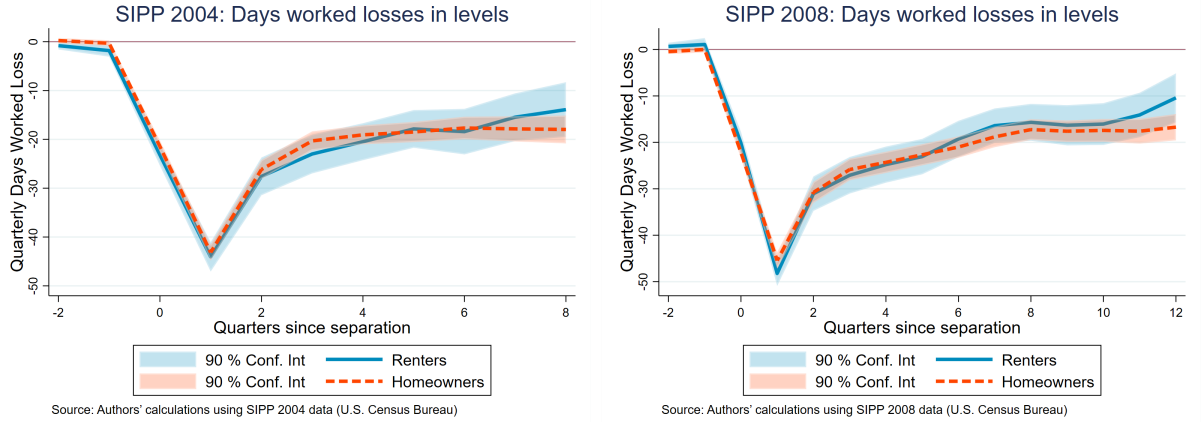

Figure 19: Days worked losses in the 2004 and 2008 panels

- During the Great Recession, larger homeowners earnings losses remain significant even when controlling for intra-spousal insurance, all sources of household income, and excluding never-married households, as shown in Figure 21. These also hold, with large standard errors, for single households, and available upon request.

- Figure 22 presents the OLS estimates for Equation 2 using the SIPP 2004 panel for separators. As opposed to the 2008 panel, the point estimates for the effect of home equity on replacement rates (left panel) and unemployment duration (right panel) are not significantly different from zero, even when splitting the sample between those with positive and those with negative home equity. Interestingly, when focusing on those with home equity below the 20 percentile (including negative equity and positive equity below 24,000 dollars), the coefficients in both regressions are positive and significant (available upon request), in line with our results presented in the main text.

