Homeownership and job separations: a surprising mix *

Eva de Francisco† Joaquin Garcia-Cabo‡

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Abstract

We document that the recovery of workers' earnings, wages, and labor supply after a job separation is affected by housing characteristics. Homeowners suffer larger and more persistent earning losses than renters, and losses increase on home equity availability and decrease on housing payments. To rationalize our findings, we propose an island search model with endogenous savings and housing decisions, where human capital dynamics depend non-trivially on workers' job status. The calibrated model recreates the larger unemployment scar for homeowners through different channels: an initial higher fall off the job ladder due to human capital decay while unemployed, an intensive use of home equity to smooth consumption, a pickier attitude towards reemployment, and lower migration to better local job markets.

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†Bureau of Economic Analysis. E-mail: eva.defrancisco@bea.gov

‡Federal Reserve Board. E-mail: joaquin.garcia-caboherrero@frb.gov

I Introduction

Unemployment leaves permanent scars on individuals, not only in terms of lost income during unemployment spells but also in the form of lower wages upon reemployment. Previous literature has studied the interaction between business cycles and the unemployment scar, but the interaction of the reemployment decision with other household characteristics is not well understood, even as workers often have to jointly decide how much labor supply, where to live, and whether to own or rent a house in a given location.

In this paper, we document that homeowners suffer larger and more persistent earning losses than renters after unemployment shocks, even in the absence of housing prices swings. We focus on labor market outcomes of recently separated workers by homeownership status at the time of a job loss, and show that the earnings of homeowners with low home equity, and of workers with high housing payments to income recover faster. To understand these findings, we build a island search model where workers are heterogeneous in their skills and have preferences over housing and non-durable consumption. Human capital stochastically increases while employed and depreciates while unemployed. In each island, there is a distribution of high- and low-paying jobs, and workers receive job offers from the island they live in that are independent of their skill level. Because homeowners have more human capital than renters and selling a house incurs in transaction costs, unemployed homeowners are more likely to face larger earnings losses than renters.

We present some new stylized facts from the Survey of Income and Program Participation (SIPP) spanning 2004 to 2013 to document the different size in unemployment scars between renters and homeowners[1]. We focus on the short- and long-run labor market outcomes of recently separated workers by homeownership status at the time of a job separation, zooming in on workers who separated from their job between 2004-2006, and 2009-2011[2]. We study the recovery of earnings, wages, employment, and hours of separated relative to non-separated similar workers. We find that renters recovered faster from unemployment than homeowners, showing an almost-full recovery after

[1] Adding to Arulampalam (2001), which focuses exclusively in the first wage after an unemployment spell, and in the spirit of the unemployment scars studies of Davis and Wachter (2011) and Huckfeldt (2022).

[2] Complementing Aaronson and Davis (2011), Bajari, Chan, Krueger and Miller (2013), Mian and Sufi (2014), and Karahan and Rhee (2019), all focused on the effects of the housing bust in the sluggish recovery after the Great Recession.

2 years. For homeowners, unemployment led to long-lasting earnings losses during both periods, even 3 years after the separation.

More specifically, we find that the earnings of homeowners with low home equity and of workers with high housing payments to income recover faster, and that the differential recovery between homeowners and renters also depends on the aggregate conditions of the economy. During the 2004-2006 expansion period, we find no differences between homeowners and renters during the first year following the separation and upon reemployment, although homeowners' recovery flattens out later on. In contrast, during the 2009-2011 bust period, renters' recovery is stronger throughout, due to both higher labor supply and better match quality upon reemployment. Despite the starkness of these findings, understanding the underlying forces driving them is not straightforward, as both the aggregate labor and housing markets experienced dramatic changes during the 2004-2013 period.

Thus, to understand these facts, we build a simple but rich enough island search model where workers' human capital changes stochastically with workers' job status. In each island, there are high-paying and low-paying jobs, and workers receive job offers from the island they live in regardless of their skills. Wages depend on the type of job and the skill level of the worker. There is an unlimited supply of one-sized houses to rent or buy in each island, and owning a house requires a minimum substantial down payment and is subject to selling costs. However, owning a house provides a higher flow of housing services than renting it and increases the credit limit acting as collateral.

Our calibrated model predictions successfully align with the data, this is, following unemployment, homeowners are more likely than renters to get reemployed with lower earnings relative to their prior job as their human capital depreciates more, leading to more persistent losses compared to renters. Our model reconciles the observed losses through the interaction among homeownership status, home equity, and the wage distribution across labor markets, as homeowners use home equity as collateral to wait for better job offers, but face more constraints to move and search globally.

In particular, homeowners living in islands with a larger share of high-paying jobs are more likely to wait for better job offers and lose more human capital. Similarly, homeowners living in

islands with worst job prospects are less likely to move away to better locations, due to the existence of selling costs, and get reemployed at low-paying jobs.

Our paper is the first in the literature to document the different cost of job loss between homeowners and renters. Davis and Wachter (2011) estimate the average cumulative earning losses of displaced workers during recessions. More recently, Huckfeldt (2022) shows that these losses are mostly concentrated among workers switching from high-skill to low-skill occupations, and proposes a job search model with selective posting of vacancies to explain his findings.

Aaronson and Davis (2011), Farber (2012) and Yagan (2019) focus on how regional shocks and migration rates contributed to the low reemployment rates observed in the aftermath of the Great Recession. Our findings hold for the 2004-2013 period and were estimated for workers whose housing status did not change during the 3 years following an unemployment shock.

On the theory front, Bajari *et al.* (2013) and Karahan and Rhee (2019) simulate a housing price bust (à la Great Recession) to understand the effects of housing price shocks on the demand for non-durable and housing consumption, and on the supply of labor respectively. Our paper is broader in scope and our model is useful to understand the behavior of homeowners and renters, even in the absence of housing price changes.

Lastly, others like Demyanyk, Hryshko, Luengo-Prado and Sørensen (2017) estimate that negative home equity is not a significant barrier to job-related mobility in different labor markets during the Great Recession.[3] Barceló (2006) finds for a panel of European countries during the 1994-1997 period 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. Our results are stronger and more general, since we find that after individual unemployment shocks, low levels of home equity actually increase job-finding rates.

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

[3]The answer to how very low or negative home equity affects mobility rates is not clear yet. Ferreira, Gyourko and Tracy (2010) estimate that negative equity and rising interest rates reduce the geographical mobility of owners, but Schulhofer-Wohl (2012) find that negative equity does not reduce homeowners' mobility.

findings, and section V presents a couple of calibrations with the model's predictions. Finally, section VI concludes.

II Data description

In this section we describe the data sources and variables used throughout our analysis. We use micro-data from the Survey of Income and Program Participation (SIPP). SIPP is 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 since its creation in 1983 has been designed as a succession of household panels. In particular we use the 2004 and 2008 panels.

The 2004 panel consists of 12 waves, containing information between February 2004 to January 2008, and the 2008 panel consists of 16 waves, with information spanning September 2008 and December 2013. Both panels contain information about 52,000 households. Within each panel, each wave contains monthly information on "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.[4] In order to define workers' employment status, we use their self-reported based 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-employment if they respond "not looking for a job and not on layoff".[5]

Next we turn to describe how we generate different income variables. For salaried workers, we construct monthly earnings 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

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

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

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 (CPI).[6] We define (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 questionnaire contains the variable *ETENURE*, an indicator variable that captures workers' housing status in a given month. In this analysis, we restrict to workers who respond either to be 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*, gender *ESEX*, 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.

II.1 Sample selection

We choose our sample taking into account that, according to the Survey of Consumer Finance, the biggest increase in homeownership rates occurs when individuals are between 30 and 40 years old. Thus, to see whether renters and homeowners behave differently after a job separation, we define a restricted prime-age workers group as those 30 or older at the beginning of each wave. Moreover, because many decisions later in life, housing being one of them, are affected by the approaching retirement decision, we also restrict our sample to individuals younger than 55 years old.

Since we want to analyze the role of housing status and housing variables on earnings recovery after a separation from their main job. In particular, we define a separation in a given month when an employed worker who was working and non absent from work in the previous month reports no employment (either unemployment or non-employment). We exclude workers declaring to be employed but absent without pay from this definition, in order to avoid workers under temporary layoff and furloughs, which 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.

