Discussion Paper Series – CRC TR 224

Discussion Paper No. 634
Project A 03, C 02

The Distribution of Household Debt in the United States, 1950-2022

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January 2025

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Support by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) through CRC TR 224 is gratefully acknowledged.

The Distribution of Household Debt in the United States, 1950-2022*

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November 2024

Abstract

Using new household-level data, we study the secular increase in U.S. household debt and its distribution since 1950. Most of the debt were mortgages, which initially grew because more households borrowed. Yet after 1980, debt mostly grew because households borrowed more. We uncover home equity extraction, concentrated in the white middle class, as the largest cause, strongly affecting intergenerational inequality and life-cycle debt profiles. Remarkably, the additional debt did not lower households' net worth because of rising house prices. We conclude that asset-price-based borrowing became an integral part of households' consumption-saving decisions, yet at the cost of higher financial fragility.

JEL codes: G51, E21, E44, D14, D31

*We thank participants of seminars at various institutions, as well as Stefania Albanesi, Charlotte Bartels, Luis Bauluz, Christian Bayer, Tobias Berg, David Berger, Douglas W. Diamond, Matthias Doepke, Karen Dynan, Eugene Fama, Olivier Godechot, Ethan Ilzetzki, Oscar Jorda, Loukas Karabarbounis, Anna Kovner, Dirk Krüger, Felix Kubler, Yueran Ma, Costas Meghir, Atif Mian, Stefan Nagel, Stijn van Nieuwerburgh, Filip Novokmet, Thomas Piketty, Raghuram Rajan, Morten Ravn, José-Víctor Ríos-Rull, Kenneth Snowden, Ludwig Straub, Amir Sufi, Alan Taylor, Sascha Steffen, Gianluca Violante, Joseph Vavra, Paul Wachtel, Nils Wehrhöfer, Eugene White, Larry White, Kaspar Zimmermann, and the anonymous referees. Schularick acknowledges support from the European Research Council Grant (ERC-2017-COG 772332), as well as a Fellowship from the Initiative on Global Markets at the University of Chicago. Kuhn thanks the Federal Reserve Bank of Minneapolis for its support. Bartscher, Kuhn and Schularick acknowledge funding from the Deutsche Forschungsgemeinschaft (DFG) under Germany´s Excellence Strategy – EXC 2126/1– 39083886 and through CRC TR 224 (Projects A03 & C02). An earlier version of this paper has been circulated under the title "Modigliani Meets Minsky: Inequality, Debt, and Financial Fragility in America, 1950-2016".

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Keywords: household debt, home equity extraction, inequality, household portfolios, financial fragility

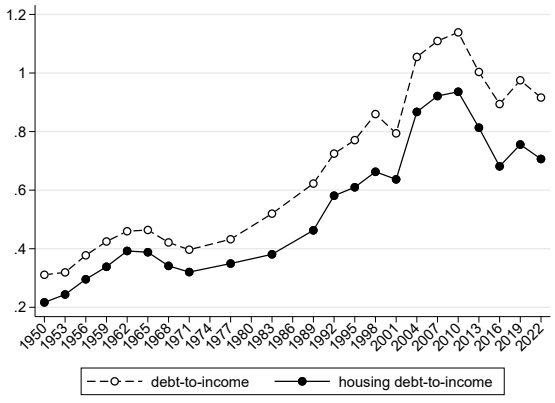
1 Introduction

Rising household debt levels characterize the modern financial history of the United States. The numbers are eye-catching. Between 1950 and the Financial Crisis, U.S. household debt grew fourfold relative to income (Figure 1a). In 2010, the household debt-to-income ratio peaked at close to 120%, up from 30% after World War II. This increase was mainly driven by *housing* debt, which consistently accounted for around 80% of total debt. Data limitations left a blind spot regarding the historical evolution of the distribution of household debt and hence limited our understanding of the causes and consequences of the secular change in household finances. Using novel household-level microdata on income, assets, and debt, this paper contributes to closing this gap.

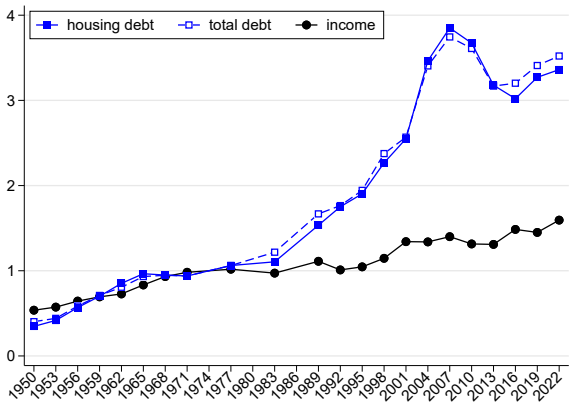
We document the evolution of household debt over the entire postwar period, asking which households have borrowed so much more, how this relates to their incomes and asset values, and which consequences their high debt levels have for the macroeconomy. Given its macroeconomic importance, we primarily focus on housing debt, but also present selected results on non-housing debt. We rely on the newly compiled SCF+ dataset that combines historical waves of the Survey of Consumer Finances (SCF), going back

Figure 1: Debt-to-income ratios and decoupling of debt and income growth

(a) Total and housing debt-to-income ratios



(b) Decoupling of mortgage and income growth



Notes: The left panel shows the ratio of average total household debt and mortgage debt to average total household income over time. The right panel shows the growth rates of average total debt, mortgage debt and income, relative to their averages over the 1970s.

to 1949, with the modern SCF that the Federal Reserve Board has administered since 1983 (Kuhn, Schularick, and Steins 2020). We further use data from the Panel Study of Income Dynamics (PSID), which provides household-level panel data on housing assets and mortgage debt since 1969.

Our first main new finding is that the nature of the debt increase has changed qualitatively over the seven decades of rising household indebtedness. In the 1950s and early 1960s, increases in debt-to-income ratios were driven by the fact that more households were taking out mortgages during the postwar homeownership boom, so debt increased at the extensive margin. By contrast, when debt-to-income ratios surged after 1980, this was due to the fact that conditional on having a mortgage, households borrowed more. The debt increase after 1980 led to a strong and characteristic divergence of debt growth, driven by housing debt, and income growth (Figure 1b). This is our second main new finding. The distribution of debt across income groups however remained strikingly stable during this divergence period. The upper half of the income distribution always owed at least 80% of both mortgage and total household debt.

Using PSID data, we find that almost half of the debt growth after 1980 resulted from home equity extraction, which is our third main new finding. Borrowing against rising house values allowed households to realize capital gains that would otherwise have remained illiquid. These realized capital gains have been concentrated in the white middle class but played out unequally across generations, with the cohorts born between 1935 and 1954 extracting most equity. The widespread equity extraction also led to changing life-cycle profiles of debt across generations. However, the concurrently rising asset prices prevented a systematic reduction in life-cycle (net) wealth accumulation.[1] These new facts of life-cycle dynamics and intergenerational inequality are our fourth main new finding. We conclude that debt accumulation in reaction to changing asset prices has become a key part of households' consumption-saving decisions since the 1980s. At the

[1]When we refer to wealth in the paper, we mean net wealth throughout, i.e. assets net of debt.

macroeconomic level, we find that though households did not become wealth-poorer, their expanding balance sheets have increased financial fragility. We illustrate the declining resilience against financial shocks by "stress testing" households with interest rate and earnings shocks that deteriorate their debt service capacity.

The microdata allow us to scrutinize the idea that the rising debt-to-income ratios after 1980 were a characteristic feature of specific population groups. We show that the decoupling of income and debt growth after 1980 is not driven by particular groups of households but applies across income, education, age, race, or marital status. These socioeconomic groups differ in both their income levels and expected future income growth. The uniform divergence of income and debt growth across all groups points to a quantitatively important role for asset price growth as a driver of the debt boom.

To support the hypothesis of asset-price-related borrowing, we rely on PSID panel data. The PSID contains data on housing and mortgages that allow us to identify home equity extractors and quantify the size and distribution of home-equity-based borrowing since the 1980s. Previous research has identified equity extraction in response to rising house prices and falling interest rates as an important factor for the household debt increase (Greenspan and Kennedy 2008, Klyuev and Mills 2007, Mian and Sufi 2011, Bhutta and Keys 2016). From the early 1980s to the 2008 crisis, we find that equity extraction alone pushed the housing debt-to-income ratio up by more than 30 percentage points. But we also document that equity extraction was responsible for a significant part of the rise in U.S. household debt even before the extraction boom of the 2000s, which has been the main focus of prior work. Looking across household groups, we find that middle-class households are the largest contributors to the extraction boom. Moreover, the equity extraction boom was almost exclusively driven by white households. This racial inequality in equity extraction aligns with previous work on the size and persistence of the racial wealth gap, for which the black-white homeownership gap plays a key role (Derenoncourt et al. 2022, Aliprantis and Carroll 2019, Bartscher et al. 2021).

From a theoretical perspective, increased borrowing against rising asset values constitutes smoothing of future capital gains income. Increasing debt levels collateralized by rising asset values relax the household budget constraint today, as they shift future income from capital gains to the present. This idea of expanded budget sets from realized capital gains relates our work to Fagereng et al. (2022), who show that a budget set expansion from movements in asset prices is welfare-enhancing. Realizing capital gains via augmenting debt instead of selling the asset is particularly relevant in the context of housing, as it allows to liquidate capital gains without selling the house, such that households still enjoy the full consumption utility of their home although their equity declined.[2]

Regarding inequality, we explore the distributional consequences of the boom in debt and equity extraction from rising asset prices. Changing asset prices at a certain point in time benefit the owners of the asset at that time and thus naturally play out differentially across generations. We therefore look at the intergenerational inequality of realized capital gains through equity extraction, and find large differences, with the 1935-1954 cohorts extracting most home equity. These cohorts entered the housing market before 1980 and benefited from the entire house price and extraction boom. Yet, we also find that their wealth levels relative to income did not fall behind other generations because of the counteracting effect of rising house prices on the asset side of their portfolio.

The long-run SCF+ data also allow us to study the life-cycle profiles of household debt across generations. We document that equity extraction led to pronounced changes in these life-cycle profiles. Our oldest cohort took out a mortgage early in life and repaid it constantly over time, such that their debt-to-income profile was falling over the life cycle. For the younger cohorts, we observe a shifting and tilting of the profiles from cohort to cohort. The turning point coincides with the onset of the 1980s debt boom. As a consequence, households from younger birth cohorts enter retirement with much more debt (see also Lusardi, Mitchell, and Oggero 2018, 2020). While the pre-war generations typically

[2]Selling the house and buying a cheaper one may involve substantial transaction, search, and potentially also emotional costs (see Aladangady 2017), and we find that few households do this in practice.

approached retirement with modest debt ratios of 30% to 60% of income, households in the cohort 1945-1954 had average debt ratios of almost 120% at the same age.

In a final step, we study the macrofinancial consequences of the debt and equity extraction boom. We rely on the rich SCF+ microdata to document the evolution of mortgage debt service as a fraction of household income over time. We find that debt-service burdens have increased substantially despite the concurrent fall in mortgage interest rates. As high debt service burdens are a frequently-debated indicator of the household sector's financial fragility, we conduct a "stress test" with respect to interest rate and earnings risk. We find that the resilience of the U.S. household sector to financial shocks has strongly declined over the debt boom, especially in the lower half of the income distribution and the middle class. Our results highlight that equity extraction poses a tradeoff between an expansion of individual budget sets and the reduced ability of the U.S. household sector to absorb financial shocks because of its high debt service burden.

Literature. The analysis of household balance sheets and their importance for financial stability and the business cycle has become an active research field in finance and macroeconomics.[3] In influential work, Mian and Sufi (2009, 2011) argue that household debt in low-income regions of the U.S. grew strongly before the 2008 crisis, followed by severe output and employment losses. In theoretical work, Kumhof, Rancière, and Winant (2015) and Mian, Straub, and Sufi (2021a) show that higher savings of the rich may lead to a fall in interest rates, higher borrowing by lower-income households, and higher financial fragility. However, Coibion et al. (2020) find that low-income households face higher borrowing costs and lower credit access as inequality increases. Adelino, Schoar, and Severino (2016), Foote, Loewenstein, and Willen (2021) and Albanesi, DeGiorgi, and Nosal (2022) study the debt boom of the 2000s and highlight the important role of the middle class in this period. Our paper is the first to study the distribution of U.S.

