Consumer Bankruptcy, Mortgage Default and Labor Supply*

Wenli Li† Costas Meghir‡ Florian Oswald§

December 3, 2024

Abstract

We specify and estimate a life-cycle model of consumption, housing demand, and labor supply in an environment where individuals can file for bankruptcy and/or default on their mortgages in the presence of house price shock, income shock, and catastrophic expenditure events. A key feature of the model is that individuals differ by education, which dictates their income process and preference. We estimate the model using data on credit reports and mortgages combined with Census data. Our model demonstrates that current bankruptcy and foreclosure laws have significant distributional impact. Specifically, Chapter 7 bankruptcy benefits low educated individuals but imposes large welfare costs on those with high education. Chapter 13 bankruptcy also benefits the low education group and affects the high education group little. Recourse laws, by contrast, are costly to low education groups, but beneficial to the high education group.

Keywords: Lifecycle, Bankruptcy, Housing, Mortgage Default, Labor Supply, Consumption, Education, Insurance, Moral hazard.

JEL Codes: G33, K35, J22, J31, D14, D18, D52, D53, E21

*This project was funded by the Sloan Foundation under grant 2011-5-24 ECON awarded in October 2011. We thank the anonymous referees and the editor as well as seminar participants at the NBER Summer Institute 2013, the Chicago Fed, UCL Implementation of Dynamic Models and SED Edinburgh conferences for constructive comments and suggestions. Florian Oswald is grateful for additional funding under ESRC transformative research grant, grant number ES/M000486/1. The views expressed here are our own and they don't represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

†Federal Reserve Bank of Philadelphia, Wenli.Li@phil.frb.org.

‡Yale, NBER, IZA, CEPR and IFS, c.meghir@yale.edu.

§University of Turin, ESOMAS Department, florian.oswald@unito.it

1 Introduction

Many countries, including the U.S. and the U.K., have bankruptcy legislation that allows a fresh start for people who cannot repay debts as an attempt to balance creditors' legitimate rights with the need to offer borrowers insurance for adverse events in a world with incomplete markets. The legislation is complex and treats secured and unsecured debt differently. The U.S. even offers choices for filing for bankruptcy. For example, under certain conditions, one can file under Chapter 7, which discharges all outstanding unsecured debt in return for the individual foregoing the assets. Alternatively, one can file under Chapter 13, keeping all assets but agreeing to repay gradually at least part of the debt, clearing the rest. The differences between Chapter 7 and Chapter 13 also depend on other institutional features such as the level of homestead exemption and the degree of recourse. The homestead exemption determines the extent to which housing equity has to be used to repay outstanding unsecured debts following bankruptcy, and it varies widely across states from 0% to the entirety of housing equity. Recourse legislation defines how non-housing assets must be used to repay debts following residential mortgage default.[1] The design of the bankruptcy system therefore implies tradeoffs between insurance and incentive with important distributional implications, not only between creditors and borrowers but also among borrowers with different risk and income profiles.

Understanding the effects of the institutional framework requires a household model that encompasses the complex interactions of various decisions, such as labor supply, savings, house purchase, and the decision to file for bankruptcy and/or to default on a mortgage. Together, these decisions help capture the many margins of household adjustment and, thus, the costs and benefits of bankruptcy legislation. An equilibrium framework is further needed to account for the feedback effect of household decisions on the cost of credit.

This paper investigates the impact of bankruptcy legislation on different education groups by specifying and estimating a life-cycle model that generalizes the Aiyagari [1994] economy.[2] In the model individuals choose to buy a house of a certain size or to rent, save in a separate liquid asset, and supply labor. Their labor productivity is subject to shocks, which, together with house price volatility[3] and the random arrival of infrequent but catastrophic spending shocks (such as divorce and medical expenses), can cause financial distress and an inability to service existing loans or mortgages. Thus, at each period individuals may file for

[1] In this paper, we define mortgage default as 60 days or more past due. See Li [2009] and papers cited within for a more detailed discussion on the interaction between house foreclosure and personal bankruptcy in the U.S.

[2] Our model is closest to that of Mitman [2016], but with a number of differences that we discuss below.

[3] See Sullivan et al. [1999] pp. 128 for an account of the importance of housing shocks as drivers of bankruptcy.

bankruptcy and/or default on their mortgage. Lenders set interest rates for unsecured debt and mortgages, taking into account borrowers' probability of filing for bankruptcy and/or default.

We estimate our model using data from several sources. First is the Survey of Consumer Finances (SCF), which provides information on education, income, assets, bankruptcy filing, and mortgage defaults. The SCF, however, doesn't contain information on bankruptcy chapter choices nor the precise timing of bankruptcy filing or mortgage default. Second is the Federal Reserve Bank of New York Consumer Credit Panel/Equifax Data (CCP). We use the anonymized microeconomic data to construct bankruptcy by chapter choice and mortgage default rates for each county and by year and then combine them with county-level house price and demographic information from the Census. Third is the Panel Study of Income Dynamics, where we obtain information on household labor supply by education and year. Our baseline economy is the period before the implementation of the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA reform) in October 2005.[4]

To estimate the model, we use the simulated method of moments [SMM, see McFadden, 1989, Pakes and Pollard, 1989] combined with the Markov Chain Monte Carlo method (MCMC) adapted for SMM by Chernozhukov and Hong [2003].[5] Using the estimated model, we then study the value of insurance offered by the system. Specifically, we examine the impact of shutting down either Chapter 7 or Chapter 13 bankruptcy option, or changing the recourse law for those who default on their mortgage. Our main findings are: current bankruptcy and foreclosure laws have significant distributional impact. Specifically, Chapter 7 bankruptcy is valued by lower educated individuals but imposes welfare costs on those with higher education. Chapter 13 bankruptcy also benefits the low education group but affects the high education group little. Recourse laws, by contrast, are costly to low education groups, but beneficial to the high education group.

Our paper builds on Oswald [2015], and shares many common features with Mitman [2016]. For instance, both papers model Chapter 7 and Chapter 13 bankruptcy filings and mortgage default, and both use an equilibrium setting to capture the price feed back effect that is crucial in households' default and bankruptcy decisions. The two papers, however, differ in several substantive ways. First, we consider labor supply; this is important because by varying labor supply an individual can change the probability of bankruptcy (by increasing labor income) and because it allows us to capture the labor market implications

[4]BAPCPA: The Bankruptcy Abuse Prevention and Consumer Protection Act on the Department of Justice website.

[5]This approach makes estimation tractable and at the same time avoids problems with moments that may not be differentiable with respect to parameters, as is often the case when simulation methods are used.

of post-bankruptcy repayment plan under Chapter 13. Second, our model features a more realistic life-cycle setup with mortgage contracts of finite maturity. This is important as mortgage vintage, which is highly correlated with borrower age, is a strong predictor of default and bankruptcy. Last but not least, we allow households to differ by education, a source of heterogeneity for income risk and preferences. In practice there are significant differences in bankruptcy and default behavior by education group: According to SCF 2001-2019, those without college degrees are twice more likely than those with college degrees to file for bankruptcy, 1.46% versus 0.62%. Among home owners with a mortgage, lower educated people are three times more likely to be foreclosed than higher educated people, 0.34% vs 0.11%.[6]

In addition to Oswald [2015] and Mitman [2016], our paper also relates closely to the many other quantitative studies of the effects of institutional arrangements of bankruptcy using Aiyagari [1994]-type economy. These papers are Athreya [2002], Athreya and Simpson [2006], Li and Sarte [2006], Chatterjee et al. [2007a], Chatterjee and Gordon [2012], Athreya et al. [2015], and Chen and Zhao [2017]. As Mitman [2016], we extend this literature by introducing both Chapter 13 bankruptcy filing and a housing market with the possibility of mortgage default.[7] Additionally, this paper shares some common features in the modeling of housing and mortgage default with the recent equilibrium models of housing including Garriga and Schlagenhauf [2009], Jeske et al. [2013], Corbae and Quintin [2015], and Chatterjee and Eyigungor [2015]. The innovation here is the introduction of unsecured debt and bankruptcy, and the joint study of bankruptcy filing and mortgage default behavior. Finally, our paper pertains to the empirical literature that examines the aftermath of bankruptcy filing or mortgage default, particularly on labor supply. This literature includes Han and Li [2007], Dobbie and Song [2015a], and Dobbie and Song [2015b].

The rest of the paper proceeds as follows. In Section 2 we present the data and some descriptive facts about bankruptcy, default and the institutional context. We then present our model in Section 3, followed by Section 4 on estimation. Section 5 discusses the implications of the model and Section 6 reports counterfactuals. Finally Section 7 concludes.

[6] Using data collected by the Consumer Bankruptcy Project of bankruptcy filers between 2013 and 2019, McDairmid and Holding [2008] report that only 24% of the filers held a Bachelor's degree or higher, 32% had a high school degree, and 6% didn't finish high school. Of those who filed under Chapter 7, 22% had a college degree of higher. Of those who filed under Chapter 13, 25% of them had a college degree or higher. In terms of income, on average bankruptcy filers had an annual income of $42K, $39K for Chapter 7 filers, and $52K for Chapter 13 filers.

[7] With the exception of Li and Sarte [2006] and Chatterjee and Gordon [2012], the literature has largely focused on Chapter 7 bankruptcy filing, and none of the cited papers model mortgage defaults.

2 Data and Descriptive Facts

Our primary analyses draw on several data sources, as no data exists that provides panel information on an individual's education, income, house tenure, bankruptcy filing, and mortgage performance. We first document stylized facts regarding the relationship between education and credit performance using household-level cross-sectional data from the Survey of Consumer Finances (SCF). For estimation, we turn to county-level data constructed from the CCP data, supplemented with county-level house prices obtained from Zillow Research,[8] and county-level demographic and economic characteristics from the American Community Survey (ACS) and the Census. Our earnings and labor supply statistics come from the Panel Study of Economics Dynamics (PSID). Before discussing the data, we first review the institutional features.

2.1 Institutional Features

In the U.S., individuals can file for personal bankruptcy under either Chapter 13, or if eligible, under Chapter 7. Those filing under Chapter 13 get to keep all their assets but have to agree to a repayment plan typically over five years and the payment is positively correlated with their earnings. After that period, all eligible debt will be discharged. By contrast, those filing under Chapter 7 have all their debt immediately discharged but have to give up their assets, including some of their home equity. The practice, however, varies by state; each state defines a homestead exemption, which is an amount of home equity that creditors cannot access. If the equity is below the exemption, the individual keeps the house. If it is above, then the house is sold and the equity over the exemption is handed over to the creditors to pay for the unsecured debt. Homestead exemptions vary across the states from zero to an unlimited amount.[9]

The other key feature of the institutional setup is the extent to which mortgage lenders can access other financial assets to repay debt not covered by the sale of a house under repossession by obtaining a Deficiency Judgment or mortgage lender Recourse [see Ghent and Kudlyak, 2011, Li and Oswald, 2017, for instance]. These features make mortgage default and bankruptcy interrelated and their design provides alternative tradeoffs between the insurance value of bankruptcy and the disincentive to work or save they induce. The institutional details across the U.S. are given in Appendix Table D.1.

[8] We use the Zillow House Value Index for All Homes at County level, see http://www.zillow.com/research/data/.

[9] BAPCPA limited the eligibility for Chapter 7 so that only those with incomes below the state median can file under Chapter 7.

2.2 Education, Consumer Bankruptcy and Mortgage Defaults at the Individual Level

To establish the direct relationship between education, consumer bankruptcy filing, and mortgage defaults at the individual level, we use SCF, a triennial cross-sectional survey of U.S. households' demographics, income, balance sheet, and other demographic and financial characteristics. We use the 2001, 2004, and 2007 SCF and keep individuals between the age of 25 and 60. The final sample comprises 45,968 individuals, and 32.4 percent have a college degree or higher.[10]

Table 1 reports summary statistics on demographics, income, assets, and loan performances by education for individuals in our sample. As expected, individuals with a college or above degree tend to have higher incomes and more net worth. They are more likely to be homeowners, less likely to file for personal bankruptcy, conditional on having mortgages, less likely to be late on their mortgage payments, and they pay slightly lower credit card interest rates. Note that the credit card interest rates reported in SCF are much lower than those reported in other sources such as the confidential supervisory data Y14-M, maintained by the Board of Governors of the Federal Reserve System.[11]

[10] Due to different sample selection, the numbers reported in this section are somewhat different from those cited in the introduction.

[11] The rates reported there have an average of over 20 percentage points, see Dempsey and Ionescu [2021] and Chatterjee and Eyigungor [2022]. Unfortunately the Y14-M data do not contain information on education. Nevertheless, Chatterjee and Eyigungor [2022] shows that the interest rates paid by high credit score individuals who typically have higher income and higher education are 5 percentage points higher.

Table 1: Income, Assets, Bankruptcy, and Mortgage Defaults by Education

Variables	Mean	Sd	P5	P50	P95
Without college degrees					
Age	43	10	27	43	58
Income ($000)	69.7	70.4	10.2	55.0	163.8
Net worth ($000)	219.8	519.3	-4.62	66.4	836.1
Homeowner	0.63	0.48	0.00	1.00	1.00
Highest rate on credit cards (%)	14.0	6.03	4.0	13.9	23
Filed for bankruptcy within the year (‰)	18.1	133	0.00	0.00	0.00
Late on mortgage payments (%)	4.29		0.00	0.00	0.00
With college+ degrees					
Age	43	10	27	43	58
Income ($000)	162.9	188.1	28.2	112.8	464.1
Net worth ($000)	749.2	1310.0	-7.86	305.9	3142.9
Homeowner	0.79	0.41	0.00	1.00	1.00
Highest rate on credit cards (%)	12.7	5.59	4.0	12.0	22
Filed for bankruptcy within the year (‰)	5.90	76.6	0.00	0.00	0.00
Late on mortgage payments (%)	1.25	11.09	0.00	0.00	0.00

Notes: Authors' calculations based on the SCF data 2001-2007, 2019 dollars. Homeowner, Filed for bankruptcy within the year, and Late on mortgage payments are dummy variables. Late on mortgage payments are only for those whe owe mortgages. Highest interest rates on credit cards are only for those who reported positive rates and who carry credit card balance. In the sample, 67 percent of the heads of the households do not have a college degree.

To further isolate the role education plays in households' bankruptcy and mortgage default decisions, we run regression analyses where we control for households' demographics such as age, marital status, number of kids, and race, as well as income and debt. We present the results in Table 2. Despite all the controls, college graduates had a lower probability of filing for bankruptcy or defaulting on mortgages.

It is important to note several caveats with the credit card rates, bankruptcy filing, and mortgage payment statistics. The credit card rate is a response to the question "What interest rate do you pay on the card where you have the largest balance?" The bankruptcy filing is in response to the following two questions: "Have you (or your husband/wife/partner) ever filed for bankruptcy?" and "When was that? If more than once, ask: When was the most recent time?" For the purpose of this paper, we only report bankruptcy filed less than one year ago for the statistics in Table 1. The mortgage performance variable is constructed if the individuals reported "behind schedule" in response to the question "Are you paying off this (land contract/loan) ahead of schedule, behind schedule, or are the payments about on schedule?" Given these caveats, we will next turn to the more precise county-level data to construct statistics for model estimation.

Table 2: Bankruptcy and Mortgage Default Decisions

Variables	Bankruptcy Filing	Mortgage Default	CC Interest Rate
No college degree	9.120***	0.116***	1.0977***
	(1.242)	(0.033)	(0.0996)
Age	0.713	0.042	-0.1275***
	(0.530)	(0.016)	(0.0440)
Age squared	-7.475e-03	-4.367e-04***	0.0018***
	(6.208e-03)	(1.91e-03)	(0.0005)
Male[1]	-5.619***	0.586***	-0.5423***
	(1.828)	(0.063)	(0.1564)
Married[1]	-1.443	-0.601[1]	0.0547
	(1.698)	(0.055)	(0.1463)
Number of kids	3.329***	-0.021	0.1258***
	(0.494)	(0.014)	(0.0399)
Minority[1]	-1.417	-0.090***	0.3332***
	(1.75)	(0.039)	(0.1014)
Income	-0.0713	-0.002	-0.0529*
	(0.135)	(0.004)	(0.0301)
Homeowner[1]	-7.089***		-1.7933***
	(1.411)		(0.1202)
Liquid assets	-0.0428	-0.001	-0.0176***
	(0.033)	(0.001)	(0.0063)
Credit card balance	-17.098***	-0.239***	-0.9068***
	(4.066)	(0.101)	(0.2560)
Mortgage	-0.306	0.024***	0.0376
	(0.298)	(0.007)	(0.0270)
Year fixed effect	yes	yes	yes
Number of observations	45,968	24,881	17,362
Adjusted R-squared	0.0057	0.0078	0.0399

Note: This table shows results using linear regression models. Variables with [1] are dummy variables. The bankruptcy filing rate is per thousand, mortgage default and unsecured credit is in percent. Income, debt, and asset are normalized by median household income (to facilitate comparison with model simulations later). Liquid asset is financial asset. Mortgage default regression is restricted to those with positive mortgage debt. Credit card interest rate regressions are restricted to those who report positive credit card interest rate and carry credit card balance. Data source: SCF 2001-2007.

2.3 Education, Consumer Bankruptcy and Mortgage Defaults at the County Level

Our data for this part of the analyses come from CCP. The CCP is a 5% random sample representative of those with a credit history and includes details of various types of debt as well as loan-level detailed

anonymized information on mortgages they have taken out.[12] It also contains anonymized information on various demographic characteristics, such as age, zip code, and Equifax Risk Score.[13] We then merge county-level information on education and employment using the American Community Survey (ACS) anonymized Public Use Micro Data Sample and the 2010 Census.