[6] Wages come from SIPP question on hourly wages, and are corrected for top-coding comparably to the CEPR wage series.

Moreover, and to avoid selection bias, we require workers to be employed full-time at the time of the separation, and we focus on separations that take place between 2004Q4 and 2006Q2 for the 2004 wave, and between 2009Q3 and 2011Q4 for the 2008 wave, to report at least three years of job tenure before the first quarter when separations start.[7]

And lastly, we focus on workers whose homeownership status does not change between 2004-2006 and 2009-2011 for the 2004 and 2008 panels, respectively.[8] Here, it is important to clarify that SIPP only reports the states' home addresses 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 house status.[9]

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, and we compare the earnings recoveries of workers in the treatment group relative to the control group for the subsequent 8 to 12 (if enough data available) quarters after the separation, and we split the sample based on homeownership status in the separation year.[10]

The slope of the recovery relative to the control group will be informative about the persistence of earnings losses, through effects in the extensive margin (unemployment) and intensive margin (reemployment at lower paying jobs). Hence, we will also look at days and hours worked in a given quarter, as well as hourly wages.

[7] 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.

[8] Since the SIPP data does not designate a household head inside a household, we look at the separations of all the workers inside a household that meet our age and job tenure criteria. We then categorize a worker as homeowner if she or he lives in a house owned by any members of her or his family.

[9] Unconditional monthly migration rates tend to be 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.

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

II.2 Econometric model

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

$$e_{it} = \alpha_i + \gamma_t + X_{it}^{'}\beta + X_{it}^{'}\beta^{HO}1\{HO\} + \sum_{k\geq -2}^{12} \delta_k D_{it}^k + \sum_{k\geq -2}^{12} \delta_k^{HO} D_{it}^k 1\{HO\} + \varepsilon_{it} \tag{1}$$

We regress the dependent variable (i.e. quarterly earnings) for all individuals i and periods $q \in \{-2, 12\}$ on person fixed effects α, year fixed effects γ, and a quadratic polynomial in age X. The indicator function $1\{HO\}$ takes value 1 if the worker is a homeowner before separations start, and takes value 0 if the worker is a renter. Earnings losses of the treatment group are measured through the 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, being 0 the quarter of separation. With this specification we can compute the change in earnings q quarters after separation by type of housing choice prior to dismissal. As an example, take the period of observation to be a year and set $q = 2010Q1$ as the time of separation. In 2011Q1, he will have $D_{i2011}^4 = 1$ (since it indicates it is four quarters after the separation). Hence, δ_k captures the earnings losses of the treatment group of renters relative to the control group, while $\delta_k + \delta_k^{HO}$ captures the losses of the homeowners. We cluster errors at the individual level.

III Reduced-form evidence: a comparison in time

We present the results of the reduced-form model with quarterly earnings as the dependent variable in Figure 1, for the 2004 wave in the left panel, and the 2008 wave in the right panel.

This figure depicts the average monetary earnings losses by homeownership status for the treated group of separated workers, including those with zero earnings in a given quarter, relative to the control group of not displaced workers.

The first thing to notice in Figure 1 is that average earnings losses for separated workers during

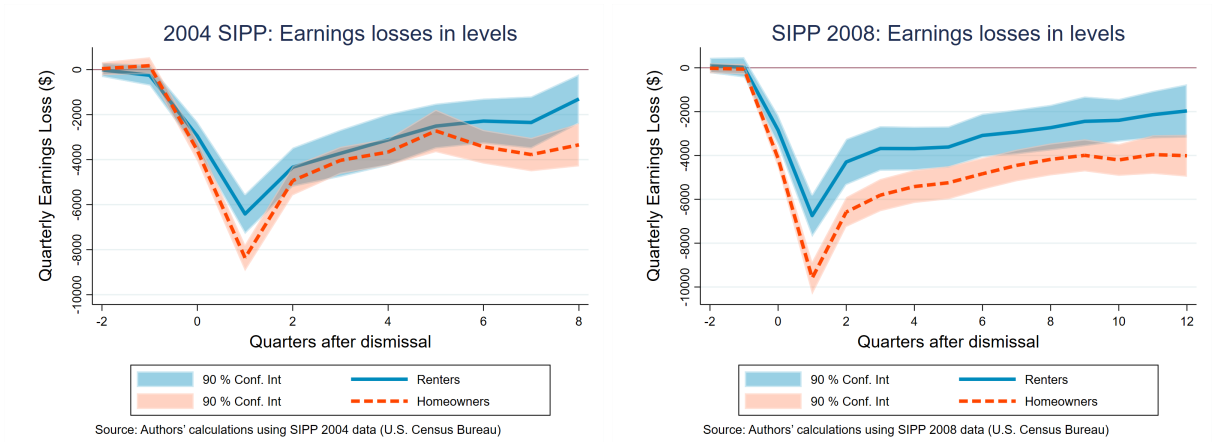


Figure 1: Average earnings losses after a dismissal

the 2009-2011 *bust* were larger and more persistent when compared to the 2004-2006 *boom*.[11]

In the 2004-2006 period, renters experienced earning losses of about $6,000 the quarter after separation, but recovered almost completely after 2 years. In the 2009-2011 period, these losses were only slightly larger upon separation but had a more sluggish recovery and were still about $2,000 below the control group even 3 years later.[12]

Turning to homeowners, their earnings losses were larger and more persistent than renters' in both the *boom* and the *bust*, and especially so in the latter period. During the *boom*, separated homeowners lost an average of $8,000 the quarter after separation relative to the control group. However, during the first year or so after separation, they experienced a similar recovery to that of renters, and only after that, homeowners' earnings growth flattened out, and became different from renters'. During the *bust*, homeowners initial losses became even larger, reaching almost $10,000 in the first quarter following the separation, but more interestingly, homeowners' recovery was significantly different and slower than that of renters both during the first year after separation and thereafter. Moreover, homeowners' earnings losses were still about $4,000 below the control group even 3 years later.

[11] Davis and Wachter (2011) document the higher cost of job separations during recessions, so while this result is not surprising, we document that for renters most of these higher costs, at least during the Great Recession, concentrated in the short run.

[12] In our robustness analysis, we have computed these losses by adding household labor income as a regressor, to control for spousal intra-household insurance, household total income–aiming to control for wealth–, and we have excluded singles for the 2008 panel. Significant differences in recoveries remain in all these cases especially during the first two years and results are available upon request.

Next, to disentangle the role of the extensive versus the intensive margin, we concentrate on measuring the losses of reemployed workers and show their recovery in Figure 2. For that, we estimate equation (1) for log earnings, allowing us to interpret it as percentage losses of reemployed workers relative to the control.[13]

In the 2004 wave, Figure 2 shows that the match quality of renters and homeowners' jobs was very similar, consistent with the existing strong labor markets' conditions and lower reallocation costs, specially favourable for homeowners. In contrast, in the 2008 wave, homeowners reemployed in relatively lower-paying jobs, associated with a lower match quality, while renters reemployed in relatively higher-paying jobs, associated with a higher match quality. After 3 years upon separation, homeowners' earnings remained around 25% below their control group.

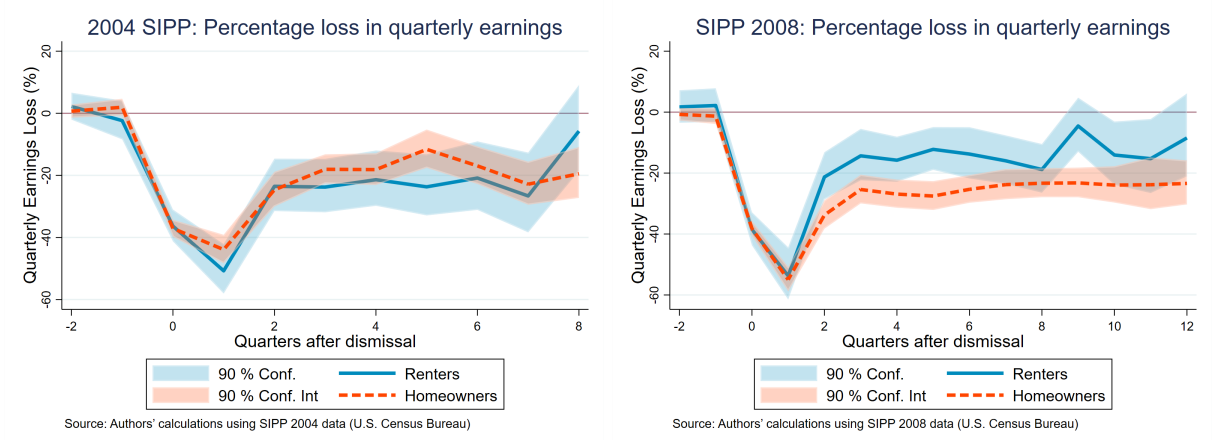


Figure 2: Average earnings after a dismissal, excluding zeroes

To our knowledge, this paper is the first to document the different unemployment scars between homeowners and renters, showing that homeownership has negative effects on both wages and on labor supply.[14] Specifically, we show that both the extensive and intensive margins play a role in the recovery, and that this crucially depends on the aggregate state of economy.