[3]For example, Mian and Sufi 2017, Chen, Michaux, and Roussanov 2020, Jordà, Schularick, and Taylor 2013, Adelino, Schoar, and Severino 2018, Albanesi, DeGiorgi, and Nosal 2022, and Mian and Sufi 2018. Trends in household debt are discussed in Dynan and Kohn (2007) and Wolff (2010).

household debt over the long run. Moreover, we study debt along another important socioeconomic dimension of the U.S. inequality debate beyond income, namely race. The long time span of our data further allows us to track birth cohorts over time and highlight intergenerational redistribution as a key inequality dimension of the debt boom.

A large literature has examined wealth and collateral effects due to house price increases and their consequences for household borrowing and consumption.[4] Different papers have shown that the propensity to extract equity increases when house prices rise and interest rates fall (Bhutta and Keys 2016, Andersen and Leth-Petersen 2021, Boar, Gorea, and Midrigan 2021). Moreover, rising house prices can lead to higher borrowing through different channels (Berger et al. 2018), most importantly the relaxation of collateral and liquidity constraints, and housing wealth effects. A growing empirical literature stresses the importance of relaxed debt constraints.[5] Leombroni et al. (2020) link intergenerational inequality back to asset prices and demonstrate how a changing wealth distribution can itself have effects on asset prices. We contribute to this literature by quantifying the importance of equity extraction in the U.S. household debt boom, and documenting its distributional consequences.

The history of U.S. household debt documented in this paper is compatible with the idea of a savings glut due to global factors (Bernanke 2005) or growing income inequality (De Stefani 2018, Mian, Straub, and Sufi 2021b), which lowered interest rates, loosened borrowing constraints, and increased house values. Several important papers have also traced house price increases to regulatory changes since the 1980s[6], and highlighted the role of expectations driving up home values and debt (for example, Kaplan, Mitman, and Violante 2020, Loewenstein 2018, De Stefani 2020). Our analysis does not speak to the

[4]For example, Iacoviello (2005), Hurst and Stafford (2004), Calomiris, Longhofer, and Miles (2013), Campbell and Cocco (2007), and Kaplan, Mitman, and Violante (2020).

[5]For example, Aladangady 2017, Cloyne et al. 2019, Andersen and Leth-Petersen 2021, Ganong and Noel 2020, Kessel, Tyrefors, and Vestman 2019, and Chen, Michaux, and Roussanov 2020.

[6]For example, Hoffmann and Stewen 2019, Favara and Imbs 2015, Di Maggio and Kermani 2017, Mian, Sufi, and Verner (2017)

initial trigger of this process.[7] We argue that once house prices were rising, homeowners made large capital gains that they extracted by increasing debt levels. While this did not imply a deterioration in net worth, it increased their vulnerability to interest rate surges.

2 Data

The main data source for this paper is the harmonized, long-run "SCF+", which allows us to track the financial situation of U.S. households since World War II by combining historical waves of the Survey of Consumer Finances (SCF) going back to 1949 with the modern waves available since 1983 (Kuhn, Schularick, and Steins, 2020). A key strength of the SCF+ data is that they provide joint information on income, debt, and asset holdings at the household level together with demographic information. Kuhn, Schularick, and Steins (2020) give a detailed description of the SCF+ and its construction.

The SCF is a key resource for research on household finances. The modern surveys have been conducted every three years since 1983 by the Federal Reserve Board (see Bricker et al. 2017 for more details).[8] The comprehensiveness and quality of the SCF explain its popularity among researchers (see Kuhn and Rıos-Rull 2016 and references therein). The historical predecessor surveys were carried out annually between 1947 and 1971 and then again in 1977. We follow Kuhn, Schularick, and Steins (2020) and use data since 1949, which is the first year in which all relevant variables are available, and pool the early waves into three-year bins to increase sample sizes. The SCF+ data are weighted with post-stratified cross-sectional weights that ensure representativeness along several socioeconomic characteristics, in particular race, education, age, and homeownership.

Of particular interest for our study is the coverage of household debt and its components,

[7] For a detailed overview on the drivers of house prices and their connection to credit markets, see Duca, Muellbauer, and Murphy (2021).

[8] The 1986 survey was designed as a panel survey to the 1983 survey but suffers from sample attrition and is therefore not included in our dataset.

which we aggregate into housing and non-housing debt. For housing debt, we focus on debt for owner-occupied housing. This includes mortgages and home equity lines of credit. We treat investment in non-owner-occupied housing like business investment and use the net position to calculate wealth.[9] Non-housing debt includes car, education and consumer loans. Data on credit card balances become available after 1970 with the introduction and proliferation of credit cards.[10] Our measure of total income is constructed as the sum of wages and salaries plus income from professional practice and self-employment, rental income, interest, dividends, and transfer payments, as well as business and farm income. If not otherwise mentioned, we abstain from sample selection.

As discussed in Kuhn, Schularick, and Steins (2020), aggregated household surveys are not always easy to reconcile with macroeconomic data sources like the National Income and Product Accounts (NIPA) and the Financial Accounts (FA). Measurement concepts differ, such that even high-quality microdata may not match aggregate data one-to-one. To judge the reliability of the SCF+ data, we compare the trends in average income and household debt in the SCF+ to data from the NIPA and FA (Appendix Figure A.2). After accounting for measurement differences affecting levels, the aggregated microdata match macroeconomic trends closely so that they can be used to study underlying distributional changes over time. The alignment is particularly close for house values and housing debt.

The key strength of the SCF+ is that it allows us to study the joint distribution of income, debt, and assets over seven decades. However, it consists of repeated cross sections and thus does not allow us to track households over time. To explore how households change their debt over time, we therefore rely on the Panel Study of Income Dynamics (PSID) as our second main data source.

[9]Several papers have stressed the importance of real estate investors (borrowers with multiple first-lien mortgages) for the debt boom prior to 2007 (Haughwout et al. 2011, Bhutta 2015, Mian and Sufi 2021, Albanesi, DeGiorgi, and Nosal 2022, DeFusco, Nathanson, and Zwick 2017, De Stefani 2020), While they accounted for a disproportionately large share of mortgage growth before 2007 compared to their relatively small population share, mortgage debt on the principal residence is on average eight times larger than that on other real estate (see Appendix Figure A.1).

[10]The appearance of new financial products like credit cards does not impair the construction of consistent data over time. Implicitly, these products are counted as zero for years before their appearance.

The PSID started in 1968 as a panel tracking U.S. households over time. Initially, the PSID provided only limited information on household assets and debt. Information on wealth and its components is only available since 1984. However, information on housing is available in each wave since 1968, and on mortgage balances since 1969 (with the exceptions of 1973-1975 and 1982). The PSID collects data at the family level and the SCF+ reports data at the household level. To account for these differences, we aggregate PSID families living together into one household for better comparability (Pfeffer et al. 2016). Following Kaplan, Violante, and Weidner (2014), we only use data from the *Survey Research Center (SRC)* sample, which tracks the original households from the first PSID wave in 1968 over time, as well as the new households formed by former members of these households (for example, adult children moving out). We use the longitudinal PSID family weights and post-stratify them to match the same Census variables that are targeted in the post-stratification of the SCF+ waves.[11] Appendix Figure B.1 compares the PSID data and SCF+ data for housing assets, housing debt, and income. We find that the two datasets align very well. Additional details are given in Appendix B. The PSID was conducted at an annual frequency until 1997 and every two years thereafter. To ensure consistency over time, we discard all even years from the sample.[12]

We further use long-run data on the consumer price index (CPI) from the *Macrohistory Database* (Jordà, Schularick, and Taylor 2017) to deflate nominal variables. All presented results are in real terms, converted to 2019 dollars.

[11] We verified that all reported results are similar when using the unweighted PSID data or the original longitudinal PSID weights without post-stratification.

[12] The only information we use from the even years is whether a household has moved over the last year. We use this information to construct a measure of whether the household has moved during the last two years, consistent with the data from the post-1997 waves.

3 Debt boom and distributional changes, 1950-2022

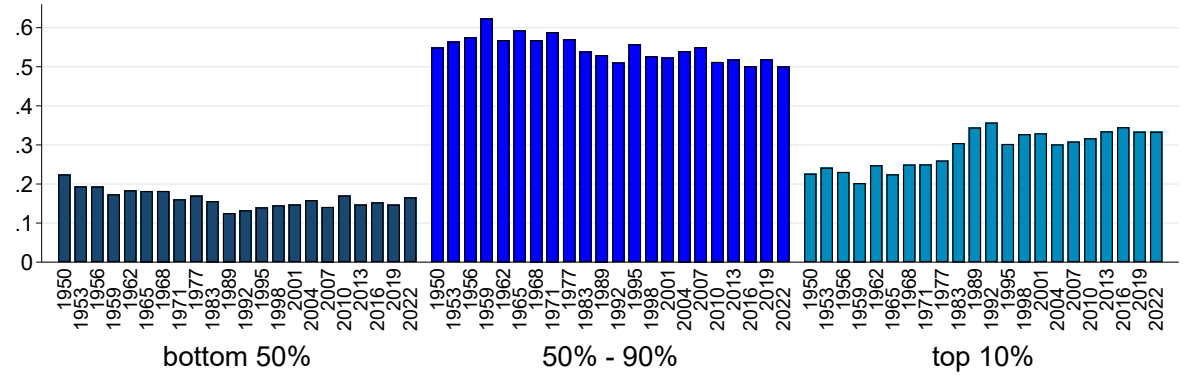
Aggregate data show the existence of a housing debt boom in the United States since 1950, yet they remain silent on its causes and consequences. To understand them, we have to look at the household level, where economic decisions are made. The SCF+ microdata allow us to study the growth and distribution of debt at the household level and by household characteristics over time.

We address two key distributional questions: How is housing debt distributed among rich and poor households, and how has this changed over time? To answer these questions, we stratify households by income. Following standard practices in the literature, we divide the population into three groups (see Alvaredo et al., 2018; Kuhn, Schularick, and Steins, 2020; Piketty and Saez, 2003; Saez and Zucman, 2016). The first group is households in the bottom 50% of the income distribution, and the second covers households between the 50th and 90th percentiles. We refer to this group as the *middle class* throughout the paper. The third group consists of the top 10% of the income distribution.

It is important to recognize that the SCF+ consists of repeated cross sections. This means we cannot track if households move between income groups between surveys. The considered groups are reasonably large, so inter-group mobility can be expected to be limited, but we also use panel data from the PSID to test this assumption, along the lines of Díaz-Giménez, Glover, and Ríos-Rull (2011). The results speak in favor of high income-group stability over time (Table A.1). On average, we find that households remain in the same income group for 77% of the years in which we observe them. Moreover, households that change income groups tend to remain close to the "border" with the previous group. For instance, among households that changed into the middle-class group, 64% were no more than two deciles away from this group two years earlier.

Figure 2 shows the share of housing debt owed by the three income groups since 1950. Housing debt shares have been strikingly stable over time. Over the entire postwar

Figure 2: Housing debt shares by income group



Notes: The figure shows shares in housing debt for the different income groups over time.

period, middle-class households have always accounted for the largest share of outstanding mortgages, on average between 50% and 60%. Low-income households in the bottom half of the income distribution owed only 20% of total housing debt. The share of the top 10% fluctuated around 20% before the 1980s and then increased to around 30%. Consequently, the upper half of the income distribution has always accounted for about 80% of housing debt. Hence, households with higher incomes not only own most assets but also owe most housing debt. These distributional facts are the same when considering total household debt, which again underlines the macroeconomic importance of housing debt.

It follows from the stability of debt shares that the middle class also played a dominant role in the growth of housing and total debt over time. From 1950 to 2007, middle-class households accounted for 55% of the housing and total debt increase, whereas households from the bottom 50% of the income distribution contributed only around 15% (Appendix Figure A.4). Hence, the explanation for soaring household debt in the United States lies in the borrowing behavior of the upper half of the income distribution, and in particular of middle-class households (see also Adelino, Schoar, and Severino 2018).

Through the lens of economic theory, (future) income dynamics are a natural candidate to explain rising debt levels and differential debt growth. To explore the role of income for debt dynamics, we rely on the joint distribution of housing debt and income and

the rich demographic information in the SCF+, considering groups of households that arguably had different income dynamics and expectations during the debt boom. First, we look at the debt dynamics by income itself. Figure 3a shows the evolution of housing debt-to-income ratios for the three income groups over time.[13] Starting in 1950, we observe a surge of housing debt-to-income ratios for households in the upper half of the income distribution. This first post-war debt boom came to a halt in the mid-1960s. After 1980, housing debt-to-income ratios started to rise strongly during a second debt boom. Although housing debt-to-income ratios increased for all households, the increase was stronger for households in the bottom 90%.