We keep individuals between 25 and 60 for year 2000 to 2006 and then collapse them by their county of residence and by year. To calculate mortgage default rates, we only keep those with a mortgage. Table 3 presents the annual non-business bankruptcy and mortgage default rates in our sample. We define mortgage default as being 60 days or more delinquent. About 1% of individuals file for bankruptcy, and in our sample period three quarters of those file under Chapter 7. About 2.1% of mortgage borrowers default on their mortgage. These numbers are comparable with a bankruptcy filing rate of 1.4% and mortgage late payment rate of 3.05% reported by the 2001-2007 SCF.

Table 3: Average Bankruptcy and Default Rates

Chapter 7 (‰)	Chapter 13 (‰)	Total bankruptcy (‰)	Mortgage Default (%)
7.634	2.210	9.552	2.130

Notes: Number of observations=21,822. Mortgage default is defined as 60 days or more past due. This is an average over county-level data for years 2000-2006. Authors' calculations based on the CCP data.

We now study how the bankruptcy and mortgage default relate to demographics and the institutional framework by running the regression at the county level using the log-odds ratio as the dependent variable:

$$\log\left(\frac{y_{jt}}{1-y_{jt}}\right) = \gamma_0 + \gamma_1 \text{College}_{j,2010} + \beta X_{jt} + \varepsilon_{j,t}, \tag{1}$$

where $y_{j,t}$ represents, in turn, overall bankruptcy rate, Chapter 7, Chapter 13, and mortgage default in county j at time t. We define two education groups, a high level, which includes all those with a college degree and more, and a lower level, comprising the rest. Hence, $\text{College}_{j,2010}$ is the percentage of the population in county j in year 2010 with a college degree or more. X_{jt} is a set of control variables. At county-year level we include the Zillow house price index, average credit card balance, average first mortgage balance, the default rate, and when explaining default behavior on mortgages, the bankruptcy rate. At county level

[12] Such information includes loan origination date, amount, current balance, requested payment amount or term of the loan, credit limit (on HELOCs), individual/joint account and payment status, whether GSE guaranteed, whether for a mobile home, whether second mortgage, and whether the account was closed in bankruptcy or foreclosure.

[13] A detailed description of the panel can be found at http://www.newyorkfed.org/research/staff_reports/sr479.pdf.

but fixed to 2010, we include the homeownership rate and median household income.[14] Finally, the state legal environment is captured by whether the state offers lender recourse, whether homestead exemption is unlimited, and if not, the size of the homestead exemption. We report the regression results in Table 4.[15]

More generous bankruptcy provisions increase the demand for credit, but creditors may respond by reducing the amount of credit supplied and increasing interest rates offered. This interplay between insurance offered by generous provisions and moral hazard is central to the motivation of our paper, and lies at the heart of discussions in Gropp et al. [1997] and Mitman [2016], among many others, and may lead to the observation that households' equilibrium default behavior is not sensitive to the exemptions or recourse. Table 4 indeed illustrates such results: Neither the size of the homestead exemption nor the indicator for states with unlimited exemptions affects the overall bankruptcy filing rates statistically significantly.[16] Whether a state allows for recourse is also not significantly associated with bankruptcy. Still, it reduces the mortgage default rate.

Table 4 demonstrates a strong association between education, bankruptcy filing rates, and mortgage default rates, even after we control for county level income and credit balance. Education is an important factor that drives behavior toward bankruptcy and the risks that people face. Higher education individuals earn more but their income is subject to higher variance shocks [see for example, Meghir and Pistaferri, 2004]. These differences will cause heterogeneous borrowing and savings behavior and resilience to shocks.

[14] We use the 2010 Census in order to have a complete coverage of counties. Our other option is to utilize the 2000 Census. Given that homeownership rates are highly persistent, the choice of the year does not to affect our results. We thank an anonymous referee for pointing this out.

[15] We have in total 1,634 counties. The use of log-odds ratio in the regression analyses precludes the use of counties with zero incidences of bankruptcy filings or mortgage defaults. As a result, in the bankruptcy regression, we cover 1,409 counties. In the Chapter 7 bankruptcy regressions, we cover 1,369 counties. In the Chapter 13 regressions, we cover 946 counties. In the mortgage default regressions, we cover 1,233 counties.

[16] However, the Chapter 7 filing rates do rise with the homestead exemptions, while Chapter 13 filing rates decline with homestead exemptions after controlling for whether the state has unlimited homestead exemption.

Table 4: Association of Bankruptcy and Mortgage Default with Institutional and Other Characteristics

	Bankruptcies	Chapter 7	Chapter 13	Mortgage Default
House price	-0.002***	-0.001***	-0.002***	-0.002***
	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Mortgage default rate	1.035***	0.603**	2.067***	
	(0.258)	(0.305)	(0.502)	
Ownership rate	0.438***	0.822***	2.467***	0.204***
	(0.147)	(0.162)	(0.260)	(0.164)
Recourse	-0.006	0.0005	-0.053	-0.072***
	(0.029)	(0.032)	(0.050)	(0.031)
Homestead exemption ($)	0.002	0.007**	-0.007**	0.002
	(0.002)	(0.002)	(0.004)	(0.002)
Unlimited exemption	-0.267	-0.714***	0.459	-0.098
	(0.205)	(0.227)	(0.346)	(0.225)
Median income	-0.016***	-0.0231***	-0.021***	-0.013***
	(0.003)	(0.004)	(0.006)	(0.004)
Mean cc balance	-0.024**	-0.016	0.010	0.021*
	(0.011)	(0.010)	(0.021)	(0.013)
Mean first mortgage balance	0.002***	0.002**	-0.007***	-0.004***
	(0.002)	(0.002)	(0.001)	
% College or more	-0.019***	-0.020***	-0.024***	-0.025***
	(0.002)	(0.003)	(0.003)	(0.002)
Bankruptcy rate				0.056***
				(0.009)
Number of observations	5790	5339	2610	4938
Adjusted R-squared	0.212	0.192	0.391	0.349

Note: Annual County-level data between 2000 and 2006, hence an observation is a county-year pair. The dependent variables are the log-odds ratios of the respective bankruptcy or default rates by county and year. As a result, the analyses exclude county year observations with zero bankruptcies or defaults. House price is the Zillow house value index at county-year level divided by 1000 deflated to 2010 levels; Ownership Rate is by county but fixed at 2010 Census level; Recourse classifies states into having mortgage recourse for lenders; Homestead Exemption is in 10000 dollars; and Unlimited exemption is a dummy equal to one if the state has unlimited homestead exemption and zero otherwise. Median income, mean credit card balance, and mean first mortgage balance are 2010 values in thousands. Bankruptcy, defaults, credit card balance, and first mortgage balance are authors' calculations based on CCP. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

To quantify the effect, Table 5 shows how the coefficients in the regression translate to different predicted rates of bankruptcy and default, which we use for estimation: the rates of bankruptcy and default are more than fifty percent higher for the low education group.

Table 5: Predicted Rates of Bankruptcy and Mortgage Default by Education

Rate	High Education	Low Education
Total bankrupty filing rates (‰)	7.72	11.40
Chapter 7 filing rate(‰)	5.79	8.79
Chapter 13 filing rate (‰)	2.08	3.96
Mortgage default rate (%)	1.67	2.88

Note: Prediction of bankruptcy filing rates and mortgage default rates by educational achievement in county-level data. We take the group of counties with % of college below the 25-th percentile as reference level for low education and compute the predicted value for a high educated county (above the 75-th percentile) using the estimate for γ_1 in (1), as shown in Table 4 - hence the prediction is for this entire set of counties. The explanatory variables are set at their respective mean values when making the predictions.

2.4 Education and Labor Supply

We use the Panel Study of Income Dynamics (PSID) data to estimate the life-cycle profiles and associated stochastic processes for income, hours worked, and homeownership rates for each education group. The PSID is a longitudinal panel survey of American families and each individual in the family about their social, economic, and health status over the life course over multiple generations.

As with the other data sets, we keep households whose heads are between 25 and 60 from 2000 to 2006. In total, we have 17,368 observations, and 40% have a college degree or above. We present summary statistics in Table 6 by education attainment. On average, individuals without a college degree work less and are less likely to own their primary residences, compared with individuals with college degrees. Additionally, they have more varying hours worked.

Table 6: Hours and Ownership Summary Statistics

	Low Educ			High Educ		
	mean	sd	median	mean	sd	median
Hours worked	1810.66	981.83	2024.00	2082.44	841.29	2100.00
Ownership	0.56	0.50	1.00	0.71	0.45	1.00
Age	42.05	10.34	42.00	43.17	10.63	43.00

Source: Authors' calculations based on data from PSID 2000-2006. All variables refer to the household head between age 25 and 60. Observations: Low Education 10,407; High Education 6,961. Ownership is the proportion of owners.

3 Model

Individuals are life cycle expected utility maximizers. The active life period starts at age 25 and lasts until age $T = 60$, with each model period representing one year.[17] Individuals differ in their completed level of schooling, and they decide how much to consume, work, and save each period, in the presence of persistent wage and house price uncertainty. For housing, they can either rent or buy one of a range of different sizes. Selling a home incurs transaction costs. Houses are financed by a long-term mortgage contract for a finite number of periods secured against the house's value. The mortgage interest rate depends on the probability of defaulting on the mortgage. Individuals can also obtain unsecured loans at an interest rate that is a function of the likelihood of bankruptcy and is set so that the expected profits of a lender making the loans are zero.

Indebted individuals can file for bankruptcy under Chapters 7 or 13. They may have to give up their house to repay some of the delinquent debt if they file under Chapter 7. Under Chapter 13, they will have to agree on a repayment scheme deducted at source from their wages for a random number of periods of fixed expected duration. They can also default on their mortgage. In this case, the state recourse law governs how much they must use their other assets to cover the remaining mortgage.

We next describe the essential elements of the model and provide examples of some of the value functions and choices. A detailed description of the model is provided in Appendix A.[18]

3.1 Preferences

Households derive utility from consuming a composite non-durable consumption good c, leisure, and housing h.[19] Labor supply decisions are modeled as choices from a set of five-hour values $l \in \{l_1, l_2, \ldots, l_5\}$, where $l_1 = 0$, $\mathbf{P} \equiv \mathbf{1}[l > 0]$, and L is the maximal available time. Houses come in H sizes, $h \in \{\underline{h}, h_1, \ldots, h_H\}$, and $\mathbf{H} = \mathbf{1}[h > \underline{h}]$. Only the smallest type $\underline{h}$ is also available for rent.[20] The per-period

[17] The assumption of maximum life expectancy is made for computational purposes and helps focus the model on periods where housing decisions and mortgage repayment are most relevant.

[18] Note that we allow for preference heterogeneity by education attainment along the following dimensions: consumption weight, housing weight in period composite consumption, and the strength of housing glow. This is reminiscent of the preference heterogeneity in discount rates or time consistency in the macro literature. See, among others, Athreya et al. [2009], Nakajima [2017], and Chatterjee et al. [2023], for examples of applications in the consumer credit macro literature. As in this literature, these assumptions are motivated by data and necessary in our set up to match homeownership rates, housing consumption, and hours worked. We will discuss further in our calibration section.

[19] We use "individuals", "households", and "agents" interchangeably.

[20] This simplifying assumption follows Mitman [2016] and many others in the literature.

utility function for individuals of education level e is

$$u_e(c,l,h) = \frac{\left[c^{\omega_e}\left(L-l-\mathbf{P}\theta_{Pe}\right)^{1-\omega_e}\right]^{1-\gamma}}{1-\gamma}\exp\left(\theta_{He}h\right)+\mu_e\mathbf{H}h, \tag{2}$$

where θ_{Pe} denotes the fixed cost of working. The additive term $\mu_e\mathbf{H}h$ makes preferences nonhomothetic, and the sign of μ_e governs whether housing is a necessity or a luxury as in Attanasio et al. [2012].

3.2 House Prices

Following Mitman [2016], we normalize the unit price of housing to be 1 at the time of purchase and thereafter, and assume house prices follow an autoregressive process with idiosyncratic shocks ϵ_{it}:

$$p_{it} = \rho_p p_{it-1} + \epsilon_{it}, \text{ with } p_{i0} = 1 \text{ and } \epsilon_{it} \sim N(0,\sigma_p^2). \tag{3}$$

We abstract from aggregate shocks, which generate complications that are beyond the scope of this paper.

3.3 Labor Productivity

Log hourly wages of an individual with education level e grow deterministically with age t and are subject to idiosyncratic shocks as follows,

$$\ln y_{it}^e = e_i + f^e(t) + w_{it}^e, \tag{4}$$

where $f^e(t)$ is an education specific polynomial in age (t), and w_{it}^e follows an age-dependent Markov chain of order one. Importantly, *both the state space and the transition matrix* of the Markov chain depend on age t and education level e. We interpret w_{it}^e as the wage residual, and include it in the consumer's state space. We take this representation of the wage process from De Nardi et al. [2020], and estimate it on PSID data following their procedure (see Appendix C). We suppress the index for education e henceforth but note that all preference parameters are separately estimated for each group. In case of a labor supply choice of $l = 0$, the individual receives benefits b instead of labor income $y \times l$.

3.4 Catastrophic Spending Shocks

In addition to wage and house price shocks, an individual is also subject to the arrival of catastrophic spending shocks. As pointed out in Sullivan et al. [2000], the main reasons cited for consumer bankruptcy are job loss (67.5% of respondents), family issues such as divorce (22.2%), and medical expenses (19.3%). We introduce an independently distributed spending shock to capture the latter two categories, over and above our income and price shocks. We adopt the setup in Livshits et al. [2007], which estimate dollar values for spending shocks from individual level medical spending data. We denote the spending shock by $\underline{a} \in \{0, 32, 102\}$ (in \$1000), and the probability of spending shock $\underline{a}$ arising by $\pi_a(\underline{a})$.

3.5 Institutions Governing Bankruptcy and Mortgage Default

Under Chapter 7, all non-exempt assets are seized to help repay the debt, and the remaining debt is discharged. The extent to which housing equity has to be used for debt repayment is regulated by the state's homestead exemption (ξ), which varies across states. Under Chapter 13, filers keep their houses regardless of the exemption level, but they sign up for a repayment plan stipulating debt repayments for as long as they are in the *bankruptcy punishment state*. In our model, exit from such a state is random, with a probability of 20% each year, leading to an average duration of 5 years.[21] Note that Chapter 13 is an option only if the creditor can expect to recoup at least as much as under a Chapter 7 liquidation. Filing for bankruptcy is costly. First, the individual is excluded from financial markets for the duration of the punishment. Second, bankruptcy incurs chapter-specific utility costs, λ_{je}, $j = 7, 13$, associated with the stigma of a bad credit record.

Homestead exemption is a legal clause, which exempts a certain amount of home equity from liquidation. If an owner finds themself with unsecured debt and, at the same time, has equity in the home below the exemption level, they could file for bankruptcy without risking losing his home in a forced sale. If an owner over the exemption limit files for Chapter 7, they loses the house, which is sold at market price, but they get to keep the exemption level from the proceeds of the sale.

An owner may default if the mortgage debt exceeds the house value, although even then, they may decide not to because default is costly.[22] If an owner defaults on his mortgages, they becomes a renter, and the house is sold to recover the debt. In all but seven U.S. states, a lender may lay claim to a fraction of other

[21] We set the exit to be random to avoid introducing an extra state variable in the model.
[22] See Bajari et al. [2008] and Guiso et al. [2009] for more discussions.

assets via recourse to cover remaining outstanding debt after default [Ghent and Kudlyak, 2011]. We denote the probability of a successful deficiency judgment by $\psi \in [0,1]$.

3.6 Financial Market

Financial institutions borrow at a fixed interest rate r from the world market and issue unsecured debt and mortgages, earning zero profits on each type of debt.

3.6.1 Mortgage Market

A mortgage is a loan of a fixed initial amount $m_0 = (1-\chi)p_0 h$, which depends on the value of the house on which it is secured ($p_0 h$), and bears a fixed interest rate r_m. It has constant payment each period, $\kappa(m_0)$, over its exogenously given term $T_m < T$ years.[23] The term χ represents the mandatory downpayment. We use the prime to denote the next period. The loan amount evolves according to

$$m' = (1+r_m)m - \kappa(m_0). \tag{5}$$

To adjust the loan for the individual default risk over the term, we define a price that will ensure zero profits on each individual mortgage contract [see Kaplan et al., 2020]. Thus, the individual will be making repayments based on the nominal value of the loan $m_0 = (1-\chi)p_0 h$ but will receive only $(1-\chi \times q_{m_0})p_0 h$, where q_{m_0} is the price of the loan. To see how this is set, define as $def(x)$ the default indicator at state of the world x, which includes wages, the house value, the outstanding mortgage, and net financial assets. The mortgage price is then determined according to the recursive formulation,

$$q_m(m|S) = \frac{1}{m(1+r_m)} \mathbb{E}_{w'|w,p'|p,\underline{a}} \left\{ def' \left(\delta_d p' h' \right) + (1-def') \left[\kappa + q_m(m'|S')m' \right] \right\}, \tag{6}$$

where $\mathbb{E}_{w'|w,p'|p,\underline{a}}$ is the expectation operator taken over all future states, included in the full state space S, introduced below, m' is the outstanding loan at the beginning of the period before the default decision.[24]

[23] The standard amortization formula is $\kappa(m) = m \frac{r_m(1+r_m)^{T_m-t}}{(1+r_m)^{T_m-t}-1}$.

[24] As in Mitman [2016], we assume that banks can observe borrowers' portfolio choices, home ownership status, and persistent states. Although there is no asset information in credit bureau files as credit scores are constructed using only liability information such as loan amount plus loan performance, income and assets affect how much to borrow, the rates charged, and loan performance. Mortgage loan-to-value ratio is an extremely important variable in mortgage lending decision. In other words, borrowers' asset and income information are already captured by their credit scores in almost all cases except for the very young first-time borrowers.