Moreover, since differences between homeowners and renters recoveries are more substantial during the Great Recession, and to simplify the analysis going forward, we focus on the 2008 wave

[13] We obtain the percentage number from the approximation given by $e^x - 1 = \%$, where x is the estimated δ_k coefficient from equation (1).

[14] Brown and Matsa (2020) examines how regional housing market distress affects job search and Yang (2019), using a different estimation strategy, only focus on the effects of homeownership on post-unemployment wages, but not on labor supply or employment rates.

for the remaining of the empirical section, but present the 2004 wave results in the appendix.

Figure 3 shows average hourly wages, days and hours worked in each quarter. There, one can see that during the first year after the job loss, only the recovery of average hourly wages is significantly better for renters than for homeowners. After the first year, we also see how days and hours worked in each quarter recover slightly faster for renters relative to homeowners. These results point towards two complementary channels in driving the observed earnings wedge between renters and homeowners: better match quality upon reemployment (from wages), and to a lesser extent, slightly higher labor supply (from days and hours) of renters.

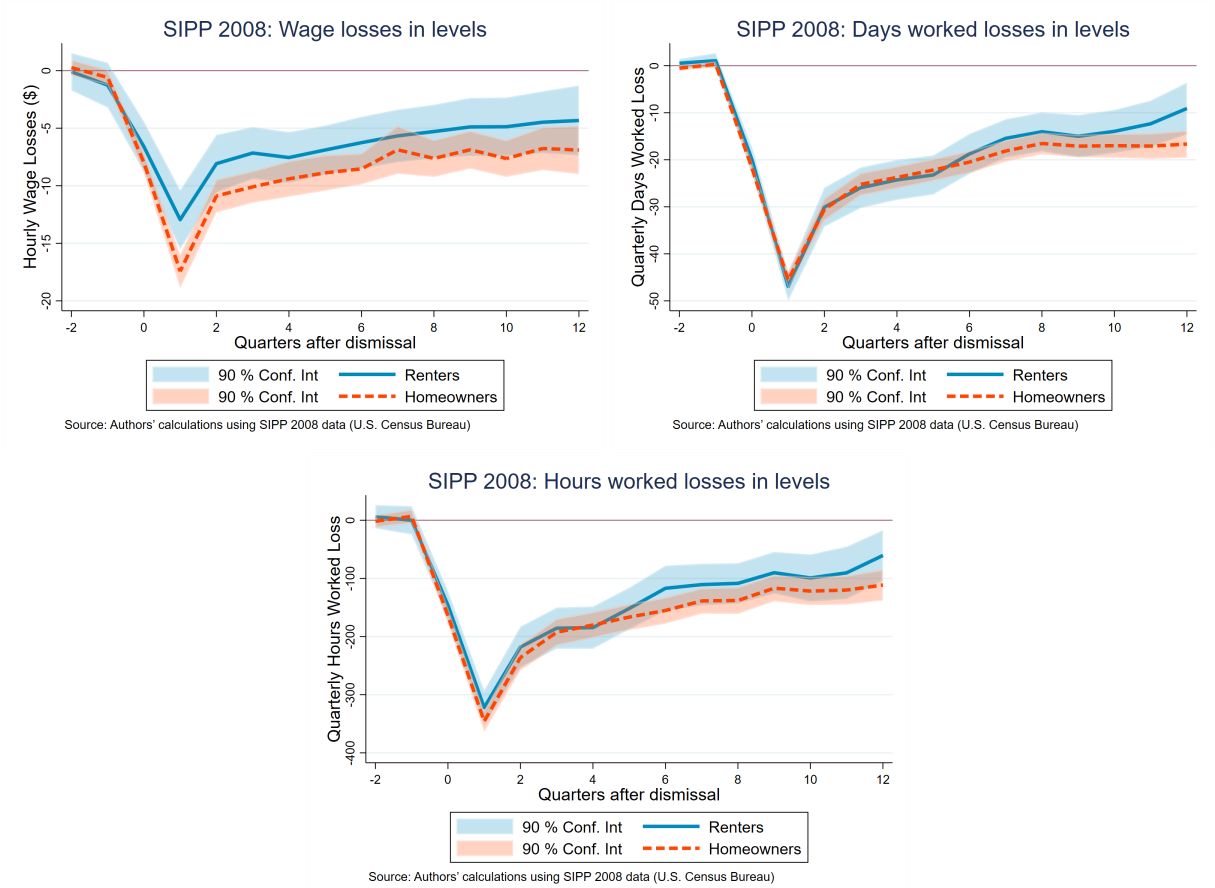


Figure 3: Extensive and intensive earnings losses in 2008 panel

We next explore within group heterogeneity in losses by looking at the earnings recovery based on observable household characteristics. First, we focus on housing payment-to-income ratios, calculated as monthly housing payments from either rental or mortgage payments over household

income for all workers[15].

Figure 4 shows that earnings' losses of households with larger housing payment-to-income ratios recovered faster than those with lower ratios. The top left panel shows the result for the pooled regression of homeowners and renters, and we split the results by workers in the top quartile of expenses (a priori in a rush to find jobs quicker to make those substantial housing payments), and those below the median. We then run the same exercise for just homeowners (top-right) and renters (bottom-center). All the cuts of the data contain the same message: those separated workers that ex-ante had larger monthly housing payments suffered lower losses and a speedier earnings recovery. A further inspection of the data also shows a significantly slower recovery in quarterly hours worked for workers below the median, suggesting a lower search intensity or a lower acceptance rate. However, whatever the reason, the wait is not translated into better matches and this slower recovery persists over time.

Second, we also analyze the role of home equity on the earnings recovery of homeowners. In our last empirical exercise, we show that the ability to borrow and smooth consumption through home equity lines also delays labor market reentry and leads to larger losses. Figure 5 shows that homeowners with larger home equity experienced larger and more persistent earnings losses upon job separation. We can speculate that higher home equity allows households to smooth consumption, possibly decreasing search effort and the need to accept initial job offers. However, the fact that earnings recovery does not catch up over time suggests that human capital depreciation plays a crucial role during unemployment episodes.

These novel facts hint to several mechanisms in determining the recovery of renters and homeowners after job separations, even in the absence of shocks in the housing market, and beyond the well-documented lower geographical mobility of homeowners.[16]

[15]

[16] As shown by Aaronson and Davis (2011), a house-lock effect does not seem to be an important driver of unemployment dynamics during the time periods we study.