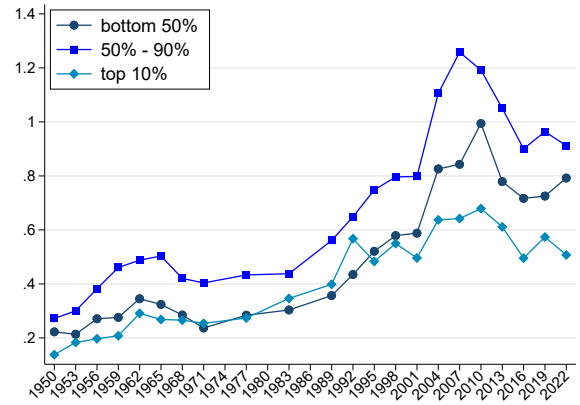
To decompose the forces behind the stronger increase of housing debt-to-income ratios among the bottom 90%, we consider mortgage and income growth separately by income group in Figure 3b. For the two groups in the bottom 90%, we find that the rising housing debt-to-income ratios resulted from strongly rising debt levels in combination with modest or stagnant income growth. By contrast, the top 10%'s increase in housing debt-to-income is muted, even though they expanded their debt share compared to the 1950s (Figure 2). This is because their income has risen much more than for the bottom 90%. Whereas income of the middle class only increased by about 25% over the past 50 years, the top 10%'s income more than doubled, corroborating the well-known rise in income inequality. The PSID data show that income groups are fairly stable over time (Table A.1). Combining this fact with low income growth of households outside the top 10% makes it seem unlikely that households in the bottom 90% were anticipating strong future income growth that they began to borrow against in the early 1980s.

An alternative to corroborate diverging trends of income and housing debt growth is to consider education as a proxy for lifetime income. The rising income disparities by education over the past decades have been widely documented (for example, Katz and Autor, 1999; Levy and Murnane, 1992). Looking at college and non-college households in

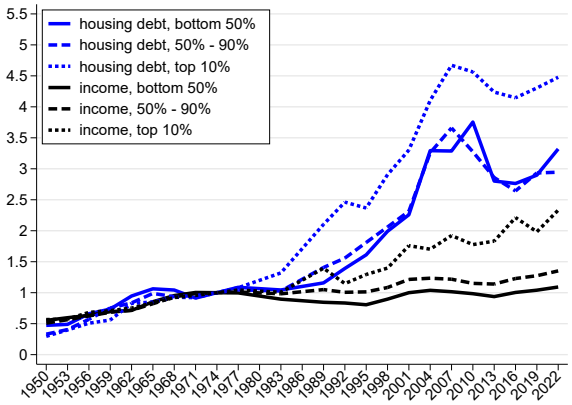
[13]The evolution of housing debt-to-income ratios by income decile is shown in Appendix Figure A.6 for different survey waves.

Figure 3: Housing debt and income along the income distribution

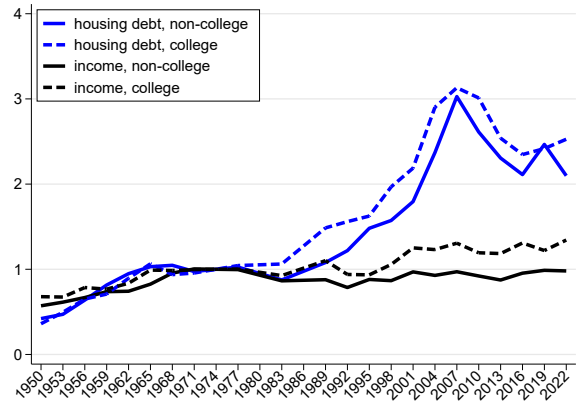
(a) Housing debt-to-income ratio



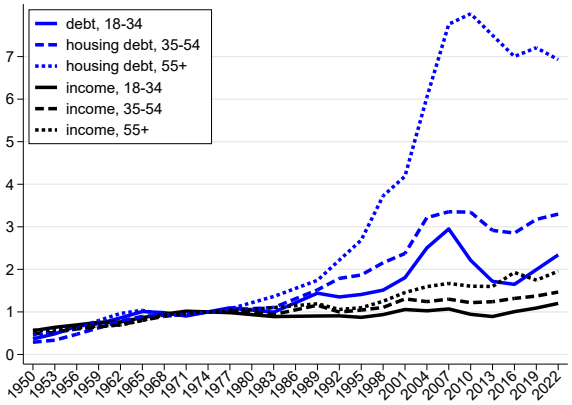
(b) Housing debt and income growth



(c) Housing debt and income growth by education



(d) Housing debt and income growth by age



Notes: Figure 3a shows housing debt-to-income ratios by income group. Figures 3b to 3d show the growth of average housing debt and income by income group, education and age, relative to 1970s averages.

Figure 3c, we find that both groups increased their mortgage borrowing substantially from the 1980s on, despite different income growth. Both college and non-college households owed on average three times as much in 2007 than in 1980, and for both groups housing debt growth exceeded income growth by a wide margin. Hence, we find a decoupling of housing debt from income dynamics, just as when stratifying by current income.

The life cycle provides a third dimension to study the relationship between future income trends and housing debt accumulation. Remaining lifetime income naturally declines over the life cycle, so older households have less future income to borrow against. Figure 3d shows mortgage and income trends for three age groups over time. We find that

housing debt increased for all age groups but that households with the lowest future income potential increased their borrowing the most, providing further evidence for a decoupling of housing debt and income growth over the last five decades. Again, all of these facts emerge almost identically when considering total household debt instead of mortgage debt, underlining the macroeconomic importance of housing debt.[14]

We conclude that rising indebtedness and a divergence of income and debt growth are a common phenomenon among U.S. households since 1980. In Appendix Figure A.5, we show that the same findings also apply if we slice the data along three additional important socioeconomic dimensions: race, marital status and the number of children. Hence, housing debt growth exceeded income growth independent of future income dynamics and for all households in the macroeconomy. This "decoupling" of income and debt growth across the population is one of our main new findings. The broad-based increase suggests that a common macroeconomic trend drove debt growth across household groups. In the next step, we decompose the increase of debt-to-income ratios into changes at the extensive and intensive margin. In other words, we investigate to what extent the total number of indebted households has increased, and to what extent indebted households have borrowed larger amounts. To get a comprehensive picture of households' indebtedness, we report results for personal debt along with housing debt.

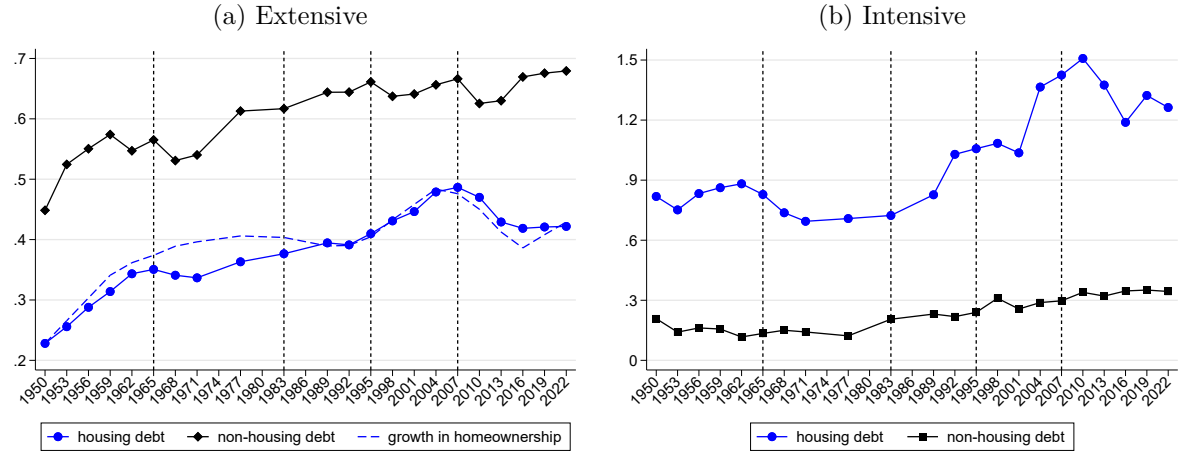
Let $d_{i,t}$ stand for the mean total debt-to-income ratio of income group i in period t. The expression $s_{i,t}^{H^+}$ is the share of households with positive housing debt (extensive margin), and $d_{i,t}^{H^+}$ is the average housing debt-to-income ratio of households with positive housing debt (intensive margin). The values $s_{i,t}^{N^+}$ and $d_{i,t}^{N^+}$ are the respective values for non-housing debt. The mean debt-to-income ratio, $d_{i,t}$, can be written as $d_{i,t} = s_{i,t}^{H^+} d_{i,t}^{H^+} + s_{i,t}^{N^+} d_{i,t}^{N^+}$. The percentage-point change in debt-to-income ratios between period t and $t-1$ can then be decomposed as follows:

[14]Results are available upon request.

$$d_{i,t} - d_{i,t-1} = \underbrace{(s_{i,t}^{H^+} - s_{i,t-1}^{H^+})\, d_{i,t-1}^{H^+}}_{\Delta \text{ extensive housing}} + \underbrace{s_{i,t}^{H^+}\, (d_{i,t}^{H^+} - d_{i,t-1}^{H^+})}_{\Delta \text{ intensive housing}}$$
$$+ \underbrace{(s_{i,t}^{N^+} - s_{i,t-1}^{N^+})\, d_{i,t-1}^{N^+}}_{\Delta \text{ extensive non-housing}} + \underbrace{s_{i,t}^{N^+}\, (d_{i,t}^{N^+} - d_{i,t-1}^{N^+})}_{\Delta \text{ intensive non-housing}} . \quad (1)$$

The first part of this expression is the change in the debt-to-income ratio due to a change in the extensive margin of housing debt. It captures by how much debt-to-income would have risen if only the share of households with housing debt, $s_{i,t}^{H}$, had changed. The second part is the effect due to variations in the intensive margin, that is, changes in debt-to-income due to an increase in borrowed amounts of indebted households $d_t^{H^+}$. The third and fourth parts are the respective effects for non-housing debt. Figure 4 shows the different components of this decomposition, s^{H^+}, s^{N^+}, d^{H^+}, and d^{N^+}, over time.

Figure 4: Extensive and intensive margins of debt-to-income ratios



Notes: The left panel shows the share of households with positive housing (dotted blue line) and non-housing debt (squared black line). Moreover, it shows the growth rate of the homeownership rate since 1950, normalized to extensive-margin housing debt in 1950 for comparison. The right panel shows the (non-)housing debt-to-income ratio of households with positive (non-)housing debt. The dashed vertical lines indicate pivotal dates related to the debt boom.

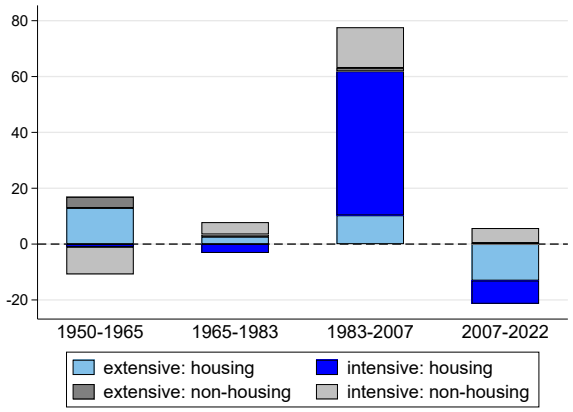
The extensive margin in Figure 4a captures the share of households with positive (non-) housing debt s_t^H (s_t^N). The intensive margin in Figure 4b is represented by the debt-to-income ratio for households with positive levels of (non-)housing debt d_t^H (d_t^N). A first look at the dynamics of the extensive margin of housing debt reveals that it closely tracks changes in the homeownership rate, shown as a dashed line. In general, we see

that in particular housing debt was growing strongly at the extensive margin during the post-war boom phase until the mid-1960s. By contrast, there was no growth at the intensive-margin over this period. Between the mid-1960s and early 1980s, both debt margins remained relatively stable. Thereafter, we see a pronounced increase in housing debt at the intensive margin up to the Financial Crisis. Since the mid-1990s, this increase was accompanied by an increase at the extensive margin, driven by rising homeownership rates. After the crisis, we see a period of falling mortgages levels that happened both at the intensive and extensive margin.

Looking at personal (non-housing) debt, we see that more households have personal than housing debt. In particular, the roll-out of credit cards in the 1970s led to an increase in the share of households with personal debt (Appendix Figure A.7). Yet, we also find that the amounts that households owe as personal debt are small compared to the average amount owed on mortgages (Figure 4b). Recently, the consequences of strongly rising student debt have received increased attention (for example, Looney and Yannelis 2015, Avery and Turner 2012). Rising student debt is visible in Figure 4b as a part of the intensive margin of non-housing debt. Since 1983, we find a significant contribution from this component. These increasing debt levels might shape the financial decisions of future generations of American households. However, from a macroeconomic perspective, the contribution of student debt is much smaller than the increase in housing debt over the same period (Appendix Figure A.7).