The curly bracket in (6) describes the repayment to the mortgage lender in case of default ($def' = 1$), when the house is sold in foreclosure at a discount $\delta_d < 1$, and in the case of continuing mortgage payments ($def' = 0$): The value to the lender in that case is the next payment κ plus the next period's pricing function times the remaining mortgage debt $m' = (1 + r_m)m - \kappa$.

3.6.2 Unsecured Debt Market

Individuals can take out unsecured loans, which they can repay at the end of the period or default by filing for bankruptcy. The equilibrium cost of the loan accounts for the possibility of bankruptcy filing and the chapter choice. Under Chapter 13, a 5-year repayment plan is set, where the amount repaid each year is equal to a fifth of the amount owed. In the model we place a cap of 15% of annual earnings, reflecting the practice in courts. Alternatively, if the individual files under Chapter 7 (subject to eligibility), no repayments are made from future income but any available assets above an exemption level (housing in our case) are seized to repay as much of the debt as possible with the rest discharged. We define this as *non-exempt equity*, given by $\nu = \max((1-\phi)(ph - m) - \xi, 0)$, where ϕ is the proportional transaction cost when selling the house and ξ the homestead exemption. In either case, the amount an individual can borrow depends on the expected repayment to the lender next period. The implicit bond price for a one-period loan is thus,

$$q_a(a'|S) = \frac{1}{(1+r)(-a')}\left\{-a'[1 - \pi_7(a', S) - \pi_{13}(a', S)] + \pi_7(a', S)\nu\zeta + \pi_{13}(a', S)\bar{y}T_{bk}\right\}, \quad (7)$$

where $\pi_j(a', S)$ is the probability of filing for Chapter j, given a savings choice a'. The squared bracket denotes the expected repayment, where $\zeta < 1$ parametrizes inefficiency in the bankruptcy technology; that is, the lender recovers only ζ of borrowers' nonexempt assets from a Chapter 7 bankruptcy. Note that decreasing homestead exemption ξ will increase ν, and, therefore, ceteris paribus will lead to larger unsecured borrowing. Finally, equation (7) reduces to the familiar $q_a(a'|S) = \frac{1}{1+r}$ with zero bankruptcy probability.

3.7 Consumer Choice

A household maximizes its lifetime utility given by

$$U_e = E_0 \sum_{t=1}^{T-1} \beta^t u_e(c_t, l_t, h_t) + \beta^T V_{Te}(a, h, p, m, \tau), \quad (8)$$

with respect to sequences $\{c_t, h_t, l_t, d_t\}_{t=1}^{T}$ of consumption, housing, labor supply, and a set of discrete choices related to bankruptcy and default decisions. The term $\beta < 1$ is the discount factor and V_{Te} is the terminal value function, which depends on the amount of home equity at the end of the active life cycle and the start of retirement. The expectation is taken with respect to contingent paths of wages, house prices, and spending shocks.

The optimization is subject to a budget constraint, which we discuss later together with value functions. The flow of labor income is endogenous and depends on labor supply. There exists a basic insurance b, set at 23% of median income, so that even when the individual is unemployed a low level of consumption is guaranteed. In addition, we allow for basic consumption support $\underline{c}$ equal to 10% of median income, which is applicable following a catastrophic consumption shock once the individual has filed for bankruptcy. Neither of these amounts varies by education.

The timing within a period is as follows: First, wage, house price, and spending shocks are resolved. Then, households make optimal savings, housing, labor, and discrete choices. When $t < T - 1$, in addition to the consumption decision, a renter in the non-bankruptcy state chooses the maximal value among three discrete choices: rent, buy, and file for bankruptcy under either Chapter 7 or Chapter 13. An owner in the non-bankruptcy state chooses among staying in the existing house, selling it, defaulting on the mortgage, and filing for bankruptcy under one of the two chapters. If the owner is in the punishment state due to an earlier bankruptcy, they choose among staying, selling, or defaulting on the mortgage.

In what follows we illustrate key features of the choice problem in several cases that are central to our problem. We omit the education subscript e for simplicity and without loss of clarity.

3.7.1 The Choice of Renters

A renter is characterized by his holding of liquid assets a, wage w, and age t. The corresponding optimal value function is $W(a, w, t)$. If they have filed for bankruptcy before, then the value function is $\tilde{W}_j(a, w, t)$, $j = 7, 13$.

$$W(a, w, t) = \begin{cases} \max\left(W^{\text{rent}}, W^{\text{buy}}, W^{\text{file.7}}, W^{\text{file.13}}\right) & \text{if } a < 0, \\ \max\left(W^{\text{rent}}, W^{\text{buy}}\right) & \text{if } a \geq 0. \end{cases} \tag{9}$$

The restriction on the discrete choice set of the renter in (9) makes explicit that one files for bankruptcy only if there exists unsecured debt.

Value of Buying As an illustration, consider the value of buying (W^{buy}) for a renter not currently in bankruptcy. A prime denotes the next period, and V denotes the owner's value:

$$W^{\text{buy}}(a,w,t) = \max_{a',h,l}\left\{u(c,l,h)+\beta\mathbb{E}_{w'|w,p'|p,\underline{a}}\left[V(S')\right]\right\} \tag{10}$$

subject to

$$\begin{aligned}
S' &= (a'-\underline{a},w',p',n',h,t+1),\\
c+a'q_a(a'|w,p,\bar{n},h) &= yl+a-\kappa[(1-\chi)p_{i0}h]-\Gamma(p_0,h,w,t), &(11)\\
\pi_7(a'|w,h) &= \mathbb{E}_{w'|w,p'|p,\underline{a}}\left\{\mathbf{1}\left[V^{\text{file.7}}(S') > V^{-\text{file.7}}(S')\right]\right\}, &(12)\\
\pi_{13}(a'|w,h) &= \mathbb{E}_{w'|w,p'|p,\underline{a}}\left\{\mathbf{1}\left[V^{\text{file.13}}(S') > V^{-\text{file.13}}(S')\right]\right\}, &(13)\\
n' &= \bar{n}-1,\\
w'|w &\sim \Pi_w(t), &(14)\\
p'|p &\sim \Pi_p. &(15)
\end{aligned}$$

The state space of the owner S contains liquid assets, wage shock, house price, mortgage vintage, house size, and age. The maturity of the mortgage is denoted by $n \in \{\bar{n},\bar{n}-1,\ldots,0\}$, where $n=0$ indicates a paid-off mortgage.[25] The budget constraint of the buyer (11) includes the first mortgage payment κ and the downpayment $\Gamma \equiv (1-q_{m_0}(1-\chi))p_0h$, where q_{m_0} is the price of the loan given by (6).[26] The function, q_a, reflecting the cost of unsecured debt, depends on mortgage debt and the house size, (m,h), and is defined in (7). The respective probabilities of bankruptcy are defined in (12) and (13). Finally, equations (14) and (15) denote the transition matrices associated with the discretizations of wage and house price processes in (4) and (3). See Appendix A for details on the value functions listed in equation (9).

[25] Given (h,p), there is a one-to-one mapping between n and m in the model

[26] Note the i.i.d. spending shock $\underline{a}$ appears only in the future state of assets, hence is part of the expectations operator.

3.7.2 The Problem of the Owner

The problem of an owner not in a bankruptcy state is given by

$$V(S) = \begin{cases} \max\left(V^{\text{stay}}, V^{\text{sell}}\right) & \text{if } a \geq 0, hp_t - m_t \geq 0; \\ \max\left(V^{\text{stay}}, V^{\text{sell}}, V^{\text{def}}\right) & \text{if } a \geq 0, hp_t - m_t < 0; \\ \max\left(V^{\text{stay}}, V^{\text{sell}}, V^{\text{file.7}}, V^{\text{file.13}}\right) & \text{if } a < 0, hp_t - m_t \geq 0; \\ \max\left(V^{\text{stay}}, V^{\text{sell}}, V^{\text{def}}, V^{\text{file.7}}, V^{\text{file.13}}, V^{\text{file.def}}\right) & \text{if } a < 0, hp_t - m_t < 0, \end{cases} \tag{16}$$

where *def* denotes default, $a \geq 0$ indicates non-negative financial assets, and $hp_t - m_t$ is home equity. Note that not all discrete choices are available everywhere on the state space, as can be seen from the restrictions for each case. For example, The default choice is an option only if home equity is negative. In other words, we assume that a person who has difficulty repaying a mortgage (say because of a negative income shock) but has positive equity in the house will always choose to sell. Owners with home equity in excess of the exemption level face eviction should they file for bankruptcy under Chapter 7. The level of homestead exemption determines whether an owner filing under Chapter 7 stays on in the house or is evicted. We define the sub-problems in Appendix A, but illustrate the value of default here.

Value of Default The default value is similar to the value of selling except that once defaulted, the individual must incur a one-time utility penalty λ_{def} and cannot borrow unsecured debt. Regarding recourse legislation, we introduce $\psi \in [0,1]$ to capture the probability with which negative equity, $(1-\phi)(ph-m) < 0$, will be rolled over into post-default life. Notice that the future value is that of a renter, but the asset state takes into account any remaining mortgage debt $\hat{d} \leq 0$ brought forward.

$$V^{\text{def}}(S) = \max_{a'>0, l \in L} u\left(c\lambda_{def}, l, \underline{h}\right) + \beta \mathbb{E}_{w'|w,\underline{a}}\left[W(\hat{d} + a' - \underline{a}, w', t+1)\right] \tag{17}$$

subject to

$$\begin{aligned} c + \frac{1}{1+r}a' &= yl + a, \\ \hat{d} &= \psi[(1-\phi)ph - m]. \end{aligned}$$

Owner in Bankruptcy State An owner who has declared bankruptcy but has kept his home can either remain a home owner (stay), sell, or default on the mortgage. His valuation is

$$\tilde{V}_j(S) = \max\left(\tilde{V}_j^{\text{stay}}, \tilde{V}_j^{\text{sell}}, \tilde{V}_j^{\text{def}}\right), j = 7, 13.$$

In the case of default, the amount of assets that the person carries over to the next period depends on the recourse and mortgage debt. His financial assets must be nonnegative as they cannot borrow. If any individual in punishment state receives a negative spending shock or a deficiency judgment, their flow utility will be $u(\underline{c}, l_1, \underline{h})$, i.e. they will consume the safety-net consumption, full leisure, and the smallest rental house, while savings and homeownership will be set to zero. They stay in punishment state in the next period.

Leaving the rest to Appendix A, we show next the value for the case when the owner keeps his home,

$$\tilde{V}_j^{\text{stay}}(S) = \max_{a'>0, l\in L}\left\{u\left(\lambda_j c, l, h\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}}\left[(1-\delta)\tilde{V}_j\left(S'\right) + \delta V(S'^*)\right]\right\} \quad (18)$$

subject to

$$\begin{aligned} S' &= (\max(a' - \underline{a}, 0), w', p', n', h, t+1), \\ S'^* &= (a' - \underline{a}, w', p', n', h, t+1), \\ c + \frac{1}{1+r}a' &= a + yl - \mathbf{1}\left[j = 13\right]\bar{y} - \kappa(p_0 h, r_m, T_m), \\ j &= 7, 13, \end{aligned}$$

where δ is the probability of exiting the state of bankruptcy, $\bar{y}$ is the loan payment agreed under Chapter 13, and λ_j is the psychic cost of a bad credit record, which depends on chapter (j).

3.7.3 Terminal Value Function

The terminal value function has the following form,

$$V_T(a, h, p, m) = \theta_W \log(a + ph - m) - \theta_{BK}\mathbf{1}\left[\text{in bankruptcy state}\right], \quad (19)$$

where θ_{BK} is a penalty if one enters the last period in bankruptcy (BK) state. This parameter is necessary to avoid counterfactual behaviour where individuals accumulate large amounts of debt which are discharged in the final period of life. We refer to θ_W as a bequest weight.

4 Parameterization and Estimation

We limit parameter estimation to the states in group 5 in Table D.1. The states in group 5 have similar institutions governing bankruptcy and mortgage default. In particular, they are in the same one-third of homestead exemption relative to state median income, and they allow for mortgage deficiencies.[27] Several parameters are set based on earlier results from the literature and are shown in Table 7 except for safety net and unemployment insurance, which we chose to be very small numbers; our model simulations are not sensitive to our choices of safety net and unemployment insurance.[28]

Appendix C describes the estimation of the age-specific wage process, following De Nardi et al. [2020]. The remaining parameters are estimated using the simulated method of moments [SMM, see McFadden, 1989, Pakes and Pollard, 1989] combined with the Markov Chain Monte Carlo method (MCMC) adapted for SMM by Chernozhukov and Hong [2003]. This approach makes estimation tractable and avoids problems with moments that may not be differentiable with respect to parameters, as is often the case with simulations.

We compute the optimal solution for the model on a grid of values over the state space and use linear or bilinear interpolation to find values in between grid points. The setup of grid points can be seen in Table D.2. We emphasize that in our setup, the mortgage lasts for roughly half the working life (15 periods out of 35), and that we have a large number of discrete choices (we have 14 value functions to compute across owners, renters, in and out of bankruptcy punishment state). The standard simulation comprises 15,000 individuals, and we initiate each individual by drawing from several distributions. The initial ownership position is randomly drawn for each individual using PSID data on ownership in period 1 (age 25). The initial asset position is drawn from a log normal distribution which mimicks the shape of the liquid wealth distribution in the SCF (see Table D.2. The initial wage and price shocks are drawn from the stationary distributions of the respective Markov chains Π_w and Π_p.) For the benchmark, we assume no correlation between the wage and price shocks, following much of the literature which has assumed either a very low correlation (eg., 0.2 in Yao and Zhang [2005] and 0.075 in Pelletier and Tunc [2019]) or independent stochastic processes for housing and labor income (eg., Mitman [2016] and Li et al. [2016]).[29] In Appendix D.2 we present simulation results where we allow the realization of the income and house price shocks to be correlated. In other words, the

[27] In principle we could estimate the model for all groups, but it would add significant computational burden.

[28] Athreya and Simpson [2006] find that the interactions of social benefits with bankruptcy are quantitatively non-negligible. Their paper abstracts from Chapter 13 choices, mortgage defaults, and labor supply decisions.

[29] Campbell and Cocco [2007] is an outlier as they assume perfect correlation between the shocks to house prices and permanent shocks to labor income.

correlation comes as shocks to agents instead of being expected.

The stochastic process of income is estimated outside the model with an approach drawn from Meghir and Pistaferri [2004]. Preferences by education group are identified by matching other elements of the model. As such, we fit various aspects of household behavior, including bankruptcy and mortgage default rates, home ownership, and labor supply separately for each group.

Table 7: Preset Parameters

Description	Symbol	Value	Source
Prob of exit from bankruptcy state	δ	0.2	Legal
Risk free gross interest rate	$1+r$	1.02	Assumption
Spending shock grid (1000$)	$\underline{a}$	[0.0, 32.00, 102.00]	Livshits et al. [2007]
Spending shock probabilities	π_a	[0.925, 0.070, 0.005]	Livshits et al. [2007]
Discount factor	β	0.99	Assumption
Rental price of housing	p_r	0.0	Normalization
Fixed cost of selling	ϕ	0.06	Data
Probability of deficiency	ψ	0.1	Li and Oswald [2017]
Homestead exemption/median income	ξ	1	Definition
Downpayment ratio	χ	0.1	
CRRA	γ	2.1	Standard value
Foreclosure depreciation	δ_d	0.78	Kaplan et al. [2020]
Mortgage interest rate	r_m	0.06	FRED average 30-year mortgage
Annual hours worked full time	l_L	2277	French [2005]
Annual leisure endownment (hours)	L	4466	French [2005]
House price shock persistence	ρ_p	0.96	Mitman [2016]
House price shocks standard deviation	σ_p	0.1	Mitman [2016]
2003 Median household income (1000$)		43	Census Bureau
Avergage length of Chapter 13 repayment	T_{bk}	5	Legal
Maximal payment/income ratio in Chapter 13		0.15	Legal
Bankruptcy technology	ζ	0.5	Mitman [2016]
Safety net	$\underline{c}$	0.1	SNAP (4 persons)/median married-couple income
Unemployment insurance/median income	b	10	2004 average unemployment insurance

Note: Freddie Mac, 30-Year Fixed Rate Mortgage Average in the United States [MORTGAGE30US], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MORTGAGE30US. The safety consumption level is computed from the ratio of foodstamp payments for a 4-person houshold (SNAP = 11676) over national median income of married households (110800) using 2023 data. We assume the ratio stays constant over time. The unemployment insurance is computed using the 2004 average weekly insurance ($262) obtained via https://oui.doleta.gov/unemploy/claimssum.asp, and the maximum unemployment duration of 39 weeks https://www.cnbc.com/2020/07/23/average-unemployment-insurance-payment-in-each-us-state.html to arrive at an annual unemployment insurance of $10218.