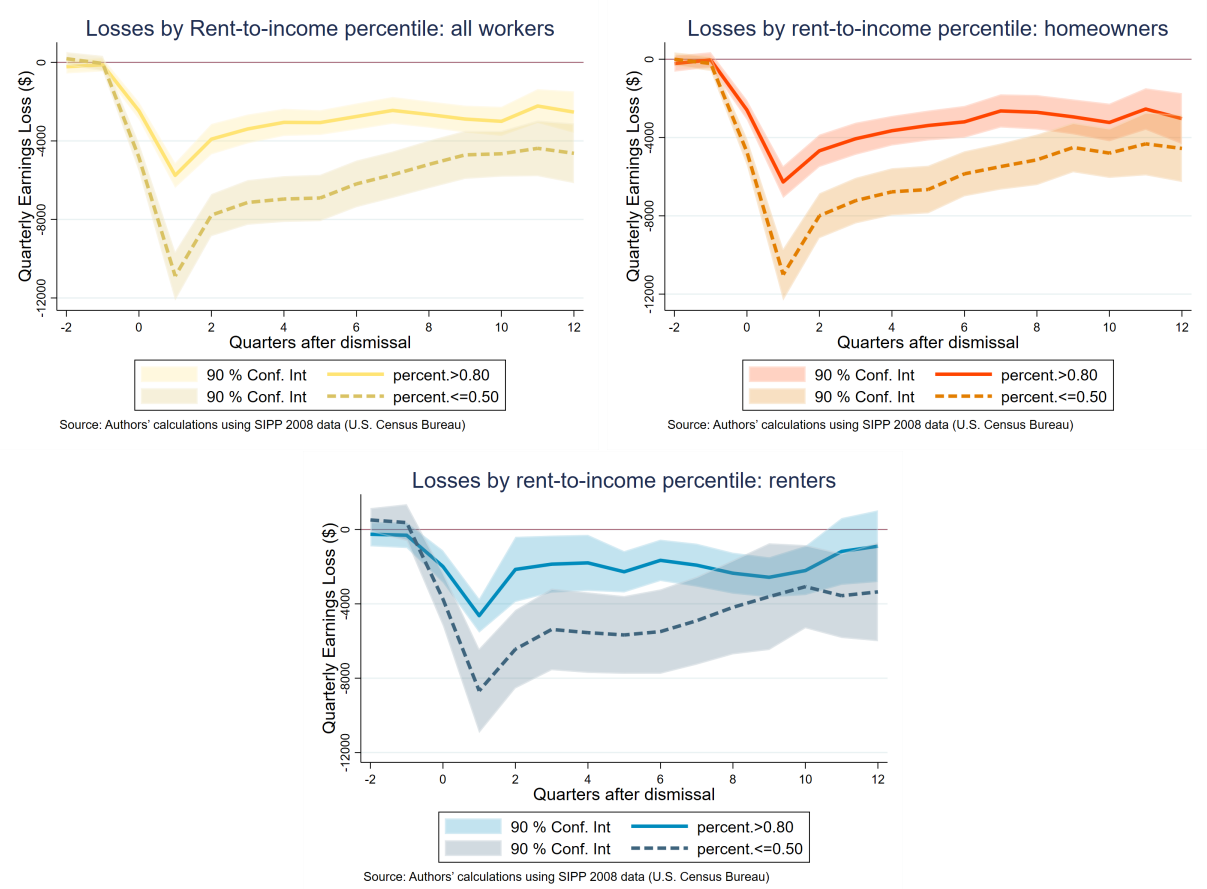


Figure 4: Earnings losses in 2008 panel by rent-to-income percentile

IV Model

Here, we propose a two-island random search model with human capital dynamics to account for the different channels that are simultaneously needed to rationalize our findings.

IV.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 in an island, an agent must live in that island.

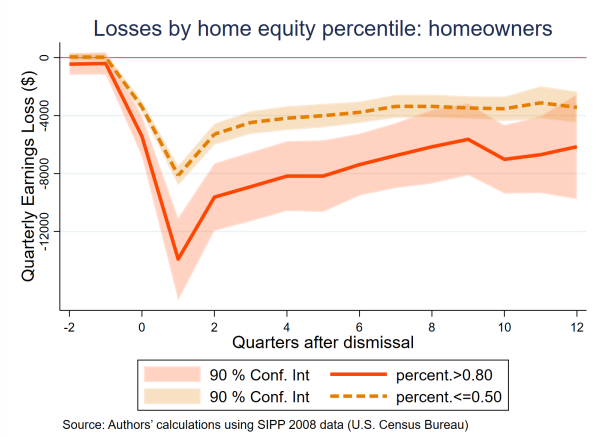


Figure 5: Earnings losses in 2008 panel by home equity percentile

Agents are rational and forward-looking and they value non-durable consumption c and housing c_h. In total, there are three assets in the economy: liquid asset a that is portable between islands and the houses in 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, dying stochastically at rate ν.

Agents can enjoy housing services renting or owning a house and for simplicity there is only a one-size house available in the model. However, as the empirical literature in housing suggests, owing a house gives agents a higher flow of services than just renting a house of the same size.

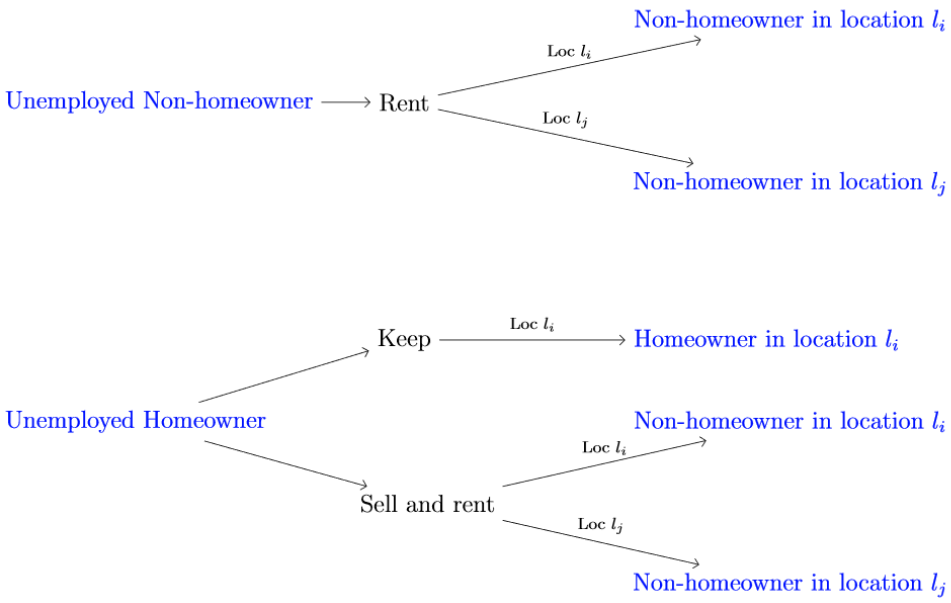
Agents can choose to rent at price p_r, or buy at price p_h. Buying a house provides collateral but requires a minimum down payment of γ percent of the value of the house. Also, any equity on the house can be used as collateral to borrow without any additional costs.

IV.2 Timing

Every period is divided into three sub-periods. The state variables of an agent at the beginning of sub-period 1 are employment and housing status, skill, liquid asset position, and island of residence. In sub-period 1, the housing and location decisions take place.

The diagrams in Figure 6 show the possible choices for the unemployed in sub-period 1. Without a loss of generality, we don't allow the unemployed to buy a house in the model, so non-homeowners in island i can stay as renters in island i or move also as renters to island j. Meanwhile, unemployed

Figure 6: Choices of the unemployed in l_i in sub-period 1



homeowners can stay in island i as homeowners, sell their house and become renters in island i, or sell their house and move to island j as renters.

Similarly, the diagrams in Figure 7 show the possible choices for the employed in sub-period 1.

Because we don't allow on the job search[17] or quits in our model, employed agents do not move from one island to another, so the only choice for employed non-homeowners in sub-period 1 is whether keep renting or buy a house in the island where they currently live to enjoy next period.

Analogously, employed homeowners in island i can keep their house or sell it and become renters at the beginning of next period.

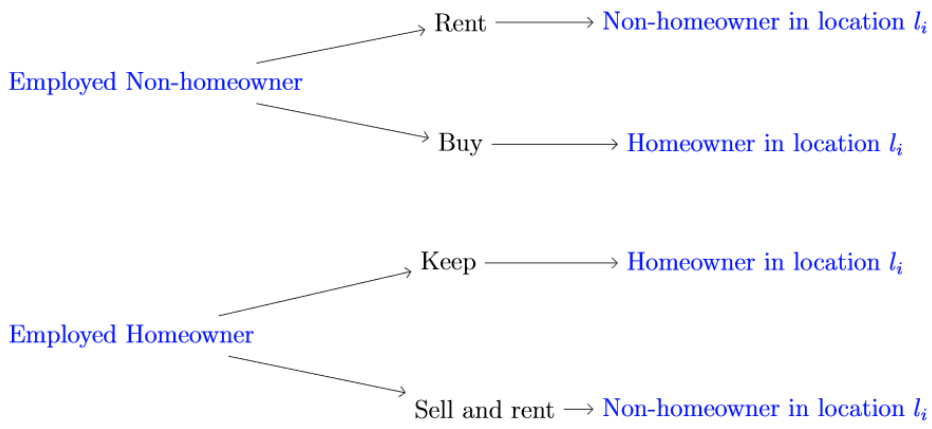
In sub-period 2, after having decided the moving and housing choices for next period, agents choose c and a', and skill evolution takes place while employed or unemployed.