Figure 5 shows the decomposition from equation (1) for the last 70 years, divided into the four time periods indicated in Figure 4. In line with the previous evidence, the increase in debt over time mainly came from housing debt. The underlying reasons for the debt increase changed, however. Up to the mid-1960s, it was mainly accounted for by the extensive margin of housing debt. After a period of stability from the mid-1960s to the early 1980s, the increase mainly stemmed from the intensive margin of housing debt, which accounts for 52pp of the 78pp increase in the debt-to-income ratio over this period.

Figure 5: Decomposition of changes in debt-to-income



Notes: The graph shows the decomposition into extensive and intensive margin effects from equation (1) over different phases of the debt boom, stratified by income. Observations with debt-to-income ratios above 50 in absolute value were excluded.

Finally, after the 2008 financial crisis, we observe a period of debt reduction, which is entirely driven by housing debt, both at the extensive and intensive margin.

In short, we find that debt grew mainly because of housing, first because more households started having debt, and later because indebted households held more debt. This shift in the nature of the post-war debt boom from the extensive to the intensive margin is another main new finding of our paper. The importance of housing debt collateralized by the underlying house value suggests growing asset values as a candidate for the macroeconomic force driving the decoupling of debt and income growth. In the following, we will provide evidence for the hypothesis of increased borrowing of incumbent homeowners (home equity extraction) as a key driver of the debt boom and the divergence of income and debt trends.

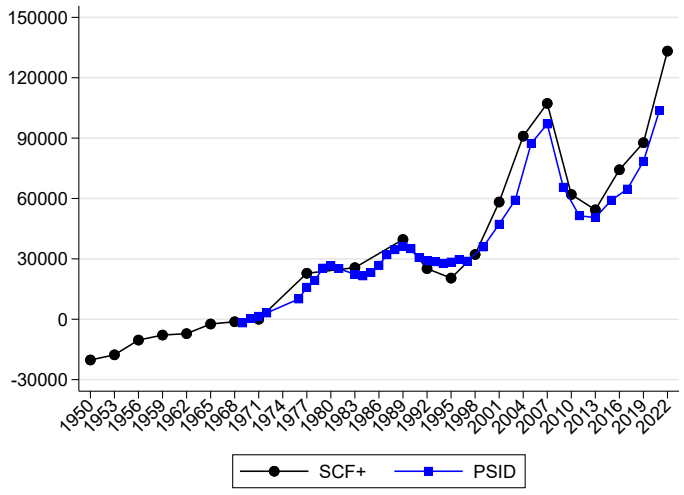
4 Debt boom and home equity withdrawal

We have seen that households in all parts of the population have increased their borrowing over time, and that there has been a broad-based divergence of income and debt growth. A plausible explanation are rising house prices and asset values. In the following, we

provide evidence in favor of this interpretation.

Figure 6 shows the change in home equity, that is, housing assets minus housing debt, over time. We compare two time series for average home equity relative to 1971, computed from the SCF+ and the PSID.[15] Both series align closely and show a striking pattern: Despite the surge in debt, home equity increased substantially. Rising home equity implies that households became wealth-richer despite their higher debt, and never had as much home equity as at the peak of the debt boom.

Figure 6: Change in home equity



Notes: The graph shows the change in average home equity since 1971 from the SCF+ and PSID.

Home equity grew only moderately until 1971. Its growth then strongly accelerated during the 1970s, and again in the mid-1990s. These periods were characterized by strong house price growth. Appendix Figure B.4 illustrates that home equity grew strongest in those regions where house prices grew most. These price increases led to average capital gains of up to $60,000 over the 1970s where house price grew most (Appendix Figure B.5).[16]

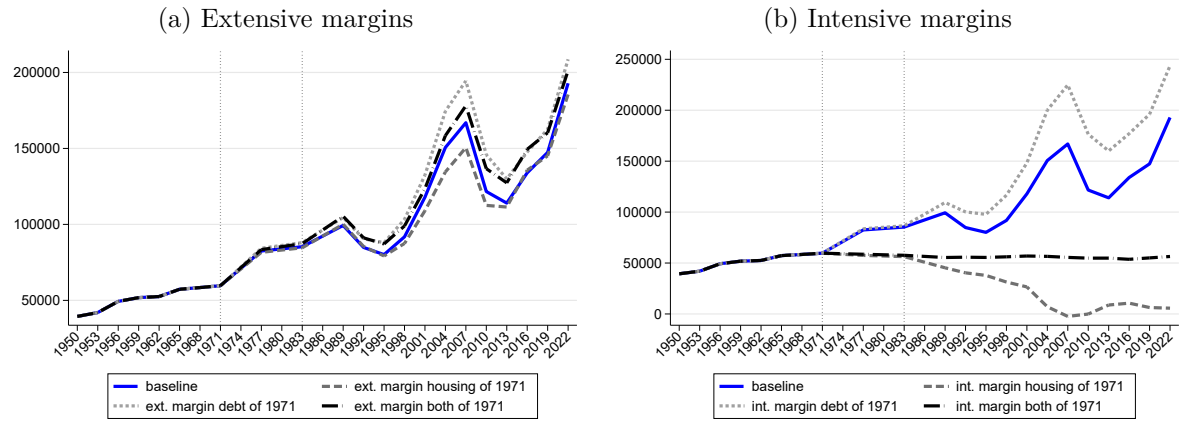
To substantiate the hypothesis that house price changes drove the surge in home equity since the 1970s, we decompose its evolution in three counterfactual experiments. We consider the extensive margin (the share of borrowers or homeowners) and the intensive

[15] As the SCF+ pools observations from 1969-1971, we use the same reference period in the PSID.

[16] This evidence is in line with the work of Guren et al. (2021), who argue that exposure to regional house price cycles led to housing wealth effects already before the boom phase starting in the late 1990s.

margin (the value of houses or housing debt, conditional on having a home or mortgage). Figure 7 shows three counterfactual scenarios. In both panels, the blue lines show the actual trajectory of home equity from the SCF+ data. Figure 7a fixes the extensive margins of homeownership and housing debt at their 1971 levels to see the marginal effects that higher numbers of homeowners or borrowers had on the evolution of home equity. In the third counterfactual, we fix both extensive margins at their 1971 levels. We find that extensive-margin changes had hardly any effect on the evolution of home equity over the 1970s, and only a modest effect over the 1980s until the mid-1990s, when the homeownership rate started to rise. Overall, extensive-margin variations played a negligible role for the growth in home equity.

Figure 7: Decomposition of home equity, SCF+



Notes: The graphs show average home equity from the SCF (blue), along with counterfactuals (gray). The counterfactuals in the left panel hold the extensive margins of housing, housing debt, or both at their 1971 values. The right panel does the same for the intensive margins. The dotted vertical lines indicate the years 1971 and 1983.

Figure 7b considers the intensive margin of housing and borrowing. We construct an analogous decomposition where we either fix homeowners' housing assets or debtors' housing debt at their 1971 levels. Now there are huge differences across the counterfactual simulations. If we hold the intensive margin of debt constant at its 1971 level, we track the evolution of the data until 1983. Afterwards, we find that home equity would have increased by $157,000 in the counterfactual scenario, instead of the observed $108,000, until 2022. Hence, the fact that borrowers adapted their savings behavior and took out

larger amounts of debt against rising asset values slowed down the growth of home equity.

By contrast, if we fix the intensive margin of housing, that is, fix (real) housing values, we get a divergence from the actual data trajectory starting in 1971, and see no growth in home equity during the 1970s. Under this scenario with constant home values, home equity would even have declined after 1983, highlighting that borrowing happened against capital gains and rising asset values. The third counterfactual keeps both housing and debt at their 1971 levels. In this case, we find no change in home equity over time, in line with small extensive-margin effects. We corroborate the pattern and timing of the described effects with higher-frequency data from the PSID in Appendix Figure B.3.

In summary, we find that the increase in average home equity over time is almost entirely driven by rising house values and that the household reaction of increasing debt levels after 1983 slowed down the rise in home equity. Starting in the 1970s, house price increases provided an ideal "breeding ground" for a home equity extraction boom. In the 1980s, financial innovations made it easier and cheaper for households to tap into their rising home equity and reap the benefits of house price surges.[17] Hence, households started to actively manage their portfolio and increased debt levels against rising asset values as part of their consumption-saving decision.

In the next step, we will quantify the role of home equity extraction for the post-1980s debt boom. To do so, we complement the SCF+ data with panel data from the PSID. As discussed in Section 2, we use data from the SRC sample at a biennial frequency. Several approaches have been proposed to measure home equity extraction. Bhutta and Keys (2016) use the New York Fed Consumer Credit Panel to calculate the amount of home equity withdrawal (HEW) based on home equity loans, HELOCs, second mortgages, and cash-out refinancings. According to their calculations, households on average extracted $40,000 between 1999 and 2010, their period of study. However, their data only cover a relatively short period and do not include individual or household demographics to study

[17] We discuss these factors in more detail in Section 6.

the distribution of equity extraction. Greenspan and Kennedy (2008) and Klyuev and Mills (2007) use aggregate data to compute the amount of home equity extraction. While this allows to consider a longer time span, the resulting measures are coarse, and aggregate data do not allow distributional analyses. Moreover, none of the existing studies compares the relative importance of HEW and other reasons for increased mortgage borrowing. The PSID permits us to overcome these limitations with a combination of a long time series for housing and mortgage data and household-level information.

To decompose the debt increase and isolate the contribution of HEW, we need to separate it from other channels that affect debt levels over time: transitions between renting and ownership, upgrading to bigger or better homes, and downgrading. We employ the following definitions:

New owners are defined as households who (1) bought a house and (2) were not homeowners in the previous survey. Their mirror image is **new renters**.

Upgraders are households who (1) were homeowners before, (2) bought a new house, and (3) either explicitly stated upgrading as a reason to move or moved to a home with a larger number of rooms. Their mirror image are **downgraders**.[18] As we are interested in their contribution to the overall debt increase, we will focus on upgraders (downgraders) who increased (decreased) their mortgage in the following.

Extractors are defined following the approach of Bhutta and Keys (2016).[19] In particular, these are households who (1) did not purchase a new home and (2) increased their nominal mortgage balance by more than 5% from one survey to the next, with a minimum increase of 1,000 dollars.[20] The debt change is computed in real terms.

[18] The number of rooms was averaged across all years a household is living in a given house to avoid spurious classifications due to one-time misreporting. Households who increased (decreased) both the size and value of their house by more than 50% were defined as upgraders (downgraders) even if they did not explicitly indicate to have moved.

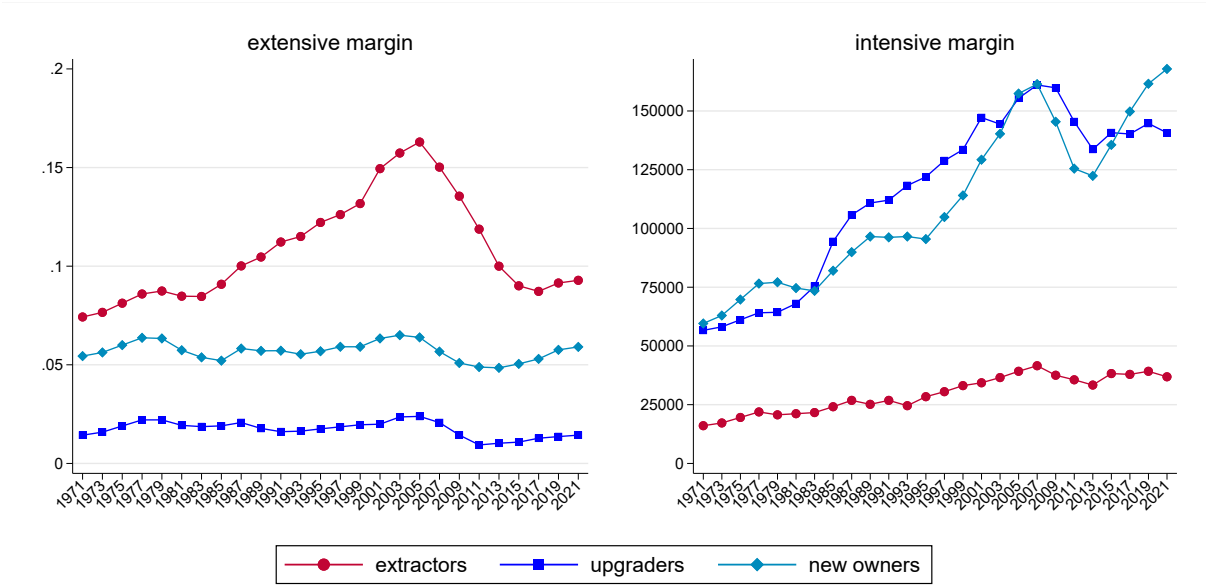
[19] See also Duca and Kumar (2014) for a similar approach.