4.1 Estimation Results and Model Fit

The estimates are presented in Table 8.[30] The education groups are not too different in the weight of nonhousing consumption in their composite consumption bundle and the bequest strength. However, we need

[30] We do not report standard errors because some of them are not well defined due to the ill-conditioned Hessian, particularly for the low education group.

a strong warm glow in housing to match the home ownership rate of the low education group. Additionally, a large fixed cost is needed to match the low hours worked by the low education group.[31]

Table 8: Parameter Estimates by Education Group

		High Education	Low Education
Utility: c, l and h			
Home ownership (warm glow)	μ	0.501	5.5
Housing services (multiplicative)	θ_H	-0.1	-0.9
Consumption exponent	ω	0.4	0.44
Fixed cost of work	θ_P	998.541	2013.932
Bequest weight	θ_W	7.91	6.614
Utility: Bankruptcy and Default			
Stigma Ch. 7	λ_7	0.39	0.349
Stigma Ch. 13	λ_{13}	0.601	0.432
Stigma default	λ_{def}	1.0	1.0
Period T BK penalty	θ_{BK}	0.0	801.09

Regarding consumer finance, the stigma effects associated with bankruptcy (λ_7, λ_{13}) and with default (λ_{def}) are high, particularly for high education people in Chapter 13 bankruptcy filing, in order to match the relatively low bankruptcy filings rates we observe in the data. Likewise, the parameter for final period bankruptcy θ_{BK} is large for the low educated group, which is required to deter them from ending working life in bankruptcy. Earlier empirical work, for example, Gross and Souleles [2002] and Fay et al. [2002], have argued that non-risk-related factors such as changes in bankruptcy stigma are important in explaining the rise in bankruptcies in the late 1990s to early 2000s. More recently, Athreya et al. [2012] find that a positive association between default costs and educational attainment is needed to explain their facts. Chatterjee and Eyigungor [2022] also rely on heterogeneity in default costs in addition to heterogeneity in discount rates to explain the heterogenous facts in the credit market that they document.[32]

Model Fit Table 9 displays model and data moments on bankruptcy filing rates by chapter, mortgage default rates, homeownership rates, and annual hours worked for each education group and for households on average and near retirement, respectively. Overall, the model does a good job at matching bankruptcy filing rates and mortgage default rates for both education groups and for the near retirement age group. However, we

[31] It is standard in the labor literature to feature fixed cost to study labor supply. In a recent paper, Gregory et al. [forthcoming] argue that heterogenous gains/costs of employment via different transition matrix are necessary to match the heterogenous employment patterns in the data.

[32] In Chatterjee and Eyigungor [2022], the most impatient type forfeits 20% of their transitory income upon defaults whereas the least impatient type forfeits 75 %.

overpredict Chapter 13 filing rates for the high education group. The average number of hours worked is a bit higher in the model than in the data for both education groups, likely a consequence of not modeling disability that pushes hours down from the age of 45 [see Meghir and Pistaferri, 2011, Low et al., 2010].

Table 9: Model Fit

Model vs Data Moments				
	High Education		Low Education	
	Model	Data	Model	Data
Bankruptcy 7 (‰)	5.93	5.794	9.731	8.787
Bankruptcy 13 (‰)	4.585	2.079	3.913	3.957
Bankruptcy age 50-60 (‰)	9.052	9.883	9.022	9.883
Mortgage default (%)	1.311	1.668	1.79	2.88
Homeownership (%)	0.718	0.727	0.561	0.605
Homeownership age 59 (%)	0.88	0.867	0.672	0.783
Hours	2186.5	2056.71	2051.39	1821.71

The model has 7.59% (4.46%) of high (low) educated people with negative net worth, corresponding well to those reported in SCF (7.5% and 4.4%, respectively). We wish to note that our model doesn't capture the economics of credit limits, which is an important instrument used by lenders to differentiate borrowers of different credit risk, see Dempsey and Ionescu [2021] and Chatterjee and Eyigungor [2022] for more discussion on the empirical regularities on credit limits. Instead of a discrete credit approval, our model imposes very high interest rates on risky borrowers, which deters them from taking out such loans. As a result, our model features a large difference in interest rates for unsecured debt across education groups, 10.8% for those with high education and 26% for those with low education.

5 Model Implications

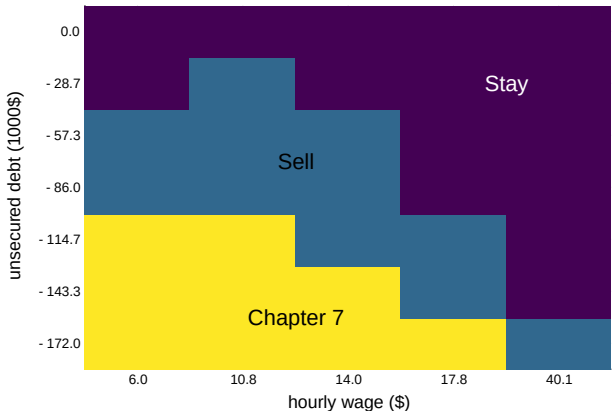
5.1 Policy Functions

To see the tradeoffs in households' decisions, we illustrate in Figure 1 a set of discrete choice policy functions from the baseline model with owners in the top row and renters in the bottom row. We project the high-dimensional policy function into wage-unsecured debt space. Starting with an owner at young age in Figure 1a, we observe that at moderate levels of unsecured debt and relatively high hourly wage, they choose to stay in the house (northeast in the plot). As unsecured debt increases and wage decreases (moving

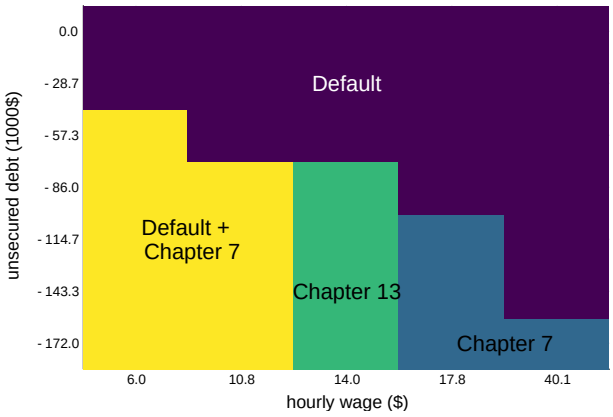
southwest), we encounter first a region of house sales and then a region of Chapter 7 is bankruptcy filing.

Figure 1b examines an owner of the same wage, but with a negative house price shock. The little home equity in the house turns quickly negative after the price shock, and the owner chooses to default (in the northeastern region). As accompanying unsecured debt increases and wages change, there are different regions where the owner will either file for Chapters 7, 13, or a combination of default and Chapter 7 (in the southwest corner). The choice between Chapter 7s and 13 depends on whether the house would be lost in Chapter 7 (which is not the case here, as there is no excess equity, and, hence, nothing to gain for the mortgage lender), and the wage rate, which determines the required Chapter 13 repayments. Here, too high a wage rate deters the owner from choosing Chapter 13, because Chapter 7 offers the same benefits (keep the house), but without the associated costs (future wage garnishments).

Figure 1: Discrete Choice Functions (High Education Group).

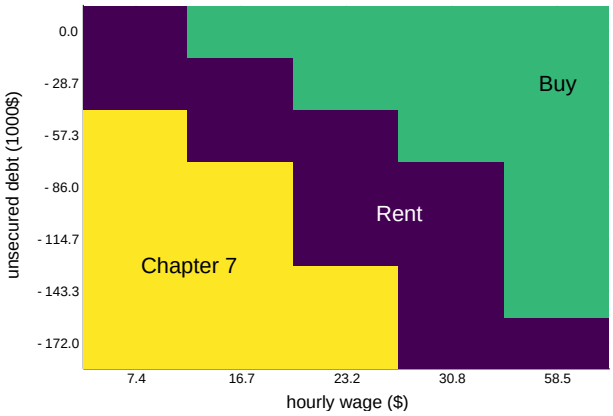


(a) Owner at age 26, with a 1-year-old mortgage.



(b) Owner at age 26 with adverse house price shock.

(c) Renter in first period (age 25) with a spending shock.



(d) Renter discrete choices at age 45.

Figure 1c presents decisions made by a young renter after receiving a negative spending shock in the

first period of life. Note that receiving a spending shock is the only way for an individual to have unsecured debt in the first period of life as we assume individuals start life with non-negative assets. At high hourly wage levels, the renter buys a house. However, as unsecured debt grows larger and wages become smaller, the renter first decides to keep renting, and finally file for bankruptcy under Chapter 13. In the adjacent Figure 1d, which depicts the renter at period 20 (age 45), with a substantially higher wage rate, we see that buying a house is optimal on a larger subset of the state space, and that the choice of bankruptcy chapter has changed to Chapter 7 - a result of the higher wage as they would incur larger Chapter 13 repayments.

Table 10 shows regressions on model generated data, comparable to the regressions on actual data shown in Table 2. It highlights the importance of education as a predictor for several key outcomes: the propensity to file for either chapter of bankruptcy, for mortgage default, and the average amount of interest charged on unsecured credit. In all cases except for Chapter 13, low educated individuals have a higher propensity to file, and are charged a higher interest.

Table 10: Discrete Choice Behaviour as a Function of the State Space: Model

	Chapter 7	Chapter 13	Mortgage Default	Unsecured Interest
	(1)	(2)	(3)	(4)
No college degree	3.110	-4.049	0.375	18.972
Age	0.841	1.170	-0.065	-0.859
Age squared	-0.015	-0.027	0.001	0.048
Wage	-3.687	-1.620	-0.189	-5.192
House price	-3.071	-4.100	-4.013	-26.140
Homeowner	5.408	-4.695		-3.919
Mortgage	0.565	-0.440	0.125	3.552
Liquid assets	-1.263	-0.739	-0.097	-17.308
Constant	9.725	19.590	13.665	31.108
Mean of outcome	5.524	4.450	1.179	15.239
Number of observations	2,704,778	2,704,778	1,694,657	722,277
Adjusted R-squared	0.014	0.022	0.050	0.073

Note: We construct simulated samples which resemble the SCF data used in Table 2 in terms of fraction of high/low educated individuals. Table shows linear regression models. The outcomes of columns (1) and (2) are measured in per thousand (i.e. column (1), mean of outcome 5.5 implies there are 5.5 chapter 7 filings per thousand people). The mortgage default and unsecured interest rates are given in percent. All p-values are zero and the standard errors are very small relative to the coefficient and hence we do not report them.

5.2 The Role of Price and Wage Risk

Our model includes many complex interactions. To better understand them, in this section we derive Elasticities in several economic outcomes and welfare effects with respect to various risks, emphasizing differences across education groups. Specifically, in Table 11 we show the Elasticities of bankruptcy filing rates, mortgage default rates, homeownership rates, and hours worked with respect to changes in the standard deviation of the house price shock and of the wage shock. When we perturb risk, we arrive at a new equilibrium with different interest rates.

Table 11: Elasticities to House Price Risk and Wage Risk

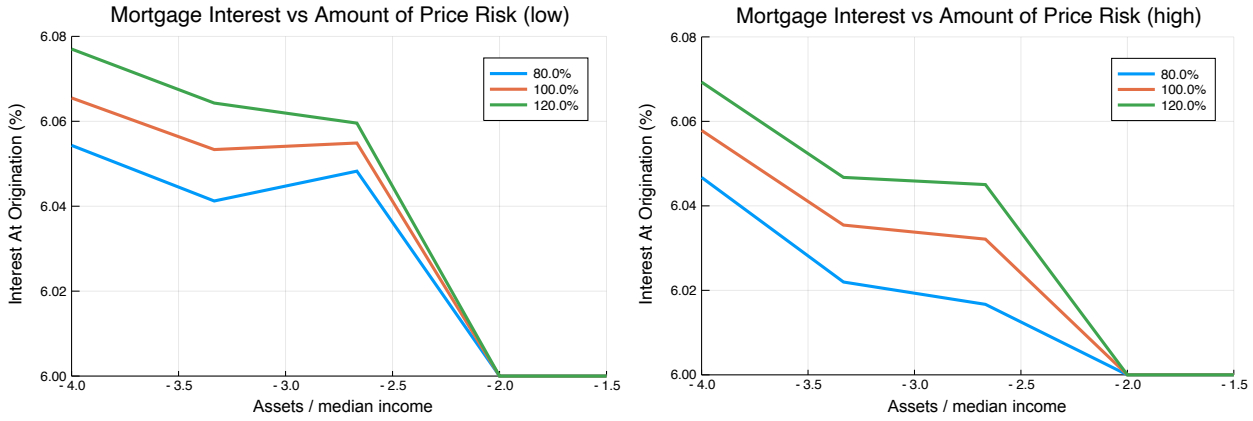
	High Education		Low Education	
	House Price (p)	Wage (w)	House Price (p)	Wage (w)
Bankruptcy	−0.069	−1.405	0.664	0.382
Bankruptcy 7	−0.057	−1.754	0.437	1.946
Bankruptcy 13	−0.084	−0.953	1.228	−3.509
Interest	0.023	−0.082	−0.022	0.333
Ownership	0.052	0.068	0.029	0.217
Default	0.205	−0.876	0.228	−0.752
Hours	−0.006	0.005	0.002	−0.164
Initial mortgage rate	0.003	0.01	0.008	−0.003
Hours renters	−0.006	0.008	0.015	0.037
Hours owners	−0.005	−0.0	0.001	−0.224
Hours renters (in Ch. 7)	−0.033	−0.011	−0.018	0.247
Hours owners (in Ch. 7)	−0.008	0.156	−0.105	−0.712
Hours renters (in Ch. 13)	−0.048	0.095	−0.004	0.201
Hours owners (in Ch. 13)	−0.114	−0.285	0.018	–

Note: The elasticities are calculated as the percent change in an outcome as a result of a one percent change in the standard deviation of the house price shock or the wage shock. There are no low-educated owners filing for Chapter 13 in the high wage variance model.

The results are reported in Table 11. There are several takeaways. First, bankruptcy filing rates are sensitive to house price risk but only for the low education group, while mortgage default rates are sensitive to house price risk for both groups. Second, both groups are sensitive to wage risks in bankruptcy filing and mortgage default. However, for the high education group, an increase in wage risk leads to a decline in overall bankruptcies, while the opposite is true for the low education group. Moreover, for the high education group, the reduction is more significant in Chapter 7 filings. This is likely the result of increased wealth accumulation when wages are more volatile. For the low education group, however, there is a large shift

from Chapter 13 towards Chapter 7 filings, suggesting that the low education group, despite accumulating more wealth, the increased likelihood of experiencing high wages makes Chapter 13 filing costly. In terms of housing, mortgage default rates decline and home ownership rates rise for both groups. Third, on aggregate, hours worked are not very sensitive to house price risks for either group. However, the labor supply by the low education group is sensitive to wage risk. There also exists substantial heterogeneity in labor responses while in bankruptcy. Notably, owners with high education who have filed under in Chapter 13 reduce labor supply with respect to either house price or wage risks. Owners with low education after Chapter 7 filing also reduce labor supply with respect to both house price and wage risks.

Figure 2: Mortgage Interest Rate by House Price Risk and Assets at Origination



(a) Initial mortgage rates for low educated buyer.

(b) Initial mortgage rates for high educated buyer.

Note: House price risk is set at 80% of baseline, at baseline (100%), and at 120% of baseline.

To provide further understanding of the underlying equilibrium, Figure 2 demonstrates how the cost of a mortgage changes with assets (relative to median income) and with the amount of house price risk. Note that the cost is forward looking and accounts for the possibility of unsecured debt being accumulated following the issuance of the mortgage. Overall, mortgage rates do not vary very much, reflecting the importance of collateral. The little variation that exists is more driven by the amount of unsecured debt at origination than by house price risk. The rate quickly converges to the low risk rate as unsecured debt declines. In addition, the interest rate faced by lower education individuals is higher at all levels of assets than that faced by high education individuals.

Finally, Figure 3 shows the close relationship between unsecured borrowing and the level of the mortgage loan for a group of high risk owners. All else equal, a higher mortgage loan implies an increased

risk of default, which can then trigger bankruptcy when there is recourse. Moreover, with some of the home equity protected by homestead exemption, a large mortgage loan may also lead to bankruptcy so that the households can have their unsecured debt discharged and thus have more resources to service the mortgages.

Figure 3: Median Interest Rates as a Function of Mortgage debt

Note. In this figure we condition on owners at relatively high risk of bankruptcy, i.e., young, low wage, and low high house price, by setting the state variables $(t \in \{1,2,3\}, n > 12, h = 2, p < 4, w < 4)$. The average mortgage debt is \$484k for this group and monotonically declines with age.

In Appendix D.3, as an event study, we analyze labor supply, assets and consumption profiles leading to and post bankruptcy filing under either Chapter 7 or Chapter 13, and contrast them, to the extent we can, to the empirical evidence documented in the literature.

6 Policy Counterfactuals

Before we conduct policy analyses, we define consumption equivalent welfare as follows. We use ι to denote the willingness to pay as a proportion of consumption c for a consumer to be indifferent between the baseline and an alternative scenario. We define the equalizing willingness to pay for the group of individuals indexed by initial simulation condition Ω as[33]

$$\iota(\Omega) = 1 - \left(\frac{E_0 U_0(\Omega) - E_0 \left(\Sigma_t \beta^t \mu \hat{\mathbf{H}}_{\mathbf{it}}(\Omega) \hat{h}_{it}(\Omega) + \beta^T \hat{V}_{iT}(\Omega) \right)}{E_0 \Sigma_t \beta^t \left(\frac{\left(\hat{c}_{it}(\Omega)^{\omega} \left(L - \hat{I}_{it}(\Omega) - \hat{\mathbf{P}}_{\mathbf{it}}(\Omega) \theta_P \right)^{1-\omega} \right)^{1-\gamma}}{1-\gamma} \exp\left(\theta_{\hat{H}_{it}} \hat{h}_{it}(\Omega) \right) \right)} \right)^{\frac{1}{\omega(1-\gamma)}}, \tag{20}$$

[33] See Appendix B for the derivation.

where E_0 is the expectation with respect to information in the initial period. Thus $E_0 U_0(\Omega)$ is the ex-ante baseline lifetime utility, given initial condition Ω. Choice variables under the counterfactual policy are shown with a hat. We compute the weighted average over all $\iota(\Omega)$, where the weights are the empirical frequencies of the initial conditions, drawn for asset position, ownership status, and initial wage shock.[34] It is important to keep in mind that during our experiments below, the feasible set of consumer choices varies; for example, we will remove the bankruptcy option from the choice set for those in bankruptcy state. However, the sequence of shocks (house price, wage, and expenditure shocks) stays constant, implying that some consumers will face catastrophic welfare losses in certain cases. We account for such outliers by winsorizing the individual-specific version of (20) at its first and 95-th percentile, before aggregating into groups Ω.