And finally, in sub-period 3, moves and housing status changes happen, random separation shocks realize and job offers arrive, some agents remain employed in the same job, while others decide whether to accept their new job offer or reject it and become unemployed.

Below, we summarize the value functions that characterize the dynamic programming problem

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

Figure 7: Choices of the employed in l_i in sub-period 1



of agents.

IV.3 Optimization problem

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

Moreover, from now on and without loss of generality, we normalize the size of the houses available in both islands to 1.

IV.3.1 Value functions in sub-period 1

In sub-period 1, only the housing and location decisions take place, but before estating agents' optimization problems, let's define d as the disposable income available after housing expenses.

Thus, following the diagrams in Figures 6 and 7, there are four types of agents in each island.

First, an unemployed non-homeowner's only choice in sub-period 1 is to decide where to live as a renter by comparing the utility of doing so between the two islands.

$$U_{NH}\left(l,a,s\right)=u(h_r)+\max_{l'}\left\{U_R\left(l',d,s\right)\right\}$$

$$s.t.$$

$$d=z(s)+(1+r)a-I_m c_m-p_r^{l'}$$

where I_m is a moving indicator function that takes value 0 if $l'=l$ and 1 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 sub-period 1 by deciding whether to continue owing its house without moving islands or to sell it and renting a house in the same or another island.

$$U_H\left(l,a,s\right)=u(h_o)+\max_{l',h'}\left\{U_O\left(l',d,s\right),U_R\left(l',d,s\right)\right\}$$

$$s.t.$$

$$d=z(s)+(1+r)a-I_s(p_r^{l'}-(1-c_s)p_h)-I_m c_m$$

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

Next, remember that there is not on-the-job search in our model, so employed agents don't move. Thus, an employed non-homeowner maximizes utility in sub-period 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 put a minimum down payment of γ percent of the value of the house, adding an additional constraint to the problem.

$$E_{NH}(l,a,s) = u(h_r) + \max_{h'} \left\{ E_R\left(l',d,s\right), E_O\left(l',d,s\right) \right\}$$

$$s.t.$$

$$d = w(s) + (1+r)a - I_b p_h - (1-I_b)p_r^l$$

$$w(s) + (1+r)a \geqslant \gamma I_b p_h$$

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

And lastly, an employed homeowner maximizes utility in sub-period 1 by deciding whether to continue owing its house or to sell and become a renter.

$$E_H(l,a,s) = u(h_o) + \max_{h'} \left\{ E_O\left(l',d,s\right), E_R\left(l',d,s\right) \right\}$$

$$s.t.$$

$$d = w(s) + (1+r)a - I_s(p_r^l - p_h)$$

IV.3.2 Value functions in sub-period 2

Once agents have chosen where to live and whether be renters or owners, they choose the optimal amount of liquid assets or debt to carry over to next period, taking into account their job prospects.

To do this, agents need to know the job destruction and job finding rates in 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. 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 it depends on the housing and employment status of the agent, as well as the quality of its job match.

Thus, the sub-period 2 value function of an unemployed renter is:

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

Similarly, the sub-period 2 value function of an unemployed owner is:

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

The sub-period 2 value function of an employed renter is as follows:

$$E_R\left(l',d,s\right)=\max_{a'}u\left(c\right)+\beta\left(1-\nu\right)\mathbb{E}\left[\left(1-\delta_l\right)\left(E_{NH}\left(l',a',s'\right)\right)+\delta_l U_{NH}\left(l',a',s'\right)\right]$$

$$s.t.$$

$$c+a'\leqslant d$$

$$a'\geqslant -B_{R,E,s}$$

And finally the sub-period 2 value function of an employed owner is:

$$E_O\left(l',d,s\right)=\max_{a'}u\left(c\right)+\beta\left(1-\nu\right)\mathbb{E}\left[\left(1-\delta_l\right)\left(E_{H}\left(l',a',s'\right)\right)+\delta_l U_{H}\left(l',a',s'\right)\right]$$

$$s.t.$$

$$c+a'\leqslant d$$

$$a'\geqslant -B_{O,E,s}$$

IV.4 Job market clearance

As mentioned above, the job market clears in sub-period 3. Job destruction and job creation shocks realize and job matching occurs at the end of the period.

For those employed, there is not on the job search and there are no quits, but in sub-period 3, jobs are destroyed with probability $\delta_{l'}$, and some employed agents become unemployed next period.

Also, at the end of the period, some unemployed agents receive a job offer in location l' with probability $\lambda_{l'}$. The offer can pay high or low wages and the probability of being offered a high paying job in l' is known by all agents. If an offer with wage $w(s)$ arrives, the unemployed agent compares the value of accepting the job at that location, and decides whether to turn the offer down and continue unemployed for another period, with the possibility of relocation, or to accept the offer.

V Calibration

One of the main contributions of this paper is to show how labor choices are intertwined with housing decisions, with a special emphasis in 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 the model for two numerical exercises aiming to recreate the main features in both the Great Recession and the thriving labor that market preceded it. Our calibration is quarterly and all parameters are externally calibrated to match standard data moments. We describe the common parameters across numerical exercises below. The annual interest rate of the economy is 3%. Individuals stochastically retire from the labor market on average after 40 years. We set the house price to match a house value to income ratio close to 3, as in (Hatchondo, Martinez and Sánchez (2015)), and the average replacement rate agents receive during unemployment is about 40 percent of their working wages, depending on the skill level of thee worker. The minimum required down payment is 20 percent of the house value, and the selling cost is 6 percent. We choose a logarithmic utility function in non-durable consumption and housing, with a relative weight of non-durable to housing consumption of 2.7 (as in Greenwood and Hercowitz (1991)). The rest of the moments targeted by the model and the key parameters associated with them are summarized in Table 1.

We discretize the skill grid into three points and the asset grid into 100 unevenly distributed points.[18] On average, human capital increases on-the-job on every five years, and depreciates every two years of unemployment.

Lastly, we use Fella (2014) and de Francisco (2023) to transform the liquid asset grid in combination with the endogenous borrowing constraints associated to 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 his/her relevant borrowing limit. This calibration highlights the tractability of our model by capturing salient features of the data.

[18] We have solved the model using a finer skill grid with 10 points and the results are very similar. Results are available upon request, as we believe the simpler calibration captures the main features and mechanisms.

V.1 The Great Recession: Symmetric islands with low job finding rates

In our first exercise, we compute a steady state economy composed of two symmetric islands, where optimally nobody moves. We set job finding and destruction rates to be the same across islands, and in particular we target a 15 percent monthly job-finding rate λ_l in each island, in line with the rates observed in the United States during the Great Recession between 2008-2010. We set the selling cost c_s to 6 percent of the house price and wage prospects in both islands are the same, this is, the probability of being offered a high paying job $\pi_{l,hp}$ is set to 45 percent for $l = 1, 2$.