[20] We also include a relatively small number of households who increased their nominal mortgage balance but moved to a less expensive, smaller, or same-sized home.

The sum of first and second mortgages is our outcome variable. Since 1996, the PSID provides detailed information on mortgage types. These reveal that on average, 92% of first mortgages are conventional mortgages, and 5% are home equity loans. Before 1994, the PSID only reports first and second mortgages in one variable. However, the largest part of extraction happens via first mortgages, as the overall quantity of second mortgages is comparatively small (Appendix Figures A.8 to A.10).[21]

In the left panel of Figure 8, we report the share of households (extensive margin) who extracted equity, upgraded, or bought a new home.[22] We see a pronounced increase in the share of extractors since the mid-1980s, whereas the shares of upgraders and new owners remained relatively constant over time. After 2007, we see a sharp decline in the number of extractors, which only stabilizes toward the end of our sample. The right panel of Figure 8 documents a surge in the amount by which households changed their debt conditional on extracting, upgrading, or changing from renting to owning (intensive

Figure 8: Intensive and extensive margins by type



Notes: The left panel shows the share of households who extracted equity, upgraded, or bought a new home over time. The right panel shows the average debt increase of these households. The series were smoothed by taking a moving average across three neighboring waves.

[21] Even at the peak of the boom in 2007, only 9% of households had a second mortgage, with an average balance of $4,600. By contrast, 47% had a first mortgage, with an average balance of $77,000.

[22] We focus on these groups because they will be most important for our following analysis. A full version with downgraders and new renters can be found in Appendix Figure C.2.

margin). The average extraction amount is approximately $37,000 between 1999 and 2010, close to the estimate by Bhutta and Keys (2016) of $40,000 for this period.[23] The SCF includes a question on equity extraction related to first mortgages since 2004. Despite some differences in mortgage classifications between the surveys, the SCF also yields a similar average extraction amount of $39,000 between 2004 and 2010. We provide a detailed overview of and comparison to the previous literature on HEW in Appendix C. We find our results to be quantitatively consistent.

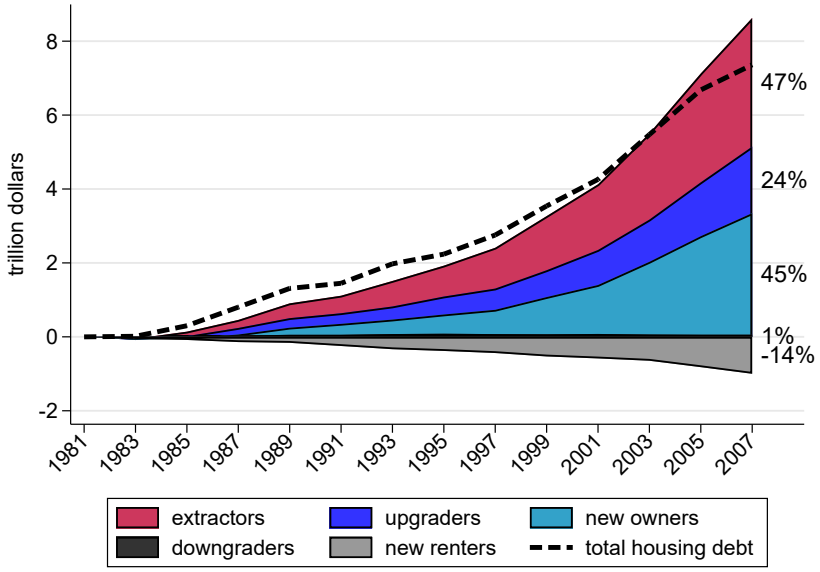
To quantify the relative importance of the different borrower types for the growth of average household debt, we use the following accounting approach. Let D_t denote the stock of housing debt in period t; D_t^+ the new debt taken out by extractors, upgraders, or new owners; D_t^- the debt paid back by households who downgrade or switch to renting; and A_t the regular amortization (and interest payments) of households who do not move or refinance. Then the law of motion for aggregate housing debt is

$$D_t = D_{t-1} + D_{t-1}^+ - D_{t-1}^- - A_{t-1}. \tag{2}$$

For D_t to increase beyond D_{t-1}, we need to observe increases in D_{t-1}^+, or decreases in D_{t-1}^- or A_{t-1}. As a specific example, consider a change in equity extraction. Two reasons account for additional debt due to equity extraction: First, there may be *more households* extracting equity. Second, conditional on extracting equity, households may extract *larger amounts*. Let b denote the base year, and let E_t denote the average debt increase of households who extracted equity in period t (intensive margin in Figure 9). Let s_t denote the share of extractors in period t (extensive margin in Figure 9). The additional debt due to increases in the share of extractors since b is $E_t^{ext} = E_t \times (s_t - s_b)$. The additional debt due to changes in the average extraction amount is $E_t^{int} = s_b \times (E_t - E_b)$. Adding these two numbers tells us how much lower average housing debt would have been if the

[23] Note that our measure refers to total extraction over the previous two years. The results of Bhutta and Keys (2016) suggest that between 10% and 20% of households extract in two consecutive years.

Figure 9: Decomposition of the housing debt boom



Notes: The graph shows the change in total housing debt since 1981 as a dashed black line, together with estimates of the change in the stock of housing debt due to HEW, upgrading, downgrading, new homeownership, and giving up homeownership. Please refer to the text for details on the construction of these estimates. The percentages on the right side are the shares of each shaded area relative to the actual increase (indicated by the dashed line) in 2007.

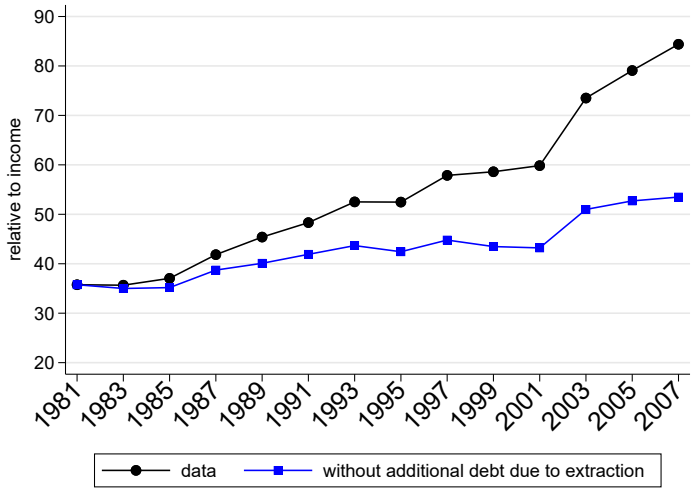
share and amount of extractors had stayed at their base-year levels. We cumulate these series over time and subtract the base-year levels to obtain the amount by which the stock of housing debt increased due to additional equity extraction. Analogous calculations are done for upgraders, downgraders, and new homeowners.

Figure 9 shows our third main new finding, the contribution of the different household types to the increase in housing debt relative to the base year. We consider data between 1981 and 2007 to cover the whole debt boom period since the 1980s. The dashed line in the figure shows the observed increase in housing debt since 1981. Overall, our accounting framework matches the total housing debt increase between 1981 and 2007 well.[24] The red area shows that home equity extraction has been the largest driver of the debt boom, accounting for 47% of the total increase in housing debt. In other words, almost half of the increase in housing debt is driven by incumbent owners borrowing against their home

[24]The close match implies that changes in D^+ and D^- in equation (2) largely account for debt changes between 1981 and 2007. The small residual suggests that no major changes in average amortization behavior occurred.

equity. Upgraders as the second group of incumbent homeowners account for another 24% of the increase. Net in- and outflows from the housing market, from new owners (45%) and new renters (-14%) account for less than a third of the increase. The net contribution of downgraders was negligible over the considered time period.

Figure 10: Counterfactual housing debt-to-income



Notes: The graph shows the housing debt-to-income ratio from the PSID. The blue line with squares shows actual housing debt minus additional debt due to extraction relative to income.

Together, upgrading and home equity extraction account for more than 70% of additional housing debt since 1981. This corroborates the previous finding that the intensive margin of housing debt is the key driver of the debt boom after 1980. Note that both extractors and upgraders tap into home equity for additional spending. Upgraders increase housing consumption by buying a larger or better house, while extractors may use the funds for home improvements or other consumption purposes. Though we cannot observe directly what households use the money for, we can get a good idea based on the SCF, which asked households about the purpose for which they extracted home equity since 1995. Around 37% of extractors use the money for home improvements and repairs. Another 35% spend the money on consumption and repayment of other debts. Other important purposes are investments in other assets (8%), vacation properties (6%), car purchases (6%), and health and education (5%).[25] Finally, we also find that the relative contribution of new

[25]Interestingly, the distribution of households naming health and education as a reason spikes in the age range 50-60, when children typically reach college age (Appendix Figure A.11).

homeownership rose in the mid-1990s. The increasing share of debt from new owners reflects the increase in homeownership rates before 2008.

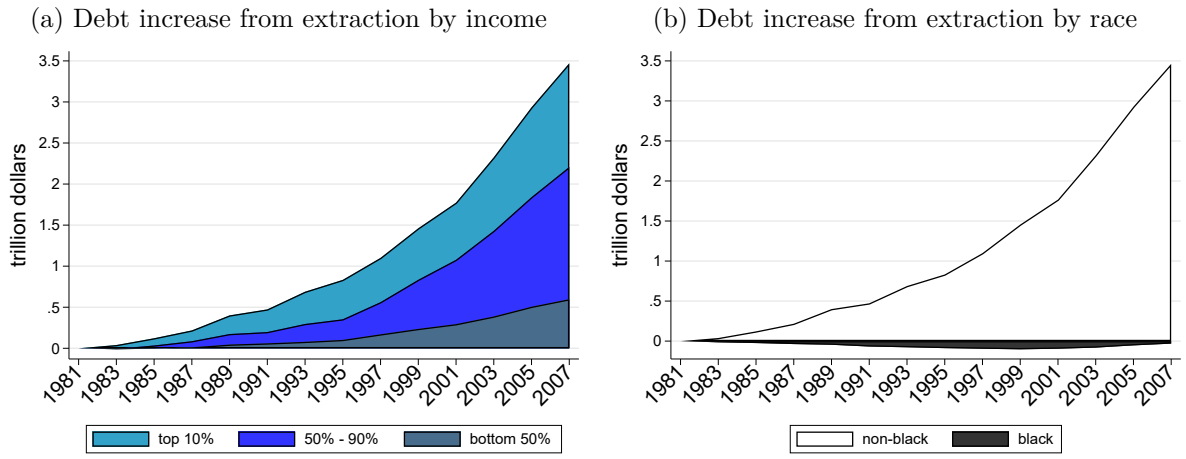
In Appendix Figure C.3, we conduct an analogous decomposition as in Figure 9 for the period of debt reduction after the Global Financial Crisis. Again, equity extraction dominate the picture. Figure 8 shows that households on average extracted slightly smaller amounts over this period, but the lion's share of the reduction comes from the extensive margin, which fell back to pre-boom levels. The other large contributor to the debt reduction are new owners. Here, the reduction mostly comes from new owners taking out smaller mortgages in the post-crisis period.[26]

Equity extraction over the boom between 1980 and 2007 was economically large: U.S. households on average extracted between 2.5% and more than 6% of their annual income each year (cf. Figure 16b). To examine the aggregate relevance of equity extraction more closely, we use the average amount of additional debt due to extraction, as in Figure 9, and multiply it with the total number of households to obtain the aggregate effect. The black line in Figure 10 shows the actual housing debt-to-income ratio from the PSID data.[27] The blue line shows the counterfactual housing debt-to-income ratio after subtracting our estimate of additional debt due to extraction. Without home equity extraction, the housing debt-to-income ratio would have increased by two thirds less from 1981 to 2007 than it actually did. Debt-to-income ratios would have stayed at around 40% until 2001 and increased only during the boom of the 2000s, when new homeowners increased aggregate housing debt. We also approximate the effect on total household debt based on the SCF+ data, which include comprehensive information on non-housing debt. If we assume that housing debt had increased by 50% less from 1983 to 2007 and that non-housing debt had not been affected by the slower increase in housing debt, total household debt relative to income would have peaked a third lower in 2007, at around

[26] While upgraders also reduced their intensive-margin debt substantially, this group is much smaller than the group of new owners, leading to a smaller aggregate impact.