6.1 The Value of Bankruptcy Protection

Chapters 7 and 13 bankruptcy laws differ substantially in the insurance they offer and the associated moral hazard implications. Their value thus differs with the level and volatility of income and with preferences for work and housing. In this section we quantify these differences between education groups. In doing so, we demonstrate important distributional implications of such policies. To achieve this, we shut down each of the chapters in turn and assess the implications. A complete abolition of all bankruptcy provisions in the presence of catastrophic consumption shocks would require introducing other forms of consumption support and consequently entails a large degree of arbitrariness.

The results are reported in Table 12. For the high education group abolishing Chapter 7 leads to a sharp decline in bankruptcies and, as a result, a fall in interest rates for unsecured debt. Mortgage defaults also decline. Hours worked do not change much on aggregate, but the hours of Chapter 13 filers increase significantly despite wage garnishing.[35] The net effect is an increase of welfare equivalent to 10% of consumption. This large effect is due to the almost complete elimination of moral hazard, making unsecured borrowing much cheaper, while still offering some necessary protection via Chapter 13.

Turning to the lower education group, bankruptcy declines and interest rates fall, though the decline is not as high compared to the high education group. Mortgage default also drops because of the reduction in unsecured debt and the decline in overall bankruptcies. Hours worked fall overall, but increase for filing

[34] We report the measure in terms of percent, such that $\iota = 1.1$ means that the average consumer is willing to pay 1.1% of consumption (hence prefers the policy scenario), whereas $\iota = -2.1$ means the consumer has a negative willingness to pay for the policy, i.e., would demand an increase of 2.1% of consumption in order to be indifferent.

[35] There are no owners filing under Chapter 13 in this regime. All the effect on hours comes from renters filing.

renters - again no owners file in this regime. There is also a decline in home ownership. The net effect of all these changes is a decline in welfare of 0.7%, stemming from the decline in insurance for this group. The overall aggregate effect of abolishing Chapter 7 is positive for welfare, and equal to 4.4% of consumption under the policy. We discuss distributional implications below.

When Chapter 13 is abolished and only Chapter 7 is available, for the higher education group, there is a significant increase in Chapter 7 bankruptcy filing, along with an increase in interest rates. On net, there is an increase in welfare for this group of about 0.6%. For the lower education group, shutting down Chapter 13 increases bankruptcy somewhat, but it has a large impact on the interest rate, because of composition changes. The net effect is a decline in welfare of about 12%. The overall aggregate effect of abolishing Chapter 13 is -5% of consumption under the policy.

These exercises indicate that the way bankruptcy law is organized has important distributional consequences masked by aggregate effects, stemming from differences in income, asset, and preferences. Specifically, the higher education people have higher income and assets, bankruptcy options raise unsecured interest rates due to moral hazard, and do not provide widespread benefits as these people have more assets to lose under bankruptcy and higher wages that are subject to wage garnishment. Put simply, they pay the cost of moral hazard with little expected benefit. The lower educated individuals, by contrast, are poorer and greatly benefit from being able to write off their debts and not having to follow repayment plans.

Although the welfare results for different education groups appear large, a main point of our paper, the overall welfare impact from abolishing Chapter 7 or Chapter 13 for the whole population is much less and comparable to some of the findings in the literature. For instance, Chatterjee et al. [2007b] (Table X) finds a welfare gain of 1.6 percent of annual consumption to implement the means testing requirement in the BAPCPA alone. For subgroups, the welfare numbers are much larger. For instance, those with good credit record and debt have a welfare of gain of 6.9 percent. The welfare gains from various experiments of varying asset exemptions in bankruptcy in Pavan [2005] (Table 6) also ranges from -1.9 percent to 9.8 percent.

Table 12: Abolishing Bankruptcy by Chapter

	High Education			Low Education		
	Baseline	No Ch. 7	No Ch. 13	Baseline	No Ch. 7	No Ch. 13
Bankruptcy 7 (‰)	6.006	–	10.445	9.861	–	13.038
Bankruptcy 13 (‰)	4.713	0.557	–	3.941	2.578	–
Interest (%)	10.8	6.7	15.4	26.7	21.3	34.1
Ownership rate	0.715	0.673	0.704	0.559	0.512	0.558
Default rate	1.338	0.807	1.302	1.806	1.446	1.797
Hours	2186.0	2190.5	2185.9	2052.1	2021.7	2052.3
Hours renters	2242.2	2238.9	2245.5	2132.0	2091.4	2147.2
Hours owners	2187.5	2175.4	2185.2	2027.1	1985.8	2022.1
Hours renters (in Ch. 13)	1623.4	1785.6	–	1785.3	1905.8	–
Hours owners (in Ch. 13)	2175.7	–	–	1851.3	–	–
Cons. equivalent (%)	–	10.244	0.587	–	−0.7	−11.894

Notes: We remove separately each bankruptcy chapter from the choice set of consumers. There are no owners in Chapter 7 punishment in the scenario without Chapter 13. The Consumption Equivalent is the weighted mean of $\iota(\Omega)$ where the weights are the empirical frequencies of Ω, and where the quantiles correspond to the distribution of $\iota(\Omega)$ from equation (20).

6.2 Changing the Level of Recourse

Mortgage lenders face different amounts of recourse to deficient mortgage contracts in different states. Our baseline assumes a probability of 10% that a deficiency judgment would be handed down to a borrower who defaults on the mortgage with negative equity, informed by court records which were analyzed in Table A.1 of Li and Oswald [2017]. In case a deficiency judgment is carried out (with probability 0.1 in the baseline), the borrower has to settle the remaining debt in the future, possibly leading to bankruptcy filing.

The impact of varying recourse is displayed in Table 13. Starting with the high education group, increasing recourse leads to declines in mortgage default, as expected, given the higher cost associated with default. It also leads to increases in bankruptcy because deficient mortgages turn into unsecured debt more often, increasing incentives to expunge the debt through bankruptcy. This has a direct impact on the average interest rate for unsecured debt, which is higher in the high recourse scenario. However, aggregate ownership and hours worked are unaffected. We see a similar impact on the less educated group. Welfare declines little for either group with the doubling of the recourse severity.

The complete abolition of recourse (by setting $\psi = 0$) interestingly doesn't affect the high education

group much. But it benefits the low education group significantly (9.4% welfare gains). Mortgage default rates for this group go up by 5 basis points or 3%. Chapter 7 bankruptcy filing rates also rise. For this group, mortgage default under recourse often leads to a costly bankruptcy proceeding, and in particular, Chapter 13 bankruptcies (in order to keep the house). With more lenient mortgage default, this is no longer the case.[36]

Table 13: Changing the Level of Recourse

	High Education			Low Education		
	Baseline	No Recourse	High Recourse	Baseline	No Recourse	High Recourse
Bankruptcy 7 (‰)	5.93	5.827	5.983	9.731	9.881	9.924
Bankruptcy 13 (‰)	4.585	4.382	4.722	3.913	3.856	4.014
Interest (%)	10.9	10.5	11.3	26.8	25.5	27.9
Ownership rate	0.718	0.719	0.717	0.561	0.559	0.56
Default rate	1.311	1.345	1.281	1.79	1.847	1.734
Hours	2186.5	2187.1	2186.2	2051.4	2050.1	2051.4
Hours renters	2243.0	2243.0	2243.4	2130.5	2132.4	2130.4
Hours owners	2187.3	2187.4	2187.3	2026.5	2024.2	2026.7
Hours renters in Ch. 13	1624.2	1627.2	1624.3	1771.0	1779.4	1775.0
Hours owners in Ch. 13	2188.8	2193.0	2185.1	2021.6	2033.8	2021.6
Cons. equivalent (%)	-	-0.14	-0.65	-	9.4	-0.65

Notes: This experiment varies the level of lender recourse, implemented via changes in the probability of obtaining a deficiency judgment after mortgage default. While the baseline has $\psi = 0.1$, the *No Recourse* and *High Recourse* scenarios feature $\psi = 0$ and $\psi = 0.2$, respectively.

6.3 Policy Counterfactuals without Education Types

In the Appendix Table D.4, we present preference parameter estimates when we do not allow them to vary by education in the column labeled "Both." The targets are now the data moments for an average household regardless of education. We see some differences in our estimates, including the housing "warm glow", the terminal period bankruptcy penalty for both groups, and the bankruptcy filing stigma by chapter for the low education group. It is important to note that the imposition of terminal period bankruptcy penalty is important in our finite time setup to ensure that households do not exit the economy in bankruptcy.[37] As expected, our model matches data moments by education less well (by design), as illustrated in Table D.5, compared to our benchmark economy.

[36] In Appendix D.5, we analyze the implications of the 2005 BAPCPA.

[37] Bankruptcy filings by older Americans, though have increased somewhat in recent years, remained very low. See Li and White [2020] for details.

We conduct policy experiments in this new environment where we abolish each bankruptcy chapter separately and report the results in Table 14. The aggregate welfare implications remain qualitatively similar to the benchmark. That is, abolishing Chapter 7 has much larger and positive welfare impact than abolishing Chapter 13. The quantitative effects, however, change significantly with the welfare gains from abolishing Chapter 7 now much more positive and the welfare gains from abolishing Chapter 13 much less negative.

Turning to the separate impact on groups by education, not surprisingly, we observe much larger changes there. Specifically, the high education group no longer benefits from the elimination of Chapter 7, and the slight gain from the elimination of Chapter 13 turns negative. By contrast, the low education group now benefits much more from Chapter 7 elimination and is also less negatively impacted by Chapter 13 elimination. These welfare implications are consistent with the observations that without preference heterogeneity, the high education group is much more likely to file under Chapter 7 and much less likely under Chapter 13, due to the large terminal period bankruptcy penalty which cause high educated individuals to file at a younger age and more under Chapter 7. The opposite is true for the less educated group as their terminal period bankruptcy penalty is now much smaller: they are filing at older age and more under Chapter 13. In other words, compared to the benchmark, the trade off between insurance and moral hazard is now much smaller for the high education group but much larger for the low education group.

Table 14: Abolishing Bankruptcy by Chapter With Homogeneous Preferences

Cons. Equivalent Welfare Changes (%)	Abolishing Chapter 7		Abolishing Chapter 13	
	No Pref. Hetero.	Benchmark	No Pref. Hetero.	Benchmark
Total population	16.6	4.4	-0.84	-5.0
High education group	-4.62	10.2	-0.3	0.59
Low education group	28.5	-0.7	-1.14	-11.9

Notes: We remove separately each bankruptcy chapter from the choice set of consumers. In the no preference heterogeneity environment, the high and low education groups differ in their income processes. See the main paper for details.

7 Conclusions

In this paper we evaluate central aspects of bankruptcy legislation and consider how these effects differ between education groups with differing exposure to risk and preferences. We do so by specifying and estimating a life-cycle model of consumption, housing demand, and labor supply in an environment where

individuals have the option to file for bankruptcy or default on their mortgage in the presence of house price shocks, catastrophic expenditure shocks, and wage/productivity shocks.

There are a number of insights from our paper. First, the availability of Chapter 7 has starkly different implications for low education and high education groups, increasing substantially the welfare of the former and decreasing it for the latter, despite the presence of Chapter 13. The aggregate effect on welfare of abolishing Chapter 7, however, is positive. For the high education group, the moral hazard aspect of Chapter 7 is the dominant factor, while for the lower education group the insurance component is central. Second, the availability of Chapter 13 also has opposing effects for the two education groups, improving the welfare of the higher group but decreasing slightly the one for the lower (given the presence of Chapter 7), with an overall effect of the presence of this chapter being positive. However, the impacts are much smaller. Third, changing recourse which in turn determines the extent of defaulted mortgages to become unsecured debt mainly affects low education people. Indeed abolishing all recourse would have a substantial positive impact on the welfare of this group.

To summarize, our paper demonstrates that in evaluating bankruptcy legislation the distributional component across demographic groups is important to consider. Future research should also consider how family labor supply interacts with bankruptcy legislation and with filing and what role the added worker effect has in mitigating extreme shocks. We leave this important issue for future work.

References

S.R. Aiyagari. Uninsured idiosyncratic risk and aggregate saving. *Quarterly Journal of Economics*, 109(3): 659–684, 1994. ISSN 0033-5533.

Kartik Athreya, Xuan S Tam, and Eric R Young. Unsecured credit markets are not insurance markets. *Journal of monetary Economics*, 56(1):83–103, 2009.

Kartik Athreya, Xuan S Tam, and Eric R Young. A quantitative theory of information and unsecured credit. *American Economic Journal: Macroeconomics*, 4(3):153–183, 2012.

Kartik B. Athreya. Welfare implications of the Bankruptcy Reform Act of 1999. *Journal of Monetary Economics*, 49(8):1567–1595, 2002. URL http://dx.doi.org/10.1016/S0304-3932(02)00176-9.

Kartik B Athreya and Nicole B Simpson. Unsecured debt with public insurance: From bad to worse. *Journal of Monetary Economics*, 53(4):795–825, 2006.

Kartik B Athreya, Juan M. Sanchez, Xuan S. Tam, and Eric Young. Labor market upheaval, default regulations, and consumer debt. *Review of Economic Dynamics*, 18:32–52, 2015.

Orazio P. Attanasio, Renata Bottazzi, Hamish W. Low, Lars Nesheim, and Matthew Wakefield. Modelling the demand for housing over the life cycle. *Review of Economic Dynamics*, 15(1):1 – 18, 2012. ISSN 1094-2025. doi: 10.1016/j.red.2011.09.001. URL http://www.sciencedirect.com/science/article/pii/S109420251100038X.

P. Bajari, C.S. Chu, and M. Park. An empirical model of subprime mortgage default from 2000 to 2007. *NBER Working Paper*, 2008.

J.Y. Campbell and J.F. Cocco. How do house prices affect consumption? Evidence from micro data. *Journal of Monetary Economics*, 54(3):591–621, 2007. ISSN 0304-3932.

Satyajit Chatterjee and Burcu Eyigungor. A quantitative analysis of the us housing and mortgage markets and the foreclosure crisis. *Review of Economic Dynamics*, 18(2):165–184, 2015.

Satyajit Chatterjee and Burcu Eyigungor. Heterogeneity in the credit card market. *Manuscript*, 2022.

Satyajit Chatterjee and Grey Gordon. Dealing with consumer default: Bankruptcy vs garnishment. *Journal of Monetary Economics*, 59:S1–S16, 2012.

Satyajit Chatterjee, Dean Corbae, Makoto Nakajima, and José-Víctor Ríos-Rull. A quantitative theory of unsecured consumer credit with risk of default. *Econometrica*, 75(6):1525 – 1589, 2007a. URL http://www.jstor.org/stable/4502043.

Satyajit Chatterjee, Dean Corbae, Makoto Nakajima, and José-Víctor Ríos-Rull. A quantitative theory of unsecured consumer credit with risk of default. *Econometrica*, 75(6):1525–1589, 2007b.

Satyajit Chatterjee, Dean Corbae, Kyle Dempsey, and José-Víctor Ríos-Rull. A quantitative theory of the credit score. *Econometrica*, 91(5):1803–1840, 2023.

Daphne Chen and Jake Zhao. The impact of personal bankruptcy on labor supply decisions. *Review of Economic Dynamics*, 26(Supplement C):40 – 61, 2017. ISSN 1094-2025. doi: https://doi.org/10.1016/j.red.2017.02.004. URL http://www.sciencedirect.com/science/article/pii/S1094202517300236.

V. Chernozhukov and H. Hong. An MCMC approach to classical estimation. *Journal of Econometrics*, 115 (2):293–346, 2003. ISSN 0304-4076.

Joao F Cocco. Portfolio choice in the presence of housing. *The Review of Financial Studies*, 18(2):535–567, 2005.

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

Mariacristina De Nardi, Giulio Fella, and Gonzalo Paz-Pardo. Nonlinear household earnings dynamics, self-insurance, and welfare. *Journal of the European Economic Association*, 18(2):890–926, 2020.

Kyle Dempsey and Anamaria Felicia Ionescu. Lending standards and borrowing premia in unsecured credit markets. *FEDS WorkingPaper*, 2021.

Will Dobbie and Jae Song. Debt relief and debtor outcomes: Measuring the effects of consumer bankruptcy protection. *American Economic Review*, 105(3):1272–1311, March 2015a. doi: 10.1257/aer.20130612. URL http://www.aeaweb.org/articles?id=10.1257/aer.20130612.

Will Dobbie and Jae Song. The impact of loan modifications on repayment, bankruptcy, and labor supply: Evidence from a randomized experiment. *Working Paper*, 2015b.

Scott Fay, Erik Hurst, and Michelle J White. The household bankruptcy decision. *American Economic Review*, 92(3):706–718, 2002.

Eric French. The effects of health, wealth, and wages on labour supply and retirement behaviour. *The Review of Economic Studies*, 72(2):395–427, 2005. ISSN 00346527. URL http://www.jstor.org/stable/3700657.

Carlos Garriga and Don E Schlagenhauf. Home equity, foreclosures, and bailouts. *Manuscript, Federal Reserve Bank of St. Louis*, 2009.

Carlos Garriga, Rodolfo Manuelli, and Adrian Peralta-Alva. A macroeconomic model of price swings in the housing market. *American Economic Review*, 109(6):2036–2072, 2019.

Andra Ghent and Marianna Kudlyak. Recourse and residential mortgage default: Theory and evidence from US states. *Review of Financial Studies*, 24:3139–3186, 2011. URL http://www.richmondfed.org/publications/economic_research/working_papers/index.cfm.

Victoria Gregory, Guido Menzio, and David G Wiczer. The alpha beta gamma of the labor market. *Journal of Monetary Economics*, forthcoming.

Reint Gropp, John Karl Scholz, and Michelle J. White. Personal bankruptcy and credit supply and demand. *Quarterly Journal of Economics*, 112(1):217–251, 1997. doi: 10.1162/003355397555172. URL http://qje.oxfordjournals.org/content/112/1/217.abstract.

David B Gross and Nicholas S Souleles. Do liquidity constraints and interest rates matter for consumer behavior? evidence from credit card data. *The Quarterly journal of economics*, 117(1):149–185, 2002.