Table 1: Common Parameters

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	Price/Income= 3
$\frac{w_h}{w_l}$	Two jobs' type salary differential	1.25	25% wage premium
δ_l	Job destruction rate	10%	2.5 years of tenure (Shimer)
γ	Down payment	20%	Standard
z	Replacement rate	$38 - 48\%$	40% for the U.S.
c_m	Moving cost	p_r	Two month's rent
π_e	Prob. of skill appreciation	0.05	Reasonable skills distribution
π_u	Prob. of skill depreciation	0.5	Reasonable skills distribution

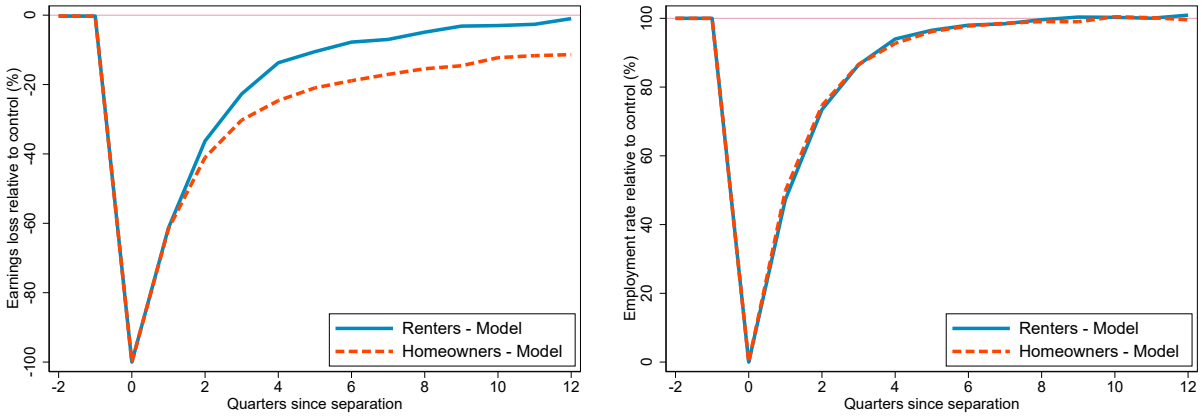
We next simulate the economy for 60,000 workers over a long time period until the economy is in a steady state. As expected given the symmetry in labor markets across islands, about 50% of population lives in each location and there is no migration. The homeownership rate is 52% in each location, with the average homeowner having 11 more years of labor market experience than the average renter. This also aligns with the fact that homeowners are more skilled, and more employed in the high-paying job relative to renters. Thus, renters earn on average 20 percent less than homeowners and have less net assets.

V.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 that 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 prior to 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 $t-2$ that do not separate in t (but they could separate after). Next, we follow these workers up to $t+12$ quarters and compare the labor market outcomes of separators versus the control group in Figure 8, focusing on the evolution of earnings and employment.

Figure 8: Earnings and Employment losses in the symmetric economy

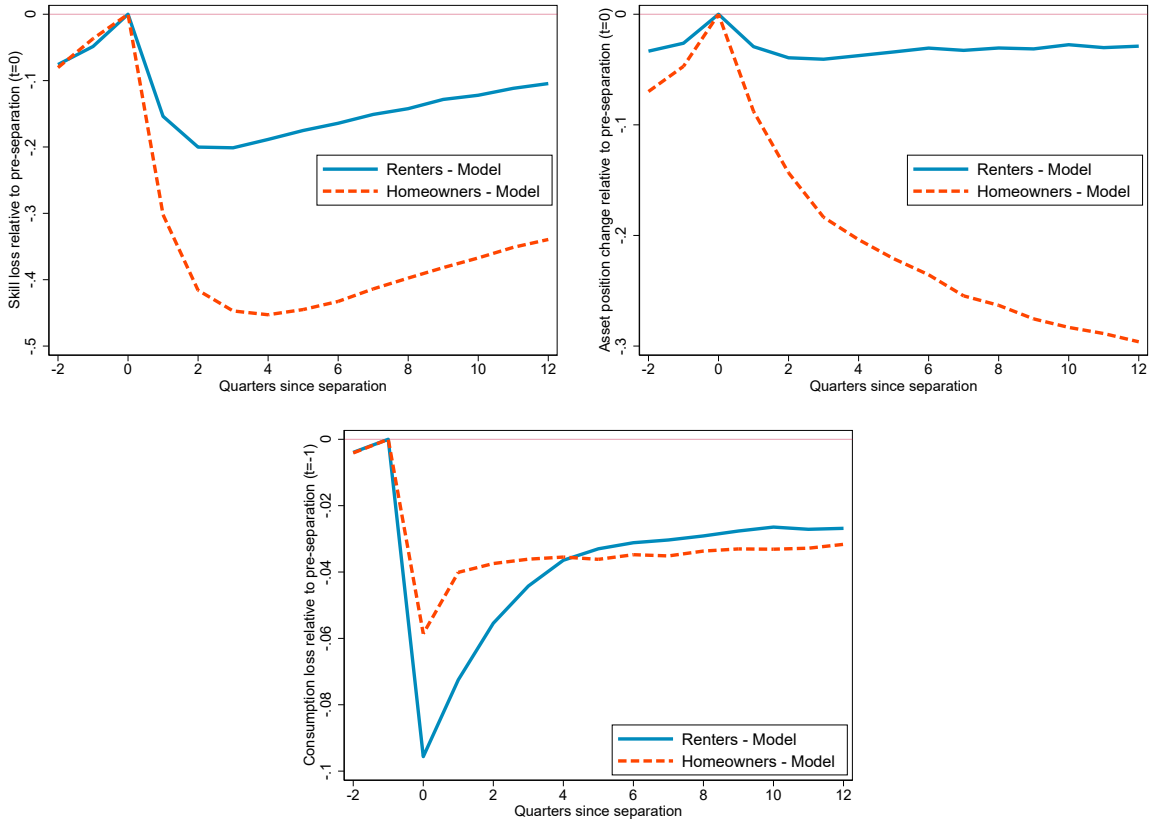


The symmetric calibration of the model in a low job-finding rate environment captures very well the empirical patterns during 2009-2011. Earnings losses (left panel) relative to the control group are prominently persistent for homeowners, whose losses remain 15% lower even after three years following the separation. Renters, on the other hand, experience an almost full recovery three years after the separation. Looking at the extensive margin, we see that the recovery in employment is sluggish (right panel). Interestingly, both renters and homeowners accept jobs at the same rate, so employment by itself cannot explain the differences in earnings recovery. Thus, we turn to the impulse response of skills, net assets, and consumption of separators to understand differences in recoveries. We present these results in figure 9.

Indeed, we see that the earnings losses differential comes 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 skill 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 homeowners were employed in higher paying jobs than renters prior to the separation, leading also to a larger occupational fall.

Figure 9: Skills, Assets, and Consumption evolution in the symmetric economy



Notwithstanding, homeowners weather unemployment using housing as collateral (top right panel) to smooth consumption. Renters, on the other hand, with little room to borrow, experience a smaller change in their net asset position, but suffer larger consumption losses (bottom panel). For both groups, post-separation consumption does not fully recover even three years later, signalling that the unemployment scar leaves permanent marks in consumption and assets too.

V.2 The 2004-2006 boom: Asymmetric islands with high job finding rates

Our second exercise aims to capture the thriving labor market observed during 2004-2006. Thus, this calibration differs from the previous one in two dimensions: First, we reflect the hot labor market by setting the monthly job finding rate λ_l in both islands to 45 percent. Second, to capture

the increased labor mobility during this period, we lower the selling cost c_s to 3 percent of the house price. Third, we introduce a reason to move from island 2 to island 1: now, the wage prospects in island 1 are better than in island 2. Hence, the probability of being offered a high paying job in island 1 is now $\pi_{1,hp} = 0.55$, meanwhile, in island 2 is unchanged, with $\pi_{2,hp} = 0.45$ as before.

We compute the new steady state for this economy. Now, 69% of agent lives in island 1 and 31% in island 2, with agents in island 1 being older. The homeownership rate is 64% in island 1, and only 41% in island 2. Workers in island 1 are now pickier when it comes to job offers, especially homeowners when compared to those in island 2. However, on average agents on island 1 have more assets due to 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.