[27] Note that the housing debt-to-income ratio has increased somewhat less in the PSID than in the SCF+, reaching 0.84 in 2007, compared to 0.92 in the SCF+ (Appendix Figure B.2).

Figure 11: Distribution of extraction



Notes: The graph shows additional debt due to extraction by income group (left) and race (right).

74% of income instead of close to around 110% (see Figure 1a).[28] Total household debt would have increased by 43% less between 1983 and 2007.

In the following, we investigate how the equity extraction boom was distributed across different groups of households. In particular, we focus on two key aspects of the U.S. inequality debate, namely households' position in the income distribution and their racial background. Figure 11 highlights the role of the white middle class in the extraction boom. First, we find that equity extraction of the middle class accounts for the majority of total equity extraction (Figure 11a). Taken together, the upper half of the income distribution extracted over 80% of all equity over this time period, leaving only a small contribution to households from the bottom 50%. Second, we find that the extraction boom was almost exclusively driven by white households (Figure 11b). Previous research has shown that racial wealth gaps have been extremely sticky over time (see, for example, Thompson and Suarez 2017, Derenoncourt et al. 2022, Aliprantis and Carroll 2019, Bartscher et al. 2021). In Appendix D.1, we trace these differences back to the large and persistent Black-white homeownership gap, which leads to a substantially smaller share

[28] In the PSID, information on non-housing debt is only available since 1984, and the quality and detail of the data are lower than in the SCF+. However, comparing the debt increase in the PSID since 1984 and the SCF since 1983 yields similar results.

of Black than white households having a mortgage. Moreover, conditional on owning a home, Black households on average own less valuable houses.[29] Housing accounts for a much larger share of the average Black household's asset portfolio compared to the average white household (60% versus 40%, see Appendix Table D.1). This means that Black households have a relatively high exposure to house price changes. They also have less liquid assets, which may make equity extraction for consumption smoothing more attractive for them. However, Black households have much less housing assets to borrow against. It is important to note that the evidence in Figure 11b does not mean that Black households did not extract equity. However, they did not extract more equity over time than they did in the early 1980s. Hence, we conclude that the extraction boom was not only mainly a middle-class affair, but a white middle-class affair.

In the final step, we provide direct evidence that home equity extraction is related to rising house prices. Previous literature has already emphasized that house price increases trigger equity extraction by relaxing collateral constraints (for example, Aladangady 2017, Berger et al. 2018, Cloyne et al. 2019, Andersen and Leth-Petersen 2021). Moreover, the role of reduced interest rates for equity extraction has been pointed out (for example, Bhutta and Keys 2016, Boar, Gorea, and Midrigan 2021). To investigate these channels and their importance for different types of households, we run the following regression in the PSID:

$$\begin{aligned} Y_{it} = \beta_0 + \beta_1 \, \mathbb{I}_{g^p>1} + \beta_2 \, \mathbb{I}_{g^i<1} + \beta_3 \, \mathbb{I}_{LTV>med.} + \beta_4 \, \mathbb{I}_{g^p>1} \cdot \mathbb{I}_{LTV>med.} + \\ \beta_5 \, \mathbb{I}_{g^p>1} \cdot \mathbb{I}_{g^i<1} + \Gamma' X_{ist} + \epsilon_{it}, \end{aligned} \tag{3}$$

where Y_{it} is a binary indicator for equity extraction of household i in period t; $\mathbb{I}_{g^p>1}$ is an indicator for whether the value of a households' home increased since the last period (without having moved); $\mathbb{I}_{g^i<1}$ is an indicator for whether the 30-year mortgage interest

[29] The same is true at the median (Appendix Figure D.2b). Conditional on having a mortgage (house), the debt-to-income (housing-to-income) ratio of Black households is actually very similar to that of white households (Appendix Figure D.2a). This reflects the lower average incomes of Black households.

rate fell since the last period; $\mathbb{I}_{LTV>med.}$ is an indicator for having an above-median LTV ratio in period $t-1$; and X_{ist} is a vector of controls, including dummies for race, sex, marital status, state, age group, income group and the number of children.

Table 1: Propensity to extract

	All	B 50%	M 40%	T 10%	White	Black
$\mathbb{I}_{g^p>1}$	0.029***	0.017*	0.040***	0.024	0.029***	0.019
	(0.007)	(0.009)	(0.011)	(0.020)	(0.007)	(0.029)
$\mathbb{I}_{g^i<1}$	0.012**	0.004	0.021**	0.006	0.014**	-0.009
	(0.005)	(0.009)	(0.008)	(0.014)	(0.006)	(0.015)
$\mathbb{I}_{LTV>med.}$	-0.020***	0.017	-0.028***	-0.046**	-0.017**	-0.094***
	(0.007)	(0.012)	(0.008)	(0.018)	(0.008)	(0.030)
$\mathbb{I}_{g^p>1} \times \mathbb{I}_{LTV>med.}$	0.056***	0.055***	0.050***	0.066***	0.053***	0.093**
	(0.007)	(0.015)	(0.009)	(0.023)	(0.007)	(0.040)
$\mathbb{I}_{g^p>1} \times \mathbb{I}_{g^i<1}$	0.004	0.004	-0.003	0.020	0.005	-0.025
	(0.009)	(0.011)	(0.013)	(0.018)	(0.009)	(0.035)
Constant	0.180***	0.121***	0.203***	0.226***	0.177***	0.245***
	(0.005)	(0.007)	(0.007)	(0.016)	(0.005)	(0.016)
Controls	yes	yes	yes	yes	yes	yes
Mean	0.206	0.141	0.236	0.245	0.205	0.222
Observations	50,109	16,644	25,892	7,571	47,394	2,714

Notes: The table presents results for Equation (3). Standard errors (in parentheses) are clustered at the household-state level (* p<.1, ** p<.05, *** p<.01). The controls include dummies for race, sex, marital status, state, age groups, income groups and the number of children.

Table 1 presents the regression results. The first column shows results for all households. The following columns show results for the three income groups, as well as Black and white households.[30] Looking at all households in column 1, we find a strongly significant increase in the propensity to extract home equity of 3 percentage points after an increase in house values. While the effects are smaller and imprecisely estimated for households in the bottom 50% and top 10% of the income distribution and for Black households, they are on average almost twice as large and highly significant for the middle class and for white households, in line with our previous findings. Looking at the marginal effect of a reduction in the mortgage interest rate, we find a similar response. The effects

[30]When stratifying with respect to income or race, we exclude the corresponding controls.

are slightly smaller than for house price increases, but again clearly concentrated among white and middle-class households. For the effect of the loan-to-value ratio, we find that households who had above-median LTV ratios in the previous period have a lower propensity to extract equity, in line with binding borrowing constraints. However, this is reversed strongly if households also experience an increase in the value of their home. This suggests an important role for the relaxation of collateral constraints. We also find a positive interaction effect between interest rate falls and house price increases, but the effects are relatively small and imprecisely estimated. In summary, Table 1 provides supporting evidence that households extracted home equity by borrowing against rising house prices, especially if collateral constraints were relaxed, and that the responses were strongest for white and middle-class households.

The argument that households extract equity via mortgages when house prices rise is supported by life-cycle theory. Housing is both a consumption and investment good, and it is indivisible. When house prices rise persistently, this leads to (expected) capital gains for homeowners in the future when they sell their house. As housing is indivisible, all capital gains can only be realized at once in a sale and thereafter, the consumption utility of the house can no longer be enjoyed. Borrowing mitigates this intertemporal consumption smoothing problem, as it allows to smooth future expected capital gains in the housing market even before they are realized through trading, and while still living in the house and enjoying its full consumption service. Home equity extraction, therefore, should be seen as optimal life-cycle smoothing behavior. We lay out this argument in more detail in Appendix E and illustrate the mechanism in a simple model.

A link between house prices and consumption-saving behavior has already been established in the quantitative literature on the housing market. Berger et al. (2018) develop a theoretical model to study the different effects through which house price changes can affect consumption spending. They demonstrate that house price increases can induce debt-financed consumption responses by relaxing borrowing constraints or inducing

wealth effects in a life-cycle framework. Their discussion emphasizes the importance of income uncertainty and borrowing constraints, as constrained households have higher effective discount rates, such that the positive effect from a revaluation of current housing assets outweighs the negative effect from higher future costs of living (see also Aladangady 2017). The life-cycle dimension is important for the wealth effect. In an infinite-horizon framework, increases in house values today are offset by increases in house values in the future, such that the expected lifetime budget constraint remains unchanged (Sinai and Souleles, 2005). However, this knife-edge result no longer applies with finite lifetimes, as the house will ultimately be sold (or bequeathed) so the capital gains are realized and enter the lifetime budget constraint.

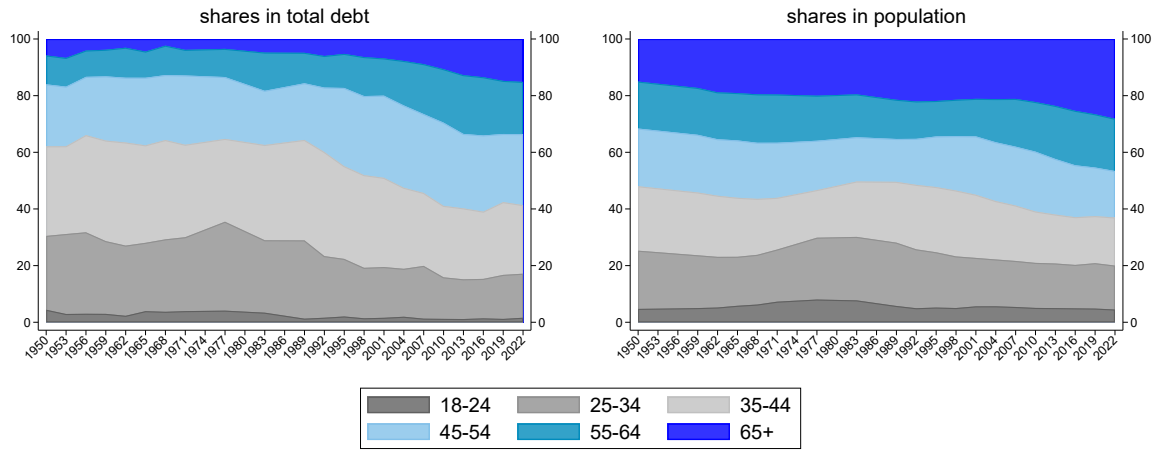
Large extraction of capital gains from rising house prices also raises the question of how unequal these effects played out across different generations. Homeownership has a natural life-cycle profile, and house price changes will play out differently across birth cohorts who are at different points in their life cycle. While young households want to buy houses and have to take out more debt for a given down payment, older households who are already homeowners benefit from rising house prices and capital gains (Loewenstein 2018). In the next section, we will use the long-time coverage of the SCF+ to follow specific generations over time to see how rising debt levels and equity extraction differ across cohorts and have changed the life-cycle debt across generations of U.S. households.

5 Debt boom and intergenerational inequality

Demographic change influences aggregate debt dynamics, as households owe different amounts of debt at different points of the life cycle. Hence, even without any change in borrowing behavior, aggregate indebtedness will change if the age structure of society changes. Additionally, borrowing behavior by age can change across cohorts, thereby affecting macroeconomic debt dynamics. Especially home equity extraction has ramifica-

tions for debt accumulation over the life cycle. Instead of steadily paying down their debt and throwing a "mortgage-burning party" after 30 years, as previously common (Story 2008), households extracting equity increase their debt balance again in the middle of the life cycle. We will use the SCF+ data to quantify the role of the changing age composition and changing borrowing behavior by age for the aggregate debt boom.

Figure 12: Shares of age groups in total debt and population

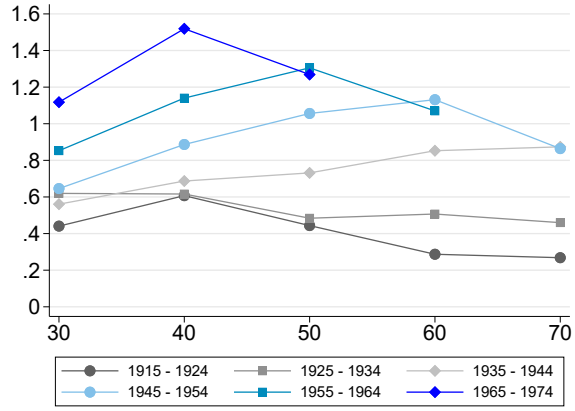


Notes: The left panel shows the share of each age group in total household debt. The right panel shows the population share of each age group among all households.