L. Guiso, P. Sapienza, and L. Zingales. Moral and social constraints to strategic default on mortgages. *National Bureau of Economic Research Cambridge, Mass., USA*, 2009.

Song Han and Wenli Li. Fresh start or head start? the effects of filing for personal bankruptcy on work effort. *Journal of Financial Services Research*, 31(2):123–152, 2007.

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

Greg Kaplan, Kurt Mitman, and Giovanni L Violante. The housing boom and bust: Model meets evidence. *Journal of Political Economy*, 128(9):3285–3345, 2020.

Wenli Li. Residential housing and personal bankruptcy. *Business Review Q*, 2:19–29, 2009.

Wenli Li and Florian Oswald. Recourse and residential mortgages: The case of nevada. *Journal of Urban Economics*, pages 1–13, 2017.

Wenli Li and Pierre Sarte. U.s. consumer bankruptcy choice: The importance of general equilibrium effects. *Journal of Monetary Economics*, pages 613–631, 2006.

Wenli Li and Michelle J White. *Financial distress among the elderly: Bankruptcy reform and the financial crisis*. SSRN, 2020.

Wenli Li and Rui Yao. The life-cycle effects of house price changes. *Journal of Money, Credit and banking*, 39(6):1375–1409, 2007.

Wenli Li, Haiyong Liu, Fang Yang, and Rui Yao. Housing over time and over the life cycle: a structural estimation. *International Economic Review*, 57(4):1237–1260, 2016.

I. Livshits, J. MacGee, and M. Tertilt. Consumer bankruptcy: A fresh start. *American Economic Review*, pages 402–418, 2007.

H. Low, C. Meghir, and L. Pistaferri. Wage risk and employment risk over the life cycle. *American Economic Review*, 100:1432–1467, September 2010.

Sarah McDairmid and Jim Holding. Food Statistics Pocketbook 2008. *Department of Environment, Food and Rural Affairs*, 2008. URL http://statistics.defra.gov.uk/esg/publications/pocketstats/foodpocketstats/.

D. McFadden. A method of simulated moments for estimation of discrete response models without numerical integration. *Econometrica: Journal of the Econometric Society*, pages 995–1026, 1989.

C. Meghir and L. Pistaferri. Income variance dynamics and heterogeneity. *Econometrica*, pages 1–32, 2004.

Costas Meghir and Luigi Pistaferri. Chapter 9 - earnings, consumption and life cycle choices. In Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics*, volume 4, Part B, pages 773 – 854. Elsevier, 2011.

K. Mitman. Macroeconomic effects of bankruptcy & foreclosure policies. *American Economic Review*, 106 (8):2219–2255, 2016.

Makoto Nakajima. Assessing bankruptcy reform in a model with temptation and equilibrium default. *Journal of Public Economics*, 145:42–64, 2017.

Florian Oswald. *Essays on bankruptcy, mortgage default, and regional migration*. PhD thesis, UCL (University College London) https://discovery.ucl.ac.uk/id/eprint/1470219/1/thesis.pdf, 2015.

Ariel Pakes and David Pollard. Simulation and the asymptotics of optimization estimators. *Econometrica*, pages 1027–1057, 1989.

Marina Pavan. Consumer durables and risky borrowing: the effects of bankruptcy protection. *PhD Thesis*, 2005. URL http://fmwww.bc.edu/EC-P/WP573.pdf.

Denis Pelletier and Cengiz Tunc. Endogenous life-cycle housing investment and portfolio allocation. *Journal of Money, Credit and Banking*, 51(4):991–1019, 2019.

T.A. Sullivan, E. Warren, and J.L. Westbrook. *As we forgive our debtors: Bankruptcy and consumer credit in America*. Beard Books Inc, 1999.

T.A. Sullivan, E. Warren, and J.L. Westbrook. *The fragile middle class: Americans in debt*. Yale University Press, 2000.

US Government Accountability Office. Bankruptcy reform: Dollar costs associated with the bankruptcy abuse prevention and consumer protection act of 2005. Technical report, US Government Accountability Office, 2008.

Rui Yao and Harold H Zhang. Optimal consumption and portfolio choices with risky housing and borrowing constraints. *The Review of Financial Studies*, 18(1):197–239, 2005.

Appendices

A The Complete Description of the Value Functions

A.1 The Choice of Renters

In what follows we describe the problem including the means test to cover the BACPCA period. Let W represent the maximal expected lifetime utility for a renter of age t if not in a bankruptcy state and let $\tilde{W}_j$ denote the utility for a renter in bankruptcy state $j = 7, 13$. Let s denote the end of period savings (i.e. $s = a'$) and $\text{med}(y)$ the state median income. We then have:

$$W(a, w, t) = \begin{cases} \max\left(W^{\text{rent}}, W^{\text{buy}}, W^{\text{file.7}}, W^{\text{file.13}}\right) & \text{if } a < 0, \\ \max\left(W^{\text{rent}}, W^{\text{buy}}\right) & \text{if } a \geq 0. \end{cases} \tag{A.1}$$

The restriction on the discrete choice set of the renter in (A.1) makes explicit the fact that one can file for bankruptcy only if there are effectively unsecured debts to discharge. the BAPCPA means test by preventing individuals with labor income above a threshold $\text{med}(y)$ to file for Chapter 7. We define the conditional value functions next.

Value of Renting

The value of renting is given by

$$W^{\text{rent}}(R) = \max_{a' \in \mathbb{R}, l \in L} \left\{ u(c, l, \underline{h}) + \beta E_{w'|w} \left[W(R') \right] \right\} \tag{A.2}$$

subject to

$$c + q(a'|w)a' = yl + a > 0, \tag{A.3}$$

$$\pi^7(a'|w) = E_{w'|w} \left\{ \mathbf{1} \left[W^{\text{file.7}}(R') > W^{-\text{file.7}}(R') \right] \right\}, \tag{A.4}$$

$$\pi^{13}(a'|w) = E_{w'|w} \left\{ \mathbf{1} \left[W^{\text{file.13}}(R') > W^{-\text{file.13}}(R') \right] \right\}, \tag{A.5}$$

$$q_a(a'|w) \text{ as in (7)}, \tag{A.6}$$

where R is the current state space and R' the state space as it evolves. Equation (A.3) is a standard budget constraint that requires expenditures (consumption c and saving/borrowing a') to be equal to cash-on-hand (labor income plus assets minus rent, which is normalized to zero). Equations (A.4) and (A.5) show how the probability of bankruptcy for each case (π^7 and π^{13} for Chapter 7 and 13 respectively) is calculated by the lender in order to define the price of debt q in equation (A.3). We use the convention that labeling a value function with $-j$ means all other discrete choice values *except* j.

Renter Bankruptcy Chapter 7

The value of filing for bankruptcy under Chapter 7 as a renter is similar to the value of staying a renter with the exception that current assets are set to $a = 0$ in the budget constraint since all assets are used against the debt. Moreover, the various penalties are applied (psychic cost of bankruptcy $\lambda_{7,e} \in (0, 1]$ and no borrowing; $\lambda_{7,e} = 1$ implies no punishment at all, $\lambda_{7,e} = 0$ would imply zero consumption as punishment.

The future value in the bankruptcy state 7 is denoted by $\tilde{W}_7$. Upon filing for Chapter j, a fee of f_j is collected, and no savings are possible.

$$\begin{aligned} W^{\text{file.7}}(R) &= \max_{l \in L} \left\{ u(c\lambda_{7,e}, l, \underline{h}) + \beta E_{w'|w} \left[\tilde{W}_7(R') \right] \right\} \\ &\text{subject to} \\ c &= yl - f_7. \end{aligned} \tag{A.7}$$

The individual suffers the utility (stigma) cost $\lambda_{7,e}$ and cannot borrow until she exits this state. This happens with probability δ in each period. Thus the expected duration of the punishment state is $\frac{1}{\delta}$. The value $\tilde{W}_7$ in the bankruptcy state is

$$\begin{aligned} \tilde{W}_7(a, w, t) &= \max_{a' \in \mathbb{R}_+, l \in L} \left\{ u(c\lambda_{7,e}, l, \underline{h}) + \beta E_{w'|w} \left[\delta W(R') + (1-\delta) \tilde{W}_7(R') \right] \right\} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl + a. \end{aligned}$$

Renter Bankruptcy Chapter 13

Individuals may not be eligible for Chapter 7, or indeed may choose Chapter 13. This problem is very similar to the previous one except that a repayment $\bar{y}$ needs to be made. Hence moving into the bankruptcy state we have

$$\begin{aligned} W^{\text{file.13}}(a, w, t) &= \max_{l \in L} \left\{ u(c\lambda_{13,e}, l, \underline{h}) + \beta E_{w'|w} \left[\tilde{W}_{13}(\bar{y}(a, w), 0, w, t+1) \right] \right\} \\ &\text{subject to} \\ c &= yl - f_{13} > 0, \end{aligned} \tag{A.8}$$

where $\bar{y}(a, w)$ is defined in (A.9).

We denote by $\bar{y}$ the amount to be repaid in each period of Chapter 13, and by $\bar{Y}$ total expected income over the next T_{bk} years. Federal law imposes a maximum debt to income ratio $\hat{y} = 0.15$ that the repayment $\bar{y}$ must respect, hence we define

$$\begin{aligned} \bar{y} &= \iota(a, \bar{Y}, \hat{y}) \frac{\bar{Y}}{T_{bk}}, \\ \iota(a, \bar{Y}, \hat{y}) &= \begin{cases} \frac{-a}{\bar{Y}} & \text{if } \frac{-a}{\bar{Y}} < \hat{y}, \\ \hat{y} & \text{else.} \end{cases} \end{aligned} \tag{A.9}$$

Then the corresponding punishment state following filing for Chapter 13 is given by

$$\begin{aligned} \tilde{W}_{13}(\bar{y}, a, w, t) &= \max_{a' \in \mathbb{R}_+, l \in L} \left\{ u(c\lambda_{13,e}, l, \underline{h}) + \beta E_{w'|w} \left[\delta W(R') + (1-\delta) \tilde{W}_{13}(R') \right] \right\} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl - \bar{y} + a > 0. \end{aligned}$$

A.2 The Problem of the Owner

The discrete choice problem of an owner not in a bankruptcy state is quite complex because of the large number of subcases, depending on the asset position, the house value and the level of income. It is given by

$$V(S) = \begin{cases} \max\left(V^{\text{stay}}, V^{\text{sell}}\right) & \text{if } a \geq 0, hp_t - m_t \geq 0, \\ \max\left(V^{\text{stay}}, V^{\text{sell}}, V^{\text{def}}\right) & \text{if } a \geq 0, hp_t - m_t < 0, \\ \max\left(V^{\text{stay}}, V^{\text{sell}}, V^{\text{file.7}}, V^{\text{file.13}}\right) & \text{if } a < 0, hp_t - m_t \geq 0, \\ \max\left(V^{\text{stay}}, V^{\text{sell}}, V^{\text{def}}, V^{\text{file.7}}, V^{\text{file.13}}, V^{\text{file.def}}\right) & \text{if } a < 0, hp_t - m_t < 0, \end{cases} \tag{A.10}$$

where $a \geq 0$ denotes someone with positive financial assets, and $hp_t - m_t$ is the net equity in the house. Again, not all discrete choices are available everywhere on the state space, as can be seen from the restrictions for each case. For example, the admissible chapter of bankruptcy depends on labor income lying below the threshold $\text{med}(y)$, as before. The default choice is an option only if home equity is negative. In other words, we assume that a person who has difficulty repaying a mortgage (say because of a negative income shock) but has positive equity in the house will always choose to sell. Owners with home equity in excess of the exemption level face eviction should they file for bankruptcy under Chapter 7. The level of homestead exemption determines whether an owner filing under Chapter 7 stays in the house or is evicted. We define the sub-problems in sequence below. Let $S = (a, w, p, n, h, e, t)$ denote the current state space.

Value of Staying as Owner

The value of staying in the current home is

$$\begin{aligned} V^{\text{stay}}(S) &= \max_{a' \in \mathbb{R}, l \in L} \left\{ u(c, l, h) + \beta \mathbb{E}_{w'|w, p'|p, \underline{a}} \left[V\left(S'\right) \right] \right\} \qquad \text{(A.11)} \\ &\text{subject to} \\ c + \frac{q(a'|S)}{1+r} &= yl + a - \kappa(p_{i0}h, r_m, T_m). \end{aligned}$$

This problem is similar to the buyer's problem defined in the main text of the paper except that there is no down-payment in the budget constraint.

Value of Selling the Home

The value of selling depends on the renter's continuation value:

$$\begin{aligned} V^{\text{sell}}(S) &= \max_{s \in \mathbb{R}, l \in L} \left\{ u(c, l, \underline{h}) + \beta \mathbb{E}_{w'|w, p'|p, \underline{a}} \left[W(R') \right] \right\} \qquad \text{(A.12)} \\ &\text{subject to} \\ c + \frac{q(a'|S)}{1+r} &= yl + a + ((1-\phi)ph - m), \end{aligned}$$

where $(1-\phi)ph - m$ is the capital that can be recovered following the sale: ϕ is the proportion of capital lost by the process of selling due to administrative and marketing costs.

Value of Default

The default value, in turn, is similar to the value of selling with the exception that for a defaulter, unsecured borrowing is impossible, and a one-time utility penalty is incurred. Regarding recourse legislation, we include a factor $\psi \in [0,1]$ here that relates to the fraction of negative equity ($(1-\phi)(ph-m)$) that is rolled over in post default life. For example $\psi = 1$ would mean that the entire remaining mortgage debt is rolled over into post default life. Notice that the future value is that of a renter, but the asset state takes into account any remaining mortgage debt d brought forward.

$$\begin{aligned} V^{\text{def}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{def}, l, \underline{h}\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \left[W(d + a' - \underline{a}, w', p', t+1) \right] \right\} \quad \text{(A.13)} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl + a, \\ d &= \psi[(1-\phi)ph - m]. \end{aligned}$$

Owner Bankruptcy Chapter 7

The value of an owner who files for Chapter 7 while staying in the home is given by

$$\begin{aligned} V^{\text{file.7}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{7,e}, l, h\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \left[\tilde{V}_7\left(S'\right) \right] \right\} \quad \text{(A.14)} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl - \kappa(p_{i0}h, r_m, T_m) - f_7. \end{aligned}$$

This value is defined only if current assets are negative, $a < 0$. Crucially, the household may stay in the house only if net home equity lies below the homestead exemption level, i.e. iff $(1-\phi)(ph-m) < \xi$.

Value of Filing and Default The value for the owner when filing for bankruptcy and defaulting on the mortgage at the same time is as follows:

$$\begin{aligned} V^{\text{file,def}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{7,e}, l, \underline{h}\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \left[\tilde{W}_7(R') \right] \right\} \quad \text{(A.15)} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl - f_7, \end{aligned}$$

assuming that any remaining mortgage debt is discharged in Chapter 7 bankruptcy.

Owner Bankruptcy Chapter 13

The main difference between Chapter 13 and Chapter 7 bankruptcy is that the owner may keep the house (and all other assets) no matter how much equity there is after signing up to a Chapter 13 repayment plan. Consequently we don't have to compute a value of eviction and we also rule out the possibility of filing

for Chapter 13 and defaulting on the mortgage at the same time.[38]

$$\begin{aligned} V^{\text{file.13}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{13,e}, l, h\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \tilde{V}_{13}\left(\bar{y}(a,w), 0, w', p', n', h, e, t+1\right) \right\} \quad \text{(A.16)} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl - \kappa(p_{i0}h, r_m, T_m) - f_{13} > 0. \end{aligned}$$

Owner Bankruptcy Punishment States

An owner in punishment state for either chapter has the discrete choice set "stay," "sell" and "default." His savings s cannot be negative (he cannot borrow). As in the case of the renter, exit from the state is governed by the Bernoulli random variable $X \sim \text{Bernoulli}(\delta)$. Thus the value for this owner is

$$\tilde{V}_j(S) = \max\left(\tilde{V}_j^{\text{stay}}, \tilde{V}_j^{\text{sell}}, \tilde{V}_j^{\text{def}}\right), j = 7, 13,$$

where the value for *stay* is given by

$$\begin{aligned} \tilde{V}_j^{\text{stay}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{j,e}, l, h\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \left[(1-\delta)\tilde{V}_j\left(S'\right) + \delta V(S') \right] \right\} \quad \text{(A.17)} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= a + yl - \mathbf{1}\left[j = 13\right] \bar{y} - \kappa(p_{i0}h, r_m, T_m), \\ j &= 7, 13. \end{aligned}$$

The value for *sell* is given by

$$\begin{aligned} \tilde{V}_j^{\text{sell}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{j,e}, l, \underline{h}\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \left[(1-\delta)\tilde{W}_j(R') + \delta W(R') \right] \right\} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl - \mathbf{1}\left[j = 13\right] \bar{y} - \kappa(p_{i0}h, r_m, T_m) + a + (1-\phi)ph - m, \\ j &= 7, 13. \end{aligned}$$

Finally, the value for *default* in the punishment state is given by

$$\begin{aligned} \tilde{V}_j^{\text{def}}(S) &= \max_{a'>0, l\in L} \left\{ u\left(c\lambda_{j,e}, l, \underline{h}\right) + \beta \mathbb{E}_{w'|w,p'|p,\underline{a}} \left[(1-\delta)\tilde{W}_j(R') + \delta W(R') \right] \right\} \quad \text{(A.18)} \\ &\text{subject to} \\ c + \frac{1}{1+r} a' &= yl - \mathbf{1}\left[j = 13\right] \bar{y} - \kappa(p_{i0}h, r_m, T_m) + a. \end{aligned}$$

The amount of assets that the person carries over into the next period depends both on the extent of recourse in the specific state and on the amount of mortgage debt. In either case, a cannot be negative since the person has already filed for bankruptcy and cannot borrow. However, it can be positive if the person started saving after filing. In a recourse state the existing financial assets will be used to pay off the mortgage (under Chapter 7). We assume that any remaining mortgage debt is then forgiven, and $a = 0$ at the time of default.