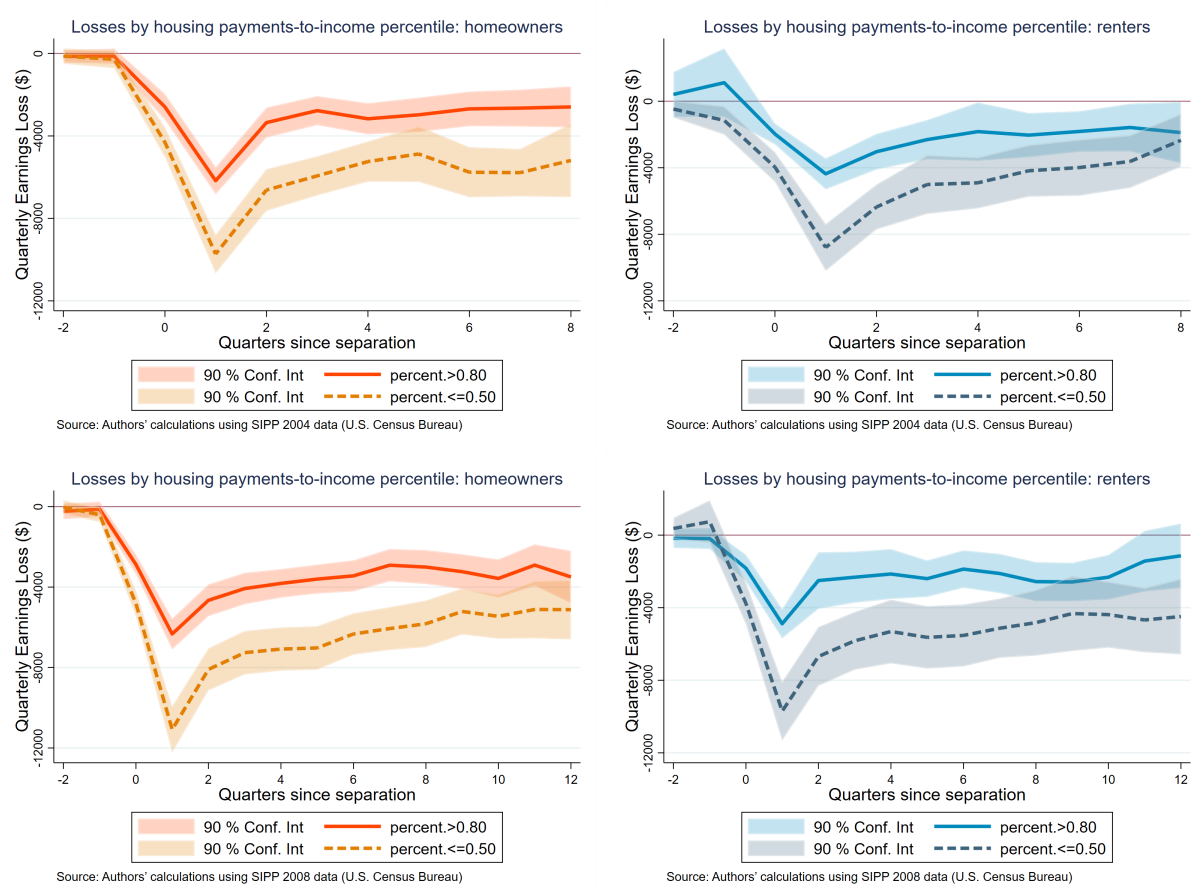

Figure 20: Workers earnings recovery by housing payments-to-income ratio in the 2004 (top) and 2008 (bottom) panels