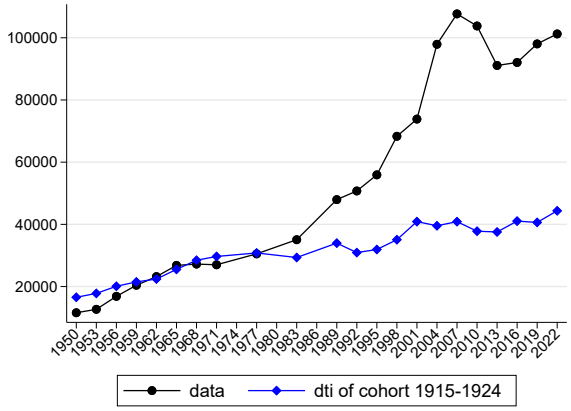
To study the effect of the changing age structure on aggregate debt, Figure 12 compares the debt shares held by different age groups to their population shares over time. The debt shares were very stable until around 1990. Thereafter, we observe a "graying" of U.S. household debt (Brown et al., 2020), with the share of debt owed by households above age 45 increasing from around 40% to 60%. By contrast, their population share only increased by around 12.5 percentage points over the same period. Thus, pure changes in the age composition do not account for the whole increase in debt held by older households, and there must have been changes in borrowing behavior over the life cycle. Indeed, the pure age composition effect from changes in population shares exerted *downward* pressure on aggregate household debt. The reason is that although older households increased their debt over time, they still have lower average debt levels than younger households. Consequently, household debt increased by less than what it would have if the age composition had remained as in 1950, all else equal (Appendix Figure D.3a).

Figure 13: Changes in life-cycle debt dynamics

(a) DTI ratios by cohort



(b) Counterfactual: DTI of oldest cohort



Notes: The left panel shows the life-cycle profiles of total debt-to-income (DTI) ratios for our synthetic cohorts. DTI ratios were winsorized at the 99th percentile within each year. The right panel shows average debt in comparison to a counterfactual assigning the average DTI ratio of the oldest cohort (1915-1924) to all households.

The previous evidence on the large contribution of home equity extraction to the aggregate debt increase, combined with the fact that it typically occurs in mid-life, suggests that home equity extraction is the likely driver behind the change in life-cycle borrowing behavior. In the PSID data, we find that the median new owner, who takes out a mortgage to buy a home instead of renting, is 32 years old, while the median extractor is 45 years old. Hence, relative to taking out debt when entering the housing market, home equity extraction increases debt later in life. To study how the life cycle of debt changed across cohorts, we rely on the long time period covered by the SCF+ and its rich demographic information. We construct synthetic birth cohorts for households with heads born 1915–1924 (1965–1974) as our oldest (youngest) cohort.[31] For all cohorts, we estimate the life-cycle profiles of total debt-to-income (DTI) ratios by regressing individual ratios on six age group dummies for households with a head aged 25-34, 35-44, 45-54, 55-64, 65-74, and 75-85 years. The estimated life-cycle profiles are shown in Figure 13a.

We observe a striking increase in DTI ratios from one cohort to the next, leading to an overall increase in DTI profiles. We also observe that the upward shift of DTI profiles

[31] In Appendix D.3, we show that the same patterns are visible in the PSID data, which allow to follow actual instead of synthetic cohorts.

did not happen in parallel but that there is a turning point that moves forward in the life cycle from generation to generation. The turning point occurs when the average household from the 1915-1924 cohort is 60 years old, the average household from the 1925-1934 cohort is 50, and the average household from the 1935-1944 cohort is 40. In other words, it coincides with the onset of the equity extraction boom around 1980.[32]

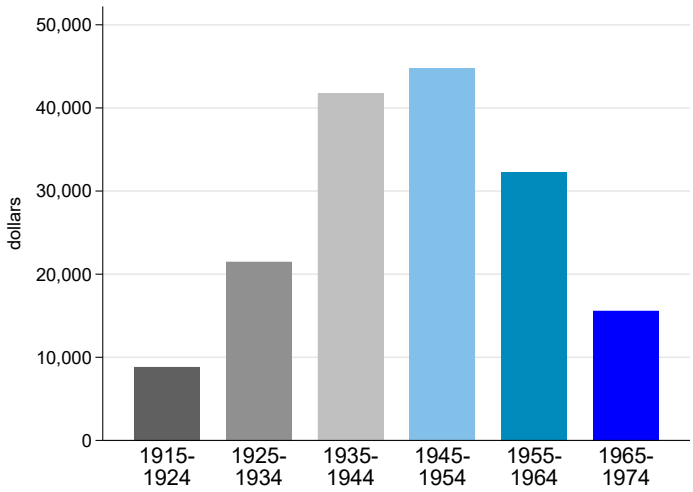
Starting with the 1955-1964 cohort, we finally observe a level increase of the entire profile, including the starting point at age 30. While the oldest generation started their economic life cycle with an average DTI ratio of around 0.4, we find that after three cohorts with similar initial DTI ratios of around 0.6 the beginning-of-life DTI ratios jump up, starting with the cohort born between 1955 and 1964, which was on average 30 in 1990. Younger cohorts had to take out more debt already when buying their first home because they entered a housing market with steeply rising prices.

As a consequence of the rising DTI profiles, households also reach retirement with substantially higher debt levels (Lusardi, Mitchell, and Oggero, 2018, 2020). Comparing cohorts at age 60, the visual contrast is stark. The oldest cohort approached retirement with modest DTI ratios of around 30% at age 60. Households born in the two decades after World War II had DTI ratios of almost 120% at the same age. Projecting forward the DTI profiles of the youngest cohort suggests that they will enter retirement with similar levels of indebtedness as their predecessors.

How much did the change in borrowing behavior shape the aggregate debt increase? To answer this question, we use that households from the oldest cohort were already on average 60 years old at the onset of the post-1980 extraction boom, and thus spent most of their lives in a world without significant equity extraction. We construct a counterfactual debt level without changes in borrowing behavior by multiplying the actual income of each household at a certain age with the average DTI ratio of the oldest cohort in that age

[32] In Appendix Figure D.4, we present versions of Figure 13a that are stratified by within-age income and net wealth, respectively. We see that the shifting and tilting occurs for all households, but is most pronounced in the middle of the distributions. We thank an anonymous referee for this suggestion.

Figure 14: Sum of extracted home equity by cohort over the extraction boom

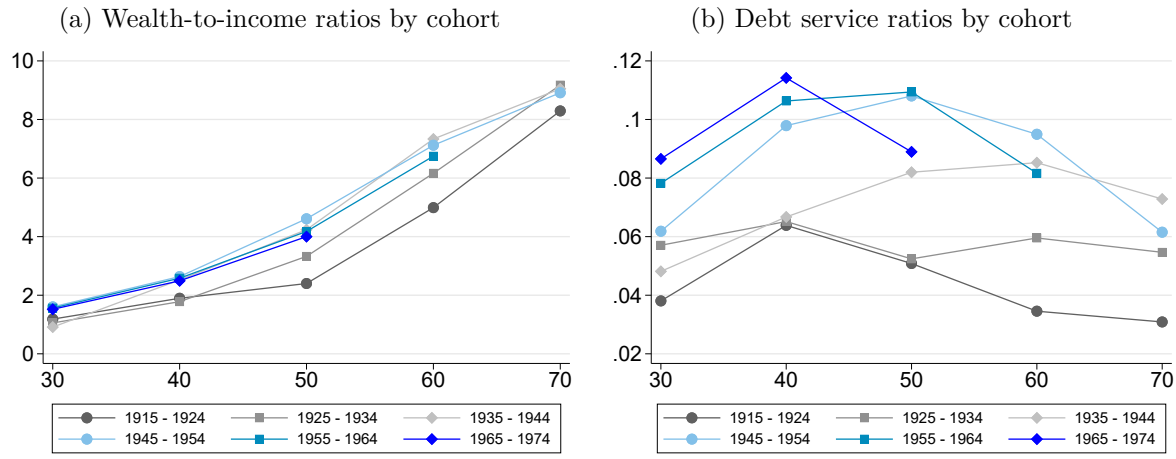


Notes: The graph shows average total equity extraction, summed over the extraction boom from 1981 to 2007, for our six different cohorts. The graph is based on the PSID. Extraction amounts were winsorized at the 1st and 99th percentile within each year.

group, thereby assigning all households the average life-cycle debt accumulation pattern of the oldest cohort (1915-1924). Figure 13b shows that in this case, the debt boom after 1980 remains largely absent. Before 1980, the counterfactual debt profile closely follows the actual average debt trajectory, suggesting that the debt profile of the oldest cohort captures the debt accumulation of the older cohorts well. For 2022, we find that if all households had maintained the life-cycle DTI profile of the cohort born between 1915 and 1924, average debt would barely have increased, reaching around 44,000 dollars instead of the observed 101,000 dollars, which highlights the importance of changed life-cycle borrowing behavior as a key driver of the U.S. debt boom.

We have seen that these rising debt levels happened against rising house values and capital gains. The timing of the house price increase implies that different generations of U.S. households had very different experiences with the housing market. Whereas the older cohorts enjoyed large capital gains from rising house prices, the younger cohorts had to get more indebted to buy a house at the beginning of their life cycle (Figure 13a). The asset-price-induced debt boom therefore played out very differently across generations and constitutes a potentially powerful driver of changes in intergenerational inequality.

Figure 15: Wealth and debt service over the life cycle



Notes: The left panel shows the life-cycle profiles of the wealth-to-income (WTI) ratio for each of our synthetic cohorts. The right panel shows debt-service-to-income (DSTI) for housing debt. WTI and DSTI ratios were trimmed at the 99th percentile within each year.

Capital gains on the household balance sheet from rising asset prices may remain "paper gains" (Sinai and Souleles, 2005) that matter for measured wealth but not for welfare. Only if the capital gains are realized, they expand the budget constraint and become welfare relevant (Fagereng et al., 2022). Above, we have discussed that home equity extraction provides a way to realize (expected) capital gains and still enjoy the consumption flow of owner-occupied housing. To quantify the income-increasing realized capital gains across generations, we therefore estimate the total extracted equity over the post-1980 debt boom for each cohort. Figure 14 shows large differences in total extracted equity from 1980 until 2007 across our six birth cohorts. The cohorts born between 1935 and 1954 bought houses at relatively low prices before 1980 and could reap large capital gains when prices were surging. Accordingly, they extracted most home equity, on average more than $40,000. The older generations could also buy houses at relatively low prices but were already older in 1980, so they only experienced a small part of the equity extraction boom. Finally, the younger generations born after 1955 typically bought into a housing market that already required high initial debt levels because of the higher prices and subsequently, they could extract less home equity.

Our fourth main new finding is that more debt did not lead to lower net worth on average

due to simultaneously increasing asset values: We find that the very different life-cycle debt profiles and equity extraction did not lower wealth accumulation across generations. In Figure 15a, we show life-cycle wealth-to-income ratios for our six cohorts. We find that younger cohorts did not have systematically lower wealth-to-income ratios than their predecessors, despite their higher debt levels. Wealth-to-income ratios at age 30 remain very similar across all cohorts. Later in life, we find that although the cohorts born between 1935 and 1954 extracted most home equity, they still remained the wealthiest cohorts in the post-war United States. By contrast, the oldest generation, which was already 60 years old at the onset of the equity extraction boom, not only extracted the least equity of all six generations but was also consistently the poorest generation.