[38] Filing for Chapter 13 and defaulting at the same time is a particularly unrealistic choice, since the consumer assumes the increased burden of Chapter 13 (wage tax) without getting to enjoy the benefits (staying in the house).

B Derivation of the expression for welfare impacts of reforms

The welfare in the baseline conditional on initial conditions Ω is $E_0 U_0(\Omega)$. Under the policy counterfactual the welfare is

$$E_0 U_0(\hat{\mathbf{c}}, \hat{\mathbf{l}}, \hat{\mathbf{h}}) = E_0 \sum_{t=0}^{T-1} \beta^t \left(\frac{\left(\hat{c}_{it}(\Omega)^{\omega} \left(L - \hat{l}_{it}(\Omega) - \hat{\mathbf{P}}_{\mathbf{it}}(\Omega)\theta_P \right)^{1-\omega} \right)^{1-\gamma}}{1-\gamma} \exp\left(\theta_{\hat{H}_{it}} \hat{h}_{it}(\Omega) \right) \right) + E_0 \left(\sum_{t=0}^{T-1} \beta^t \mu \hat{\mathbf{H}}_{\mathbf{it}}(\Omega) \hat{h}_{it}(\Omega) + \beta^T \hat{V}_{iT}(\Omega) \right),$$

where we use the notation $\hat{\mathbf{c}}, \hat{\mathbf{l}}$, and $\hat{\mathbf{h}}$ to denote the entire vector of consumption, labor supply and housing over the active lifecycle until the period $T-1$ in the counterfactual world.

To obtain the welfare measure, and keep to the same notation as in the main paper, we find $1 - \iota(\Omega)$ such that

$$E_0 U_0(\Omega) = E_0 U_0 \left((1 - \iota(\Omega)) \hat{\mathbf{c}}, \hat{\mathbf{l}}, \hat{\mathbf{h}} \right). \tag{B.1}$$

Solving for this equation gives the result in equation (20) in the paper. The important point to note is that the terminal value function needs to be taken to the left hand side (together with the additive housing term) before we factorize our $1 - \iota(\Omega)$ and divide by

$$E_0 \Sigma_t \beta^t \left(\frac{\left(\hat{c}_{it}(\Omega)^{\omega} \left(L - \hat{l}_{it}(\Omega) - \hat{\mathbf{P}}_{\mathbf{it}}(\Omega)\theta_P \right)^{1-\omega} \right)^{1-\gamma}}{1-\gamma} \exp\left(\theta_{\hat{H}_{it}} \hat{h}_{it}(\Omega) \right) \right) \tag{B.2}$$

to get the expression in equation (20) in the main paper. In that expression, if $\iota(\Omega) < 0$, then consumption in the counterfactual world has to be increased to match the welfare at baseline, and it represents a decline in welfare. A positive ι similarly implies an increase in welfare in the counterfactual world (the counterfactual is preferred).

C Wage Process

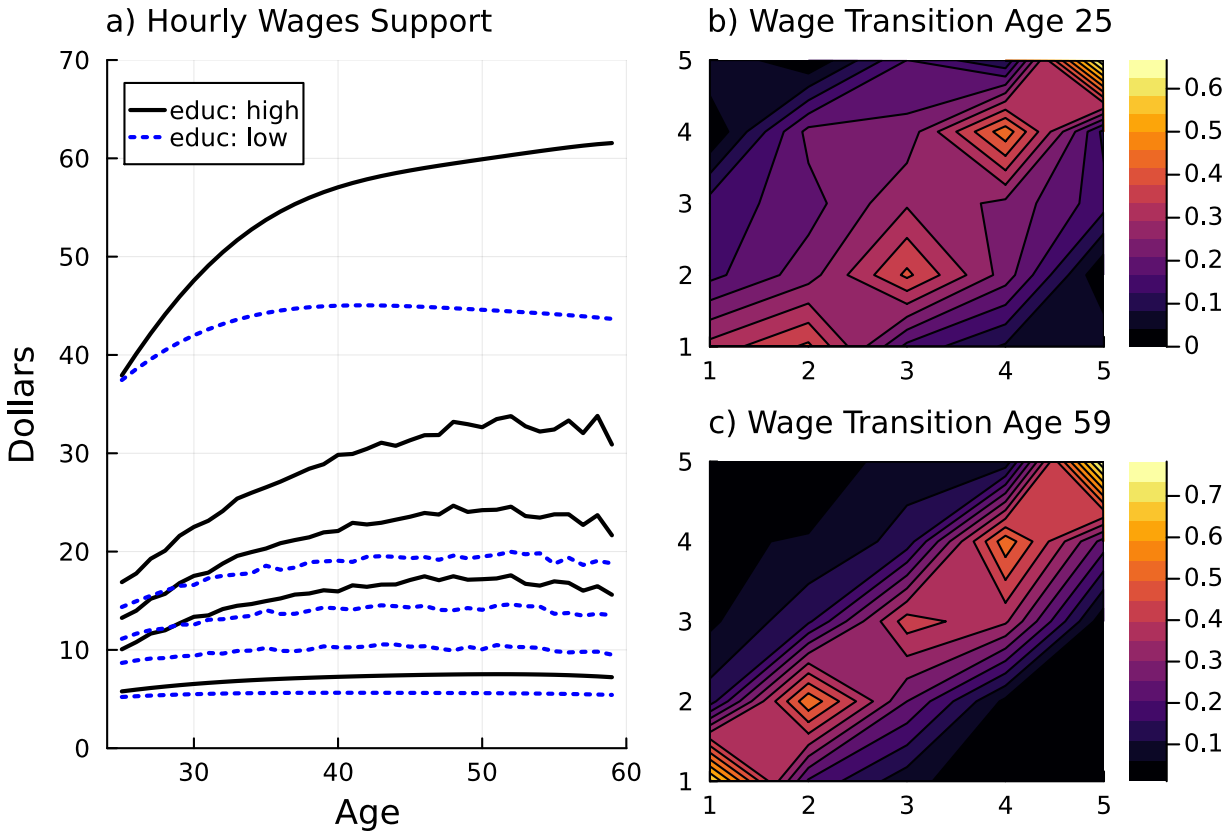
We employ the same procedure as in De Nardi et al. [2020] to estimate wage support points by age and age-specific transition matrices $\Pi_w(t)$. The method in De Nardi et al. [2020] allows for a generalization of the traditional income process used in macroeconomics. For further details and thorough comparison to the traditional approach, please refer to De Nardi et al. [2020]. We replicate their results using the outline in section 4 of their paper, but splitting the data into two education groups. We use PSID data from 1969–1997, because thereafter we have biennial observations only on wage. We subset the data to household heads between age 25 and 60, whom we observe in at least two consecutive periods, and we drop observations with annual earnings below \$900. We use 2003 as the base year for consumer price index (CPI) adjustment.[39]

[39] We use the headline CPI obtained from the Bureau of Labor Statistics.

Finally, we keep only observations with a valid education entry, and real hourly wage in $[4, 999]$. We classify all observations with less than 13 years of education as "low" education, and the remainder as "high."

We regress log real earnings on a year dummy and a fourth order polynomial in age (term $f^e(t)$ in equation 4), by education group. From the residual of the regressions, we recover the support of the wage shock w_{it} at each age t for 5 bins, and for each education group, as well as their respective transition across time. The binning classifies the residuals at each age into 5 regions delimited by the quantiles of the corresponding residual distribution. We illustrate the outcome in Figure C.1.

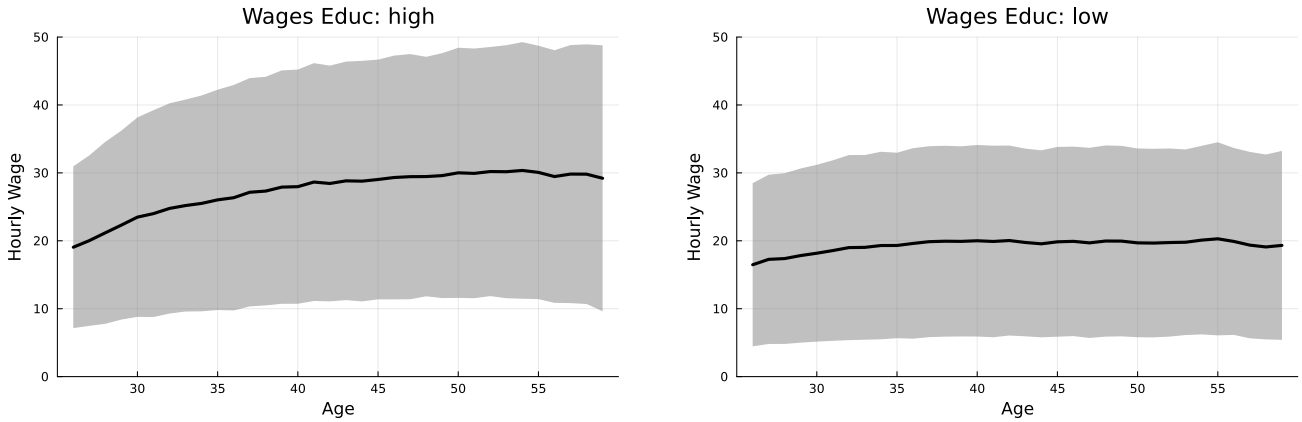
Figure C.1: Wage Support and Age-Specific Transition Matrices for Wage Shock w



Note: We sort the empirical distribution of wage residuals into 5 quintiles, and take the midpoints to be the points of support for the corresponding bin. The transition matrix at each age (right panel of plot) is estimated by counting the proportion of bin i in period t which ends up in bin j in period $t+1$. The right panels illustrate the probability associated with each transition from state i to state j for the high education group.

We illustrate the evolution of the cross sectional average and standard deviation of simulated wages by age and by education group in Figure C.2.

Figure C.2: Mean and Standard Deviation of Hourly Wages by Age and by Education Group from the Simulated Model



(a) High Education Group

(b) Low Education Group

Note: Each simulation comprises 15000 individuals. The solid line represents the average wage, given age, while the shaded area represents its standard deviation.

D Additional Supplemental Materials

D.1 Additional Tables and Figures for the Baseline Economy

We present in Table D.1 state legislatures governing deficiency judgment, homestead exemptions and group them accordingly. In Table D.2, we present additional numerical parameters for calibration.

Table D.1: Grouping of U.S. States by Legal Environment Concerning Bankruptcy and Mortgage Default

State	Deficiency	Homestead Exemp. ($)	Median Inc. ($)	ξ Exemp./Med. Inc.	group
NC	No	18500	45607.13	0.41	1
WA	No	40000	59951.18	0.67	1
AK	No	54000	63456.71	0.85	2
CA	No	50000	58509.89	0.85	2
MT	No	100000	43752.43	2.29	2
ND	No	80000	51275.34	1.56	2
AZ	No	150000	49907.10	3.01	3
MN	No	200000	59445.86	3.36	3
AL	Yes	5000	43445.55	0.12	4
GA	Yes	10000	49418.75	0.20	4
IL	Yes	7500	54433.88	0.14	4
IN	Yes	7500	48301.03	0.16	4
KY	Yes	5000	42728.06	0.12	4
MD	Yes	0	68697.79	0.00	4
OH	Yes	5000	49214.44	0.10	4
TN	Yes	5000	43074.65	0.12	4
VA	Yes	5000	62967.78	0.08	4
WY	Yes	10000	53708.11	0.19	4
AR	Yes	17425	41227.34	0.42	5
CO	Yes	45000	61377.39	0.73	5
DE	Yes	50000	56565.67	0.88	5
HI	Yes	17425	64089.82	0.27	5
LA	Yes	25000	42654.21	0.59	5
ME	Yes	35000	50249.51	0.70	5
MI	Yes	17425	51084.04	0.34	5
MO	Yes	15000	48774.10	0.31	5
NE	Yes	12500	53861.02	0.23	5
NJ	Yes	17425	68284.69	0.26	5
NM	Yes	30000	45115.96	0.66	5
OR	Yes	25000	52448.20	0.48	5
PA	Yes	17425	51987.45	0.34	5
SC	Yes	17425	44104.29	0.40	5
SD	Yes	30000	49528.12	0.61	5
UT	Yes	20000	60398.63	0.33	5
WI	Yes	40000	53704.30	0.74	5
WV	Yes	25000	42656.15	0.59	5
CT	Yes	75000	67675.40	1.11	6
ID	Yes	104471	50053.53	2.09	6
MA	Yes	100000	63015.52	1.59	6
MS	Yes	75000	38908.97	1.93	6
NH	Yes	100000	68438.14	1.46	6
NV	Yes	550000	54782.10	10.04	6
NY	Yes	50000	52655.17	0.95	6
RI	Yes	200000	55399.59	3.61	6
VT	Yes	75000	55026.47	1.36	6
FL	Yes	∞	47917.01		7
IA	No	∞	52378.80		7
KS	Yes	∞	48913.09		7
OK	Yes	∞	46108.99		7
TX	Yes	∞	48876.19		7

Note: Columns 2 and 3 are taken from table 7 (Mitman [2016] online appendix). Homestead exemptions are for individuals. The amount is doubled for married couples. Median income is in 2011 dollars. We first split States into two groups by whether they allow deficiencies, and then into three equal-sized groups by ξ. States with unlimited homestead exemption are in group 7.

Table D.2: Numerical Parameters

Number of grid points chapter 13 repayment	4
Number of grid points assets	31
Number of grid points wage	5
Number of grid points p	5
Number of grid points mortgage	15
Number of grid points house size	2
Number of periods	35
Levels of Labor supply	5
Scale factor on asset grid	1.3
Number of discrete choices renter (excluding buying)	3
Number of discrete choices owner in BK state	1
Number of discrete choices owner	6
Number of discrete choices owner in BK state	3
Initial unit price of house	1
Size of smallest house	0.0
Size of a small house	300
Size of a large house	600
Number of simulated individuals	15000
Mean of LogNormal initial asset distribution	-2.1
Standard Deviation of LogNormal initial asset distribution	0.9

Note: The parameterization of initial assets implies a median of 0.12 assets in period 1 (relative to median income), with a long right tail. House sizes are calibrated from PSID data for 2004 on the national house value distribution, in 100s of dollars, as the midpoints of intervals defined by the quantiles $[0.05, 0.5, 0.95]$, i.e. after winsorizing outliers and splitting values at the median. Given that we assume that the price of each house upon purchase is $p_0 = 1$, initial value is equal to the size of the house.

D.2 Correlated House Price and Wage Shocks

We address the concern that shocks to house prices and to household permanent labor income may be correlated particularly at the aggregate level. It is important to first point out that the evidence on the magnitude of the correlation is mixed. Cocco [2005] uses PSID data at the household level where house value is self assessed and estimates the correlation between the permanent shock to housing returns and the permanent shock to labor income to be 0.55. Using state real per capita disposable personal income and real house price growth rates between 1975 and 2005, Li et al. [2016], on the other hand, estimates the correlation between the permanent shock to housing returns and the permanent shock to labor income to be at most 0.30. Separately, using a macro model that accommodates multiple aggregate shocks including shocks to household income via aggregate productivity, shocks to credit conditions, and beliefs about future housing demand and a calibration approach, Kaplan et al. [2020] finds that the main driver of movements in house prices and rents in recent history was a shift in beliefs about future housing demand, not shifts in credit conditions nor changes in income. Garriga et al. [2019] also argues that shocks to expectations about housing finance conditions which effectively means higher future housing demand are needed to generate sizable movements in house prices that we witnessed leading to the Great Recession. The implied correlation between shocks to income and shocks to house prices in the context of our model is then very weak.

It is therefore not surprising that much of the literature which we follow has assumed either a very

low correlation (eg., 0.2 in Yao and Zhang [2005], and 0.075 in Pelletier and Tunc [2019]) or independent stochastic processes for housing and labor income (eg., Mitman [2016], and Li and Yao [2007]).[40] Another complication with our set up is that we abstract from aggregate shocks and instead focus on idiosyncratic shocks, i.e., bad luck, on house price, wage, and expenditure. It is far less clear whether such idiosyncratic shocks are correlated. We nevertheless present below simulation results from the model when the correlation is 0.5, 0.1, or zero – which we maintain as our baseline. However, these correlations come as shocks to agents instead of being expected.

Table D.3: Comparing the Baseline Model with Correlation Between House Price and Wage Shocks

	High Education			Low Education		
	$\rho = 0$	$\rho = 0.1$	$\rho = 0.5$	$\rho = 0$	$\rho = 0.1$	$\rho = 0.5$
Bankruptcy 7 (‰)	6.055	5.934	5.835	9.646	9.215	8.875
Bankruptcy 13 (‰)	4.693	4.546	4.298	3.946	3.897	3.767
Interest (%)	10.8	10.6	10.1	26.7	26.6	25.7
Ownership rate	0.714	0.719	0.722	0.556	0.565	0.571
Default rate	1.344	1.267	1.046	1.833	1.677	1.386
Hours	2186.1	2186.1	2184.5	2052.6	2051.2	2046.6
Assets	2.422	2.512	2.622	1.678	1.735	1.824
Hours renters	2242.4	2242.3	2241.3	2133.4	2132.3	2130.1
Hours owners	2187.8	2187.1	2184.8	2027.0	2025.9	2021.0
Hours renters (in Ch. 13)	1621.6	1629.6	1630.9	1778.2	1798.8	1788.5
Hours owners (in Ch. 13)	2160.3	2190.8	2226.9	1957.7	2097.8	2047.8

Note: We set ρ according to the empirical estimates with $\rho = 0.1$ being the empirically most relevant case.