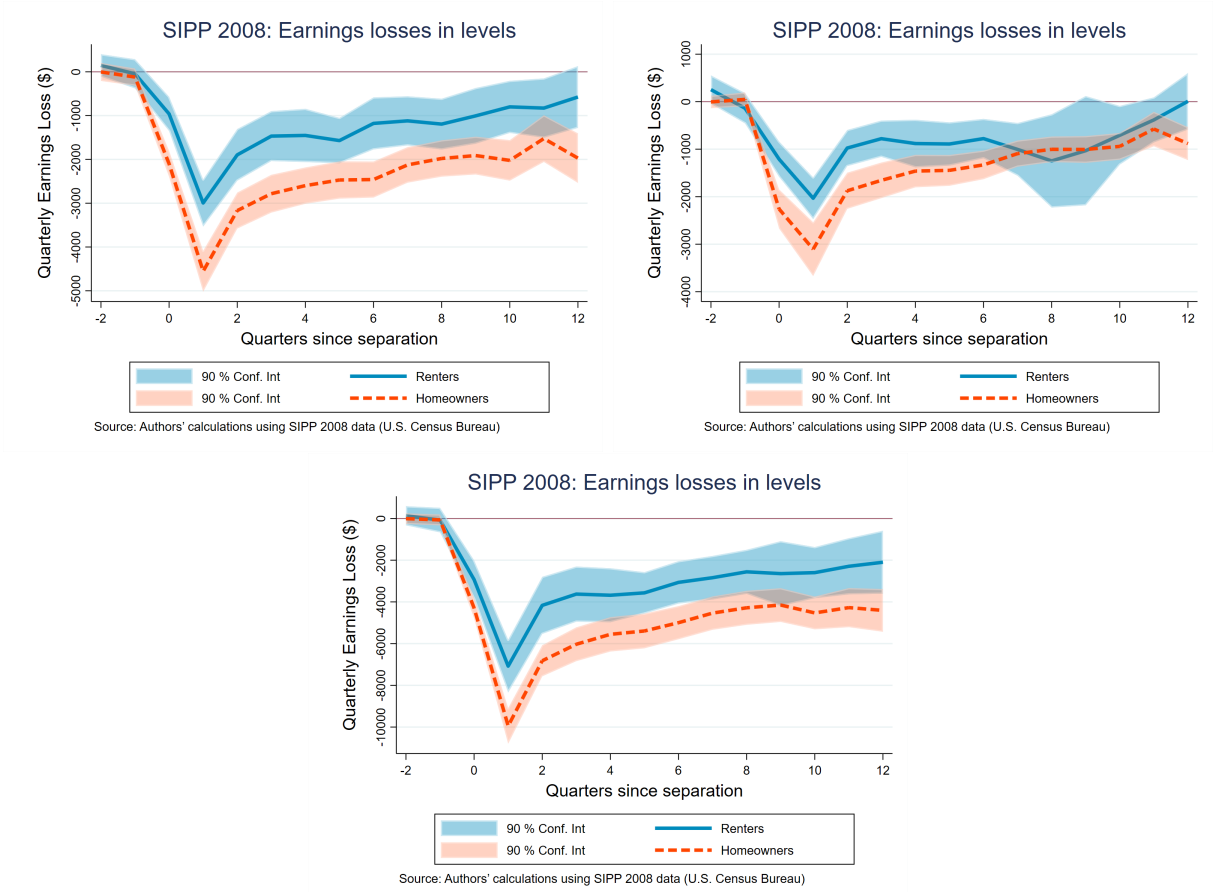

Figure 21: Losses in 2008 panel by controlling for household labor earnings (left), controlling for household total income (right), and excluding never-married households (bottom)

Note: Vertical lines reflect the 90 percent and 95 percent confidence intervals for the point estimates.

Figure 22: Wage replacement and unemployment duration by home equity availability

B Appendix B: Additional Model Results

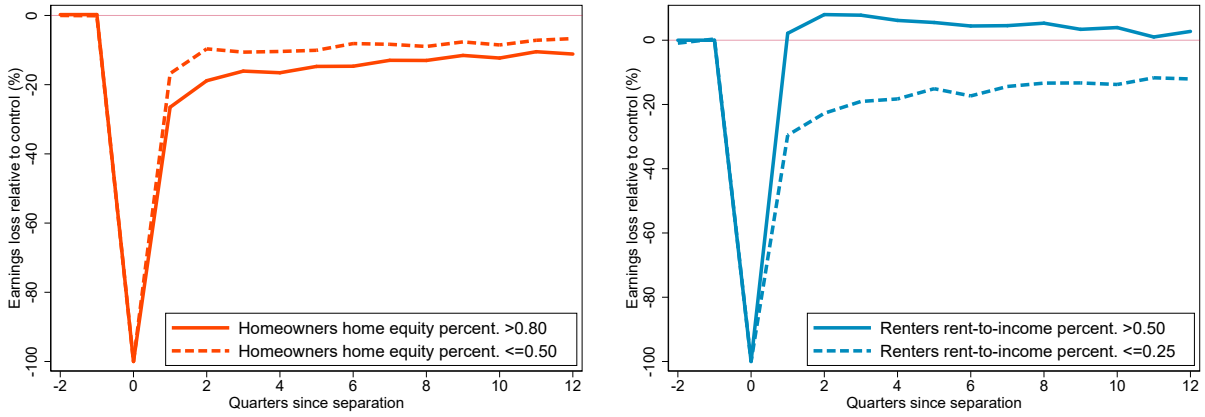

Figure 23: Earnings losses by home equity percentile and rent-to-income