Figure 10: Earnings, Employment, and Skills - Symmetric vs Asymmetric economies

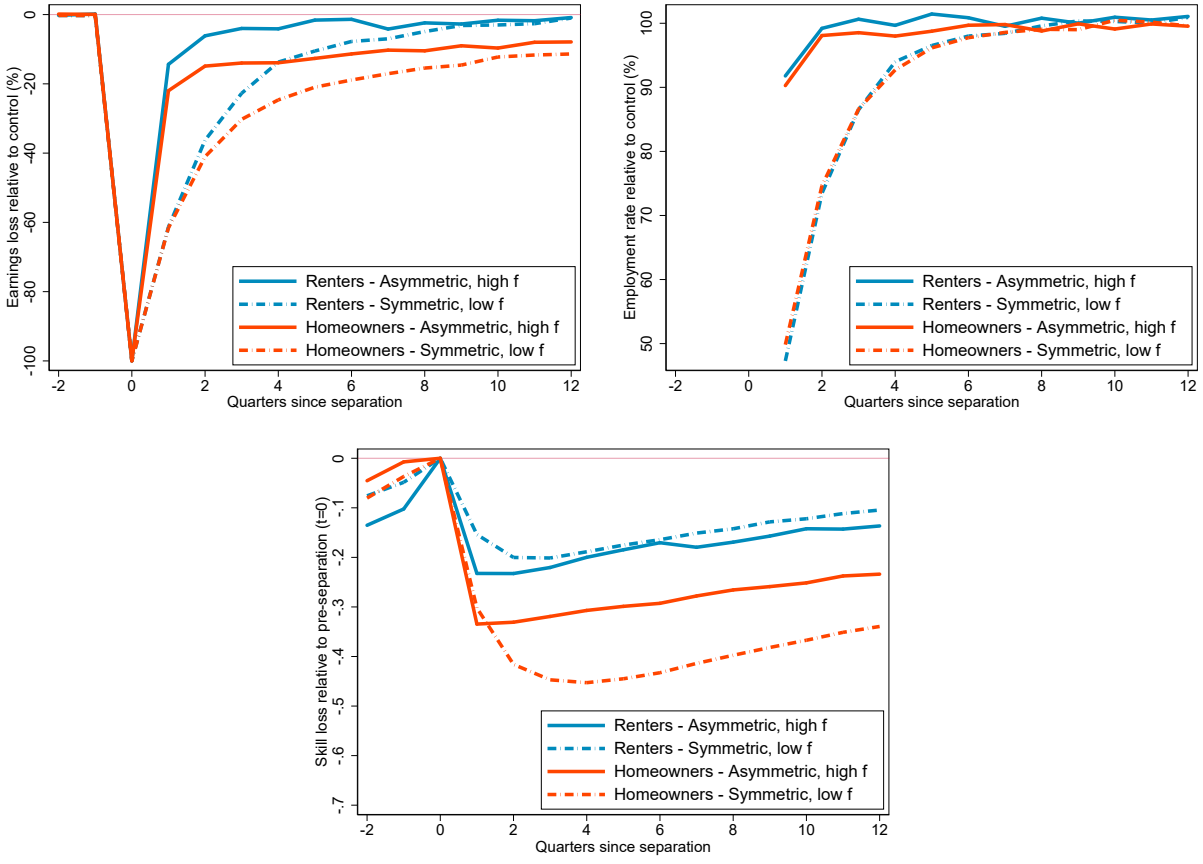
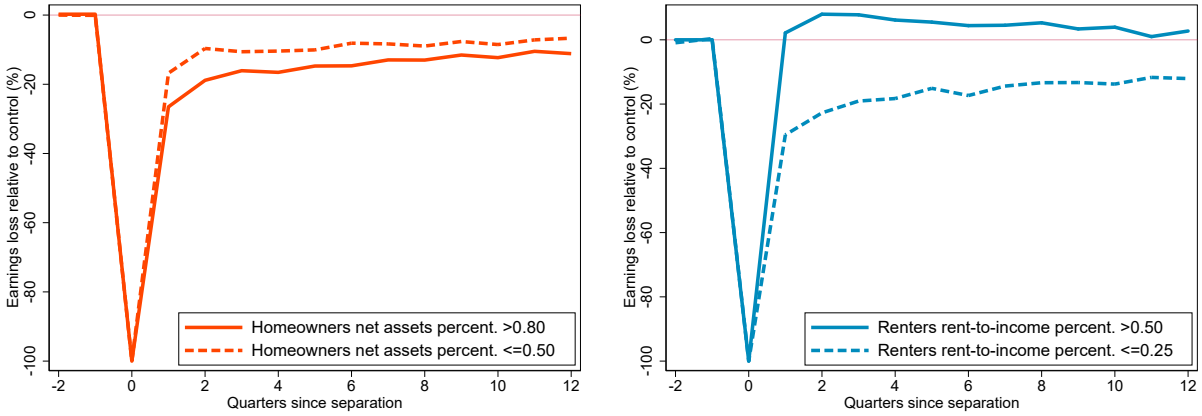


Figure 10 explores the behavior of homeowners and renters after a job separation in more detail.

The left top panel shows that earnings losses are less persistent for both groups compared to the symmetric case (as solid lines are above dashed lines throughout), and also that the difference in the earnings scar between homeowners and renters narrows. A higher job finding rate leads to a faster employment recovery (right top panel), and lower skill depreciation (bottom panel). In particular, higher reemployment rates significantly reduce the skill depreciation suffered by homeowners and ameliorate occupational falls among them, but renters' earnings still recover faster since the effect of skill depreciation on wages is still larger for homeowners.[19] Moreover, a smaller proportion of homeowners move to island 1 compared to renters, and a wealth effect appears in island 1, making homeowners there more selective accepting jobs.[20] Thus, the model replicates quite well our findings for both the 2004-2006 period and the Great recession.

Furthermore, our model captures two untargeted facts. The first one, shown in the left panel of Figure 11 is that homeowners with less home equity recover faster than other homeowners. And the second one, shown in the right panel, is that renters with higher house payments to income also recover faster than other renters.[21]

Figure 11: Earnings loss by Net assets and Rent-to-income -Asymmetric economy



All in all, the ability to smooth consumption, either with cash at hand or with credit easily

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

[20] We present moving rates as well as the assets evolution for this exercise in the online appendix.

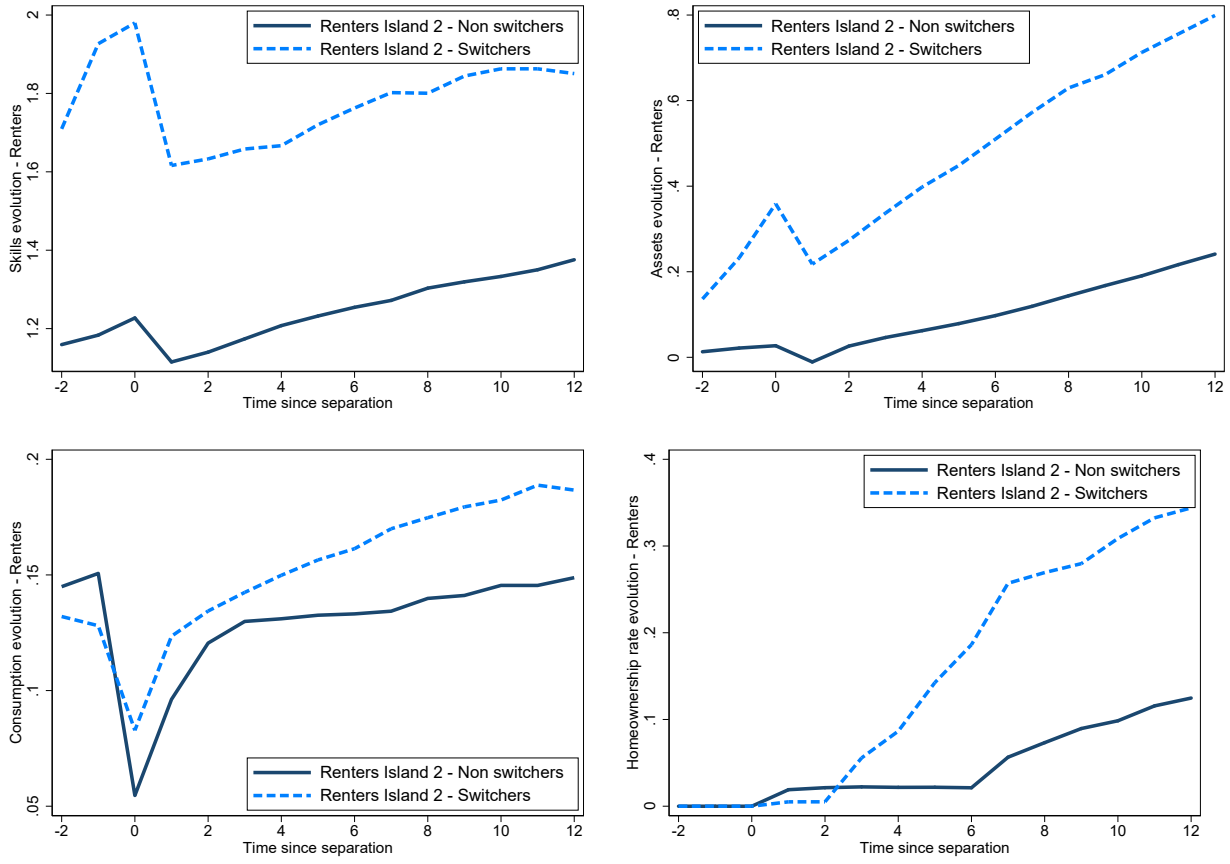
[21] In the model we restrict the analysis of net assets to homeowners, as there is not enough variation for renters. Similarly, we only depict the percentiles of rent-to-income payments for renters, which have clearly defined rent payments per period, even though the empirical observation holds for renters and homeowners. While we could compute a mortgage equivalent quarterly payment, we believe this is unnecessary.

available plays a key role in our model by affecting job acceptance rates. That, together with human capital depreciation, are clear determinants of the earnings dynamics after a job loss. Moreover, because agents with more assets also have more skills on average, the decay of their skills has a proportionally higher effect on their future earnings.