We illustrate the results in Table D.3, where we draw the idiosyncratic shocks with either a positive correlation of 0.1 or 0.5 and compare them to the benchmark economy. As the shocks become more positively correlated in realization, in our calibrated economy households are more likely to become homeowners due to the persistent high income effects which allow them to afford the down payment requirement despite rises in house prices. They work slightly fewer hours but accumulate more assets. As a result, households are less likely to file for bankruptcy under either chapter particularly Chapter 13 or default on their mortgages. The quantitative impact, however, is not large particularly in the more realistic case where $\rho = 0.1$.[41]

D.3 Labor Supply, Assets and Consumption Before and After Bankruptcy Filing

Labor supply serves as a mechanism for individuals to mitigate adverse income shocks and potentially stave off bankruptcy as they can work longer to compensate for the lower wage. Adverse wage shocks, however, also discourage work effort. The implicit earnings tax induced by the repayment scheme under Chapter 13 adds to these disincentives. Next, we examine labor supply and wage rates before and after a bankruptcy filing. In interpreting the results, it is important to keep in mind that the vast majority of bankruptcies in the model are caused by a large negative wage shock, only occasionally accompanied by

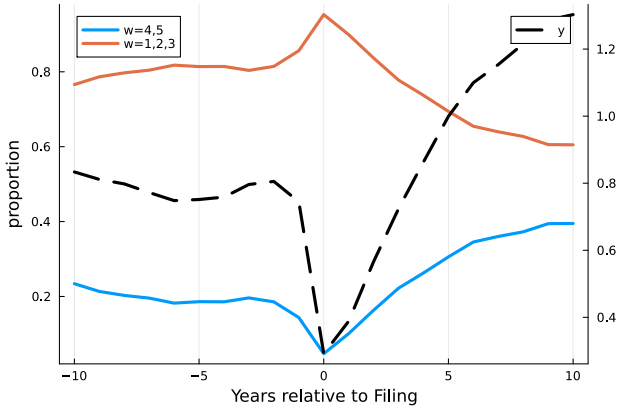
[40] Campbell and Cocco [2007] is an outlier as they assume perfect correlation between the shocks to house prices and permanent shocks to labor income.

[41] In a perfect foresight setting, households particularly homeowners may choose to save less, which may lead to even smaller effect on bankruptcy filings or mortgage defaults.

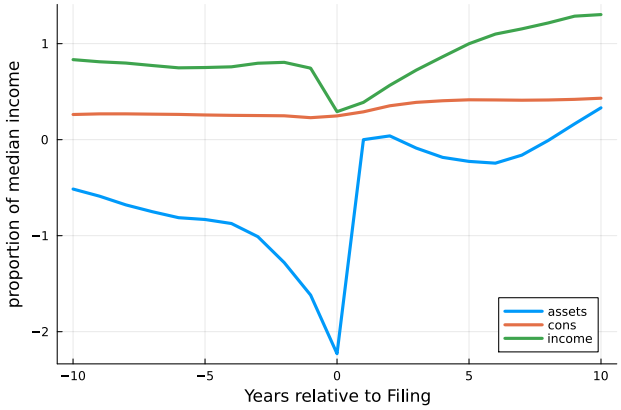
spending shocks: 93% for the higher education people and 95% for the low. What the catastrophic spending shock does is forcing unsecured borrowing, making them vulnerable to negative wage/employment shocks.

Figure D.1a reports the fraction of individuals receiving adverse wage shocks ($w = 1, 2, 3$) versus positive ones ($w = 4, 5$) leading up to bankruptcy. Figure D.1b depicts the movements of assets, consumption, and labor income. As seen, adverse shocks dominate and (not shown) there is a shift towards the worst shocks within the adverse group as we approach the date of filing. Labor income, the product of wage and labor supply, is relatively stable, as a result of the increase in labor supply (Figure D.1c for eventual Chapter 7 filers and Figure D.1d for Chapter 13 filers). On one hand, those who eventually file for bankruptcy work much fewer hours than average in the ensuing years following bankruptcy filing. On the other hand, they did increase labor supply as an attempt to avoid bankruptcy filing prior to the filing, despite the decline in wages. Consumption remains stable, because of insurance provided by bankruptcy and the safety net.

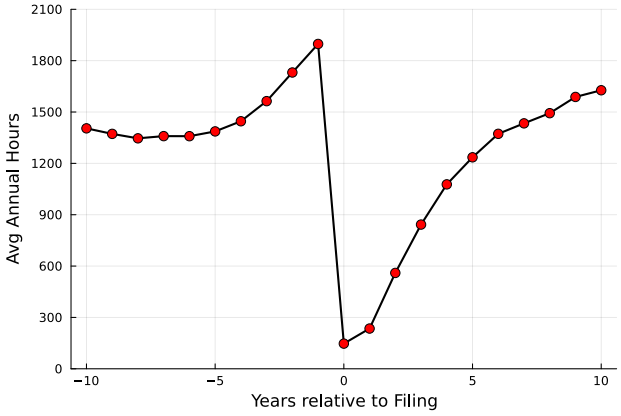
Figure D.1: Event Study Around the Point of Bankruptcy Filing for High Education Individuals



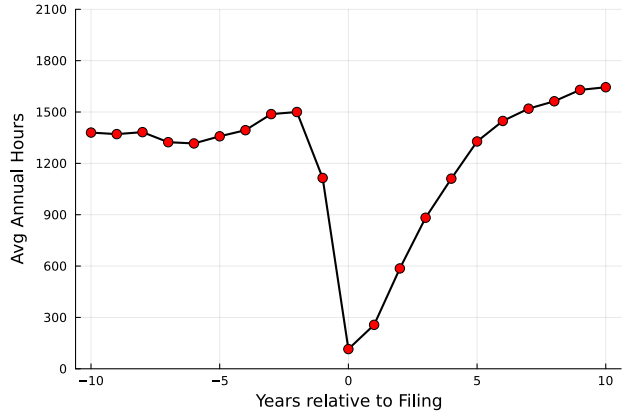
(a) Proportion of filers receiving negative wage shocks ($w = 1, 2, 3$) versus positive ($w = 4, 5$) (left axis) and labor income (y) (right axis).



(b) Average assets, consumption and income of high educated filers.



(c) Average hours of work: Chapter 7 filers.



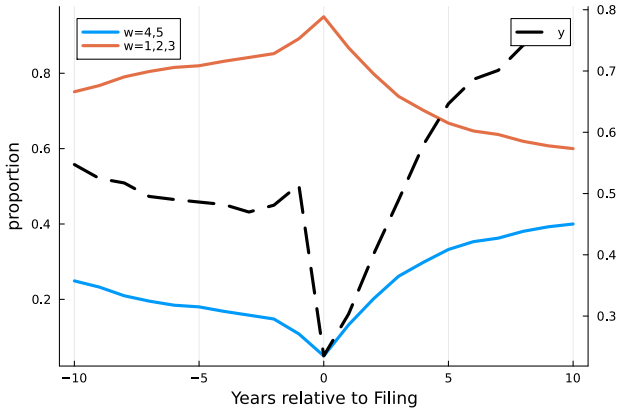
(d) Average hours of work: Chapter 13 filers.

Note. We split the simulated economy into individuals who will ever file for bankruptcy (treated group) and ones who will never (control group). We align all treated individuals at their age of (first) bankruptcy filing and label it year 0. We show selected outcomes for the treated group as averages conditional on the time to the year of filing.

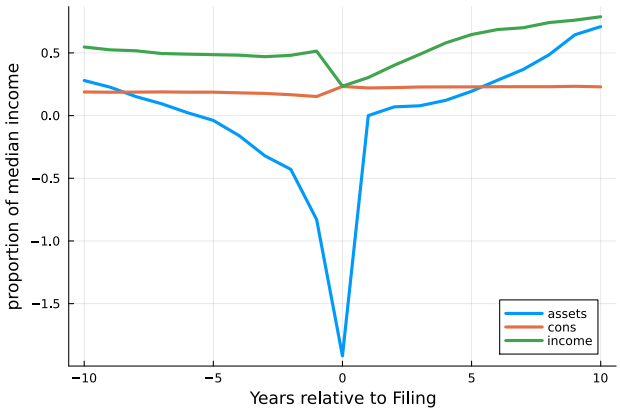
Figure D.2 reports the same information for the lower education group. Two observations stand out.

First, low education bankruptcy filers work much fewer hours than their high education counterparts, due to lower wages though their hours also increase rapidly in the year immediately before filing for Chapter 7 bankruptcy. Second, the recovery in income and hours is protracted, similar to the high education individuals.[42]

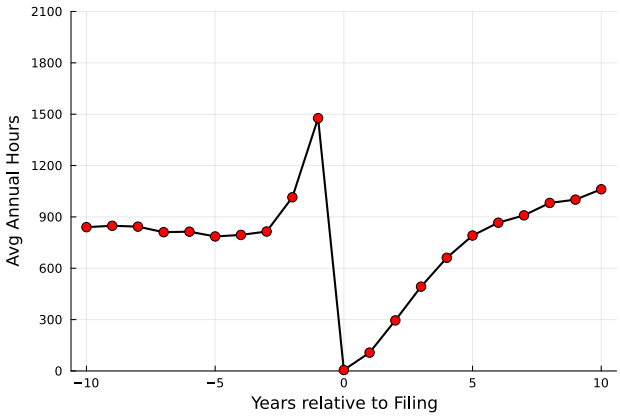
Figure D.2: Event Study around the Point of Bankruptcy Filing for Low Education Individuals



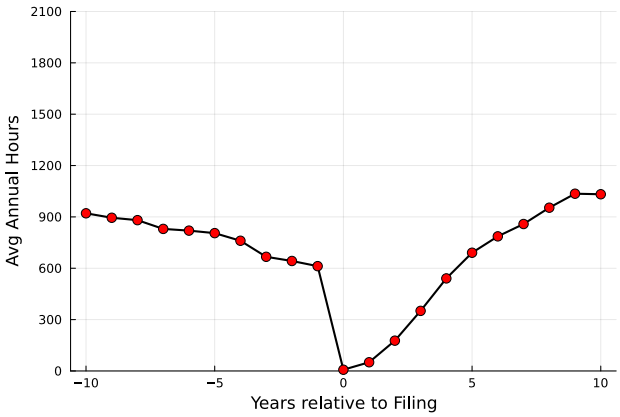
(a) Proportion receiving negative shocks ($w = 1, 2, 3$) versus positive ($w = 4, 5$) (left axis) and labor income (y) (right axis).



(b) Average assets, consumption and income of low educated filers.



(c) Chapter 7 filers' hours.



(d) Chapter 13 filers' hours.

Note. We split the simulated economy into individuals who will ever file for bankruptcy (treated group) and ones who will never (control group). We align all treated individuals at their age of (first) bankruptcy filing and label it year 0. We show selected outcomes for the treated group as averages conditional on the time to the year of filing.

[42] Our findings that earnings decline leading to the bankruptcy filing and rebound after filing (Figures D.1b and D.2b) are qualitatively consistent with the findings in Dobbie and Song [2015a] (Figure 2 Earnings). Dobbie and Song [2015a] also report employment changes, which features a much prolonged decline than the hours worked that we focus here. Data on individual hours worked before and after bankruptcy filing do not exist to the best of our knowledge.

D.4 No Preference Heterogeneity by Education

Table D.4: Parameter Estimates Aggregating low and high education groups

		High Education	Low Education	Both
Utility: c, l and h				
Housing (warm glow)	μ	0.501	5.5	1.12
Housing (multiplicative))	θ_H	-0.1	-0.9	-0.1
Consumption exponent	ω	0.4	0.44	0.4
Fixed cost of work	θ_P	998.541	2013.932	998.541
Bequest weight	θ_W	7.91	6.614	7.91
Utility: Bankruptcy and Default				
Stigma Ch. 7	λ_7	0.39	0.349	0.47
Stigma Ch. 13	λ_{13}	0.601	0.432	0.59
Stigma default	λ_{def}	1.0	1.0	1.0
Period T BK penalty	θ_{BK}	0.0	801.09	35.1

Table D.5: Model Fit When Preferences Do Not Vary by Education

Model vs Data Moments				
	High Education		Low Education	
	Model	Data	Model	Data
Bankruptcy 7	7.864	5.794	9.946	8.787
Bankruptcy 13	1.801	2.079	5.604	3.957
Bankruptcy age 50-60	6.185	9.883	11.407	9.883
Default	1.27	1.668	1.845	2.88
Homeownership	0.724	0.727	0.556	0.605
Homeownership age 59	0.891	0.867	0.687	0.783
Hours	2198.45	2056.71	2178.1	1821.71

D.5 The Impact of the BAPCPA reform

The Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) was signed into law in April 2005 and took effect after October 17 of the same year. The bill was designed to make it more difficult to file for bankruptcy, and in particular, to file under Chapter 7. For instance, under the reform, to be eligible for filing under Chapter 7, individual earnings have to be lower than the state median. The cost of bankruptcy filing has also gone up significantly after the reform. According to a report by the US Government Accountability Office [2008], average total of filing and attorney costs of Chapter 7 increased from $900 to $1500 after the reform, and those for Chapter 13 from $3700 to $5700. This reform has been evaluated extensively in the literature as we have reviewed in the introduction. We revisit it here from the perspective of our model, distinguishing between education groups.[43]

[43] In addition to a means test introduction, the homestead exemption is limited in different ways after the reform, which we do not directly model. For example, if a debtor added value to their home in the 3 years preceding the bankruptcy, the bill provides that anything in excess of $125,000 cannot be exempted.

We analyze the effects of the BAPCPA reform by looking at two steady states of the model economy, before and after the reform. Throughout, we keep the stochastic shocks describing the economic environment constant. The policy equilibrium in the model is characterized by the implementation of the means test to access Chapter 7, the implementation of homestead exemption cap, and the increase of monetary filing costs. The results are shown in Table D.6 by education group.

The result that the low educated are less negatively affected by the BAPCPA reform arises for several reasons. First, the means-test for Chapter 7 filing affects them less, as evidenced by more of them switching into Chapter 7 filing after the reform. The rise in the average interest rate is offset by the riskier individuals now filing for Chapter 7 bankruptcy and enjoying the insurance associated with the filing. Second, the income of the low educated group is more persistent. As pointed out in Athreya [2002] and related studies, exclusion from the credit market is less costly when income shocks are persistent.

Table D.6: Impact of BAPCPA Reform

	High Education		Low Education	
	Baseline	BAPCPA	Baseline	BAPCPA
Bankruptcy 7 filing rate (‰)	5.93	5.558	9.731	11.691
Bankruptcy 13 filing rate (‰)	4.585	4.487	3.913	1.289
Interest (%)	10.9	10.4	26.8	31.9
Ownership rate	0.718	0.716	0.561	0.562
Default rate	1.311	1.336	1.79	1.757
Hours	2186.5	2186.3	2051.4	2053.6
Hours renters	2243.0	2240.6	2130.5	2148.2
Hours owners	2187.3	2187.4	2026.5	2023.3
Hours renters (in Ch. 13)	1624.2	1629.9	1771.0	1744.9
Hours owners (in Ch. 13)	2188.8	2171.6	2021.6	2040.5
Cons. equivalent (%)	-	-1.566	-	-1.033

Notes: Implemening the BAPCPA reform. We increase both Chapter 7 and Chapter 13 monetary filing costs f_7, f_{13}, and we impost a cap on homestead exemption of \$125,000. Additionally, we implement a means-test for access to Chapter 7 bankruptcy, i.e., only those with income below the state median income are eligible for Chapter 7 bankruptcy.

To further understand the results, we conduct a decomposition exercise where we impose the rise in bankruptcy filing costs and the mean-test requirement for Chapter 7 bankruptcy filing separately. The results are reported in Table D.7. As expected, we see that high education individuals are more negatively affected by the implementation of means-test for Chapter 7 bankruptcy filing, while low education individuals are more negatively affected by increases in filing cost.

Starting with the high education group, we see that the reform has the expected effect of reducing both Chapter 7 and Chapter 13 cases, due to means tests requirement for Chapter 7 filing and higher filing costs for both Chapters. As a result, average unsecured interest falls. Aggregate ownership and default are barely affected by the reform. Aggregate hours worked do not change much either. However, renters in Chapter 13 work slightly more while owners in Chapter 13 work slightly less. Overall, higher educated individuals are negatively affected BAPCPA, with a willingness to pay of about -1.57%.

For the lower education group, bankruptcy rates are slightly lower than the baseline, but there is some substitution from Chapter 13 bankruptcy towards Chapter 7 bankruptcy. This results in a significant increase

in interest rates for unsecured deb. In terms of labor supply, renters filing under Chapter 13 work slightly less, while owners slightly more. On balance, the BAPCPA reform implies a 1.033% decrease in consumption equivalent welfare for the low education group.

Table D.7: Decomposition of Impacts of BAPCPA Reform

	High Education			Low Education		
	BAPCPA	Same Cost	No Meanstest	BAPCPA	Same Cost	No Meanstest
Bankruptcy 7 (‰)	5.558	5.389	6.323	11.691	9.731	11.682
Bankruptcy 13 (‰)	4.487	4.542	4.551	1.289	3.915	1.287
Interest (%)	10.4	10.2	11.3	31.9	26.7	31.9
Ownership rate	0.716	0.717	0.718	0.562	0.561	0.562
Default rate	1.336	1.33	1.319	1.757	1.789	1.757
Hours	2186.3	2186.7	2185.8	2053.6	2051.5	2053.6
Hours renters	2240.6	2241.1	2242.8	2148.2	2130.5	2148.3
Hours owners	2187.4	2187.5	2187.2	2023.3	2026.6	2023.3
Hours renters (in Ch. 13)	1629.9	1633.4	1625.8	1744.9	1772.5	1731.0
Hours owners (in Ch. 13)	2171.6	2155.6	2198.9	2040.5	2040.5	2021.6
Cons. equivalent (%)	-1.566	-1.41	-0.719	-1.033	-0.0	-1.029

Note. The *Same Cost* scenario implements the means test, but does not increase monetary filing costs. *No Means-test* implements BAPCPA but removes the meanstest from the policy.