V.2.1 The role of wealth and skills on labor reallocation across islands

To conclude our analysis we acknowledge that so far, we have focused on the unemployment scars of the average renter and homeowner. We now explore how labor reallocation affects the recoveries after a job loss within groups, and show that the average effect masks substantial heterogeneity. We start with the most mobile group: renters.

Figure 12: Reallocation among renters: movers vs stayers

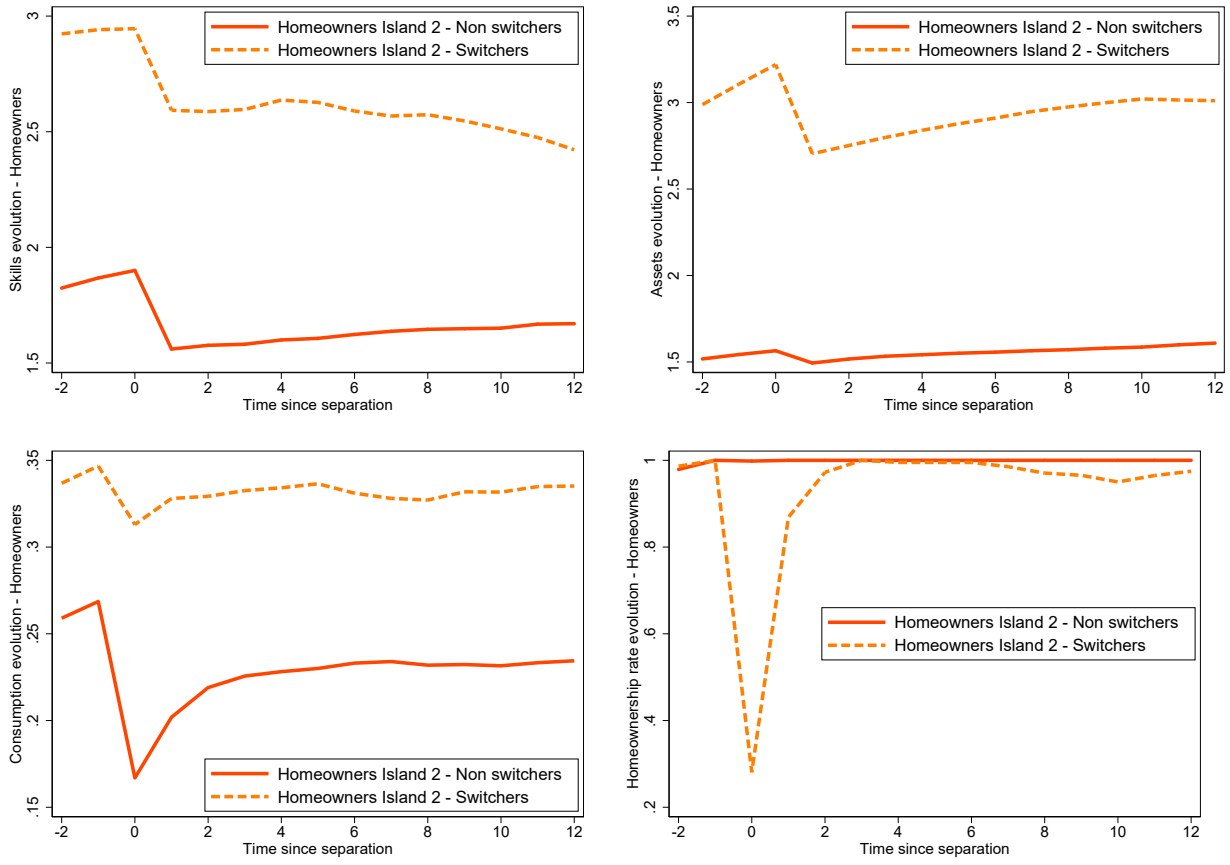


The top panels of Figure 12 show that prior to a job loss, renters who reallocate are on average

more skilled and wealthier than other renters. Higher skills give them a better opportunity to extract the benefits of moving to island 1, where more high-paying jobs are available. However, besides skills, wealth still plays an important role in our model. A group of hand-to-month renters, with almost no liquid savings and credit constrained, are unable to move to island 1 and exhibit a slower and more timid consumption recovery delaying homeownership, as shown in the bottom panels of Figure 12.

In our model, as in the data, migration rates for homeowners are lower than for renters, but our simulation highlights some interesting similarities between movers and stayers across groups.

Figure 13: Reallocation for homeowners: movers vs stayers

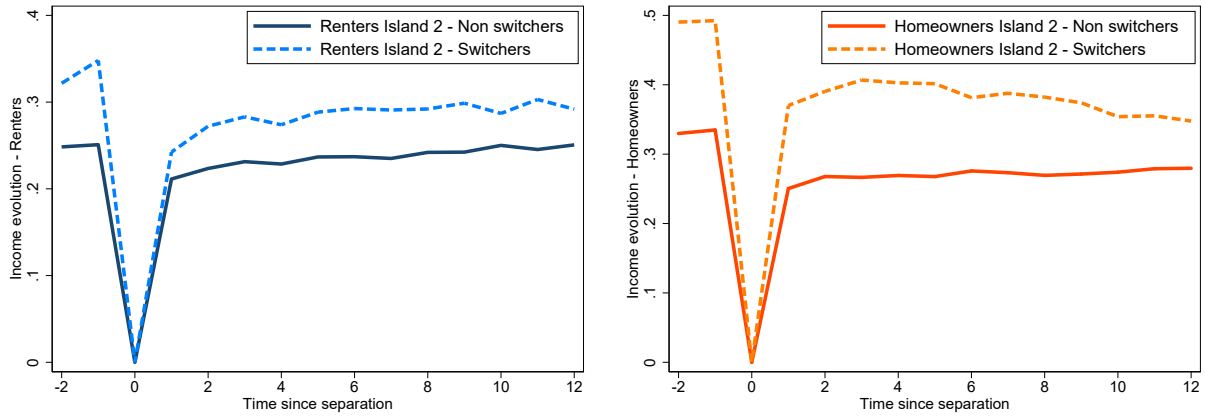


For example, the top panels of Figure 13 show that prior to a job loss, homeowners who reallocate are on average more skilled and wealthier than other homeowners. However, among homeowners, the initial loss of skills is similar and significant, and although stayers are less wealthy than movers,

they are not poor, they are just wealthy hand-to-mouth homeowners with most of their wealth tight up around the down payment of their house.

All in all, the combination of wealth and skills is key to understand the unemployment scar in our model, and even though assets of movers take a big hit on the spot, their earnings recovery is faster and stronger than that of stayers.

Figure 14: Earnings recovery: movers vs stayers



VI Conclusions

We have documented the importance of housing characteristics to reconcile the observed unemployment scar. Recently unemployed homeowners experience a larger drop in earnings than renters, but more surprisingly, the earnings recovery of homeowners is also slower and weaker. In particular, we find that household mortgage and rent payments prior to unemployment, as well as the availability of savings and home equity are associated with differential earnings recovery across workers.

We propose a model that captures many of the trade-offs that homeowners and renters face after a job loss and show that accounting for workers' housing characteristics and local job markets is key to understand the different unemployment scars between homeowners and renters. The model reconciles the different earnings recovery of separated homeowners and renters between 2004-2006 and 2009-2011.

The paper suggests that unemployment policies should tight unemployment insurance to the

retention or acquisition of new skills. Also, to the extent that the government can more easily spot what occupations are steadily shrinking in the economy, policies subsidizing the acquisition of skills in highly demanded occupations should be optimal.

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

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A Appendix: Additional Empirical Results

Figure 15: Mobility by state vs proportion of renters