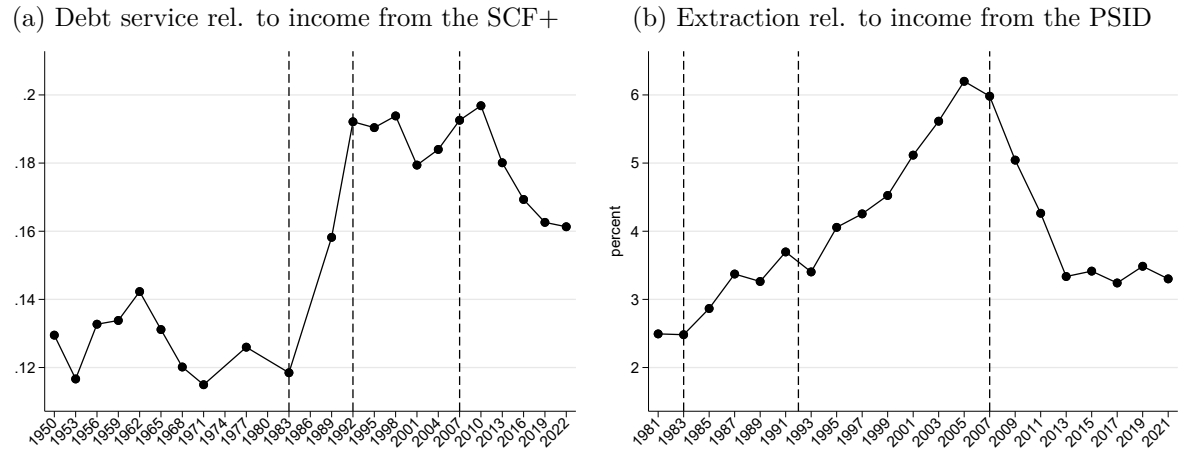
Although the debt expansion has not lead to lower net wealth for the generations most exposed to equity extraction, their balance sheets have become more inflated and thus more risky. Figure 15b shows the debt-service-to-income (DSTI) ratios of our six cohorts over the life cycle. Again, we can clearly discern when each cohort reached the 1980s. At this point, as for the DTI profiles in Figure 13a, the DSTI profiles turn upward. For the three youngest cohorts born between 1945 and 1974, we see a downward shift after the 2008 financial crisis. However, these generations' DSTI ratios are still at historical highs, in particular at later stages of the life cycle, when future income is likely to decline. Therefore, they are more vulnerable to interest rate increases or other shocks to their debt service capacity than generations that were not affected by the extraction boom. In the last section of the paper, we use the SCF+ data to study the implications of rising debt levels for households' debt service costs relative to their income over time.

6 Aggregate consequences of the debt boom

In Figure 16a, we show DSTI ratios from the SCF+ over time for all households with positive housing debt.[33] DSTI ratios were relatively stable before the 1980s. After the onset of the extraction boom, they rose sharply until the early 1990s. However, while the extraction boom accelerated even more from the early 1990s to the 2008 crisis, as illustrated in Figure 16b, DSTI ratios stabilized in the early 1990s and remained surprisingly stable until the Financial Crisis. Over time, two counteracting forces shaped the evolution of the DSTI ratio: Falling mortgage interest rates exerted downward pressure, whereas the rising debt-to-income ratios had an opposing effect. Starting from the early 1980s, conforming mortgage interest rates fell from more than 12% to 6% in the 2000s (Appendix Figure C.5). The observed stable DSTI ratio during the 1990s is the result of falling interest rates and increasing debt levels roughly canceling each other.

Mian, Straub, and Sufi (2021a) jointly account for these developments in a theoretical framework with rising income inequality as the exogenous cause. They propose a theory

Figure 16: Extraction and debt service



Notes: The left panel shows mortgage debt service costs relative to income, conditional on having mortgage debt, from the SCF+. The right panel shows home equity extraction relative to income from the PSID. The dashed lines indicate the years 1983, 1992 and 2007 in both graphs.

[33] Debt service comprises the entire cash flow of households to service the mortgage including interest, amortization, fees, and taxes if they are paid to the mortgage company.

where high saving rates and strongly rising top incomes lead to a decline in interest rates, drive up house prices, and make mortgage debt cheaper for the bottom 90% of the income distribution. This theory assigns home equity extraction a key role in the debt boom after 1980, for which our analysis provides empirical support. Their theory also predicts that extracting households did not get poorer over time, consistent with our evidence.

Other explanations for the decline in mortgage interest rates are deregulation and innovations that reduced the cost of debt and made equity extraction easier (Justiniano, Primiceri, and Tambalotti, 2019). Regulatory reforms like the *Monetary Control Act of 1980* and the *Garn - St. Germain Act of 1982* and technological advances like the introduction of credit scoring made financial instruments to cash out home equity cheaper (Campbell and Hercowitz, 2009; Exler and Tertilt, 2020). Until 1982, the *Truth in Lending Act of 1982* allowed consumers to rescind home equity credit within three days, which made second mortgages expensive for banks. The deregulation in the early 1980s allowed more banks to sell second mortgages, and they quickly gained popularity (Elia, 1981; Story, 2008). Another factor facilitating lending was the spread of mortgage-backed securities. These had been invented on the late 1970s and spread quickly in the 1980s, allowing banks to finance mortgage lending with bonds and alleviating them of the need to increase deposits (Doepke and Schneider 2006). In response to these developments, the financial industry started to aggressively market home equity borrowing products and invented new products like home equity lines of credit (Maki 2001). The HEL market grew from $1 to $100 billion between 1982 and 1988 (Story 2008 and Appendix Figure C.4), with higher competition lowering the costs for borrowers.

The lower mortgage costs allowed households to sustain larger debt balances over long periods. High balances however become problematic once debt costs increase, which can entail sizeable consumption cuts (Ahn, Galaasen, and Mæhlum, 2023). We see in Figure 16a that DSTI ratios remained elevated compared to historical levels even after the debt reduction after the Financial Crisis. If interest rates surge, households may have to reduce

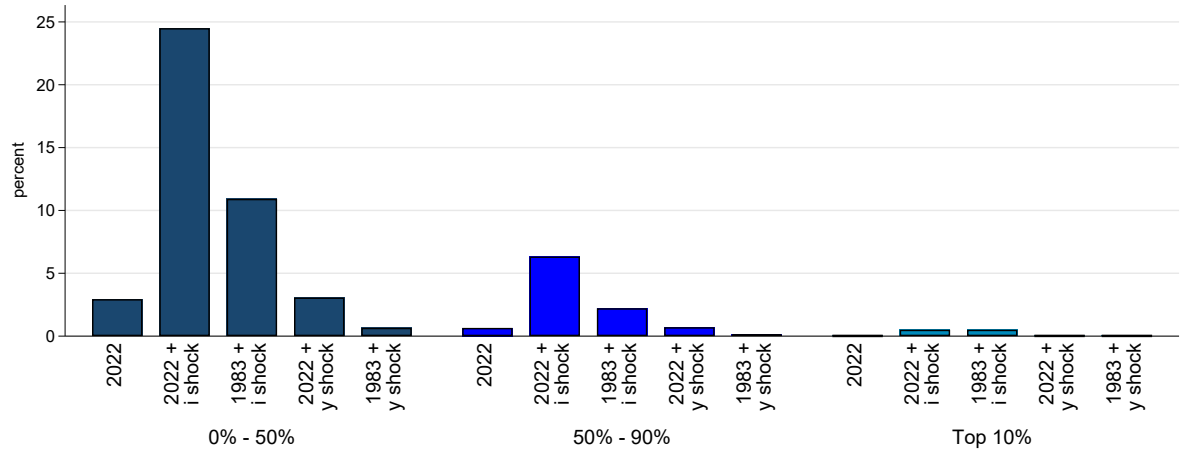
their borrowing or consumption to service the higher interest payments. Mian, Straub, and Sufi (2021a) highlight this risk and its consequences for macroeconomic demand in a high-debt environment in theory.

During the debt boom, mortgage interest rates were mostly declining but they recently surged pronouncedly, making the consequences of such an increase a highly relevant question. By the end of 2022, mortgage interest rates were around 3.3 percentage points higher than the average over the previous two years (Appendix Figure C.7a). We use this interest rate hike as the shock in a "household stress test" based on information from the most recent SCF in 2022 to quantify the interest rate exposure resulting from extended household balance sheets. Our experiment is a simple comparative statics exercise, abstracting from general equilibrium and behavioral effects. We assume that all households in the 2022 SCF who have bought a new house or refinanced a mortgage during the past two years (2020 and 2021) have to pay 3.3 percentage points more interest on their mortgage.

As we do not know exact reset rates, we do not include adjustable rate mortgage (ARM) holders in the analysis. However, their number is small: only 5% of mortgage holders had an ARM in the 2022 SCF. By contrast, around 19% of borrowers had moved over the past two years, and around 23% had refinanced a mortgage. The shock induced by our stress test is thus economically sizable: The aggregated additional debt costs from the interest shock across all households amounts to 0.85% of total household income.

Higher DSTI ratios imply higher committed monthly payments that reduce the resources of households for other expenditures. Ganong and Noel (2023) find that it is typically a lack of liquidity and not high LTV ratios that leads households to default on their mortgage. To get a sense of how many households might be forced to borrow less than desired or cut their consumption after the shock, we calculate how many households will have critically high DSTI ratios. Additionally, we consider a shock to household income. Here, we take the Great Recession of 2008 as the baseline for our stress test. From 2008 to 2009, the share of households with unemployed heads in the CPS increased

Figure 17: Share of households with critically high DSTI ratios



Notes: The graph shows the share of households with critically high debt-service-to-income (DSTI) ratios in 2022 by income. It additionally shows counterfactuals for this share if households were hit by the interest shock ("2022 + i shock") or the earnings shock ("2022 + y shock") described in the text, or if they were hit by these shocks, but starting from DSTIs as low as in 1983 See text for additional details ("1983 + i/y shock").

by 5.3 percentage points for the bottom 50%, by 2.8 percentage points for the middle 40%, and by 1.8 percentage points for the top 10%, (Appendix Figure C.7b). We employ the estimates on earnings losses following job displacement by Davis and von Wachter (2011), who document that earnings drop by 39% after displacement. We thus let the income of the main wage earner drop by 39% for an additional 5.3/2.8/1.8 percent of bottom 50%/middle 40%/top 10% households. We shock households randomly within each income group and average results across 99 random draws.

Figure 17 shows the share of all households from the 2022 SCF who have a critically high DSTI ratio, together with the share who would have a critically high DSTI ratio after the interest (bars labeled "2022 + i shock") or earnings shock (bars labeled "2022 + y shock"). We consider a threshold of 43% as critically high, in line with the Dodd-Frank Act (Hizmo and Sherlund 2018). In addition, we ask what the share of households with critically high DSTI ratios would be after the same shocks, but starting from pre-boom DSTI ratios (bars labeled "1983 + i/y shock").[34]

[34]We do this by scaling 2022 DSTI ratios with the ratio of average 1983 to average 2022 DSTI ratios for each income group before applying the shock. To avoid extreme outliers, we trimmed DSTI ratios at the 99th percentile.

The top 10% are well protected against both kinds of shocks. However, households from the middle class and the lower half of the income distribution are much more exposed to interest shocks. Around 3% of bottom 50% households already had critically high DSTI ratios in 2022 without an additional shock. This share would surge to almost 25% if those who bought or refinanced in 2020 or 2021 had already had to pay 2022 interest rates. By contrast, it would only rise to 11% if households had started out with 1983 DSTI ratios. The share of middle-class households with critically high DSTI ratios increases from below 1% to above 6% after the interest rate shock when starting from current DSTI ratios. Again, the increase would be much smaller when starting from 1983 DSTI ratios (around 2%). While the qualitative patterns are the same for the income shock, the overall effect size is small. This is because only a few households are hit by substantial negative income shocks even in a recession, whereas an interest shock affects all households who would like to take out a mortgage.

While our analysis remains silent on the exact response margins, for example, which households will borrow less, who will no longer be able to buy a home, or who will have to cut their consumption, our stress tests show that the secular increase of DSTI ratios has made households more susceptible to shocks that affect their debt service capacity, especially interest rate shocks. In summary, our analysis in this paper highlights the tradeoff underlying the household debt boom: the higher debt levels allowed households to expand their individual budget sets by realizing capital gains, especially the generations of incumbent homeowners in the 1980s; but the rising debt levels also increased the financial fragility of the U.S. household sector to historically high levels.

7 Conclusion

This paper studies the increase in household debt in the United States since World War II. Relative to income, household debt has risen by a factor of four. Using long-run

household-level data from the SCF+, we document the growth of U.S. household debt, its composition and distribution, as well as its changing nature over time. The past seven decades saw two debt booms, one after World War II and one from the 1980s to the 2008 financial crisis. The first boom was triggered by a homeownership expansion in the postwar era, and therefore mainly happened at the extensive margin. By contrast, the second boom phase was characterized by a decoupling of income and debt growth and strong debt increases at the intensive margin. This boom dwarfed the first one.

We emphasize the nexus between house prices, housing wealth, and equity extraction. House price increases led to a substantial increase in household wealth, to which households responded by increasing their mortgage balances to extract home equity. Such home-equity-based borrowing accounts for about half of the increase in U.S. housing debt during the post-1980s debt boom. We show that the white middle class was the largest contributor to the extraction boom. Moreover, we show that equity extraction, which typically occurs in the middle of the life cycle, led to pronounced changes in the life-cycle profiles of debt. However, since the debt growth was backed by growth in housing values, household wealth remained similar across cohorts. These findings highlight the importance of incorporating portfolio adjustments, debt decisions, and asset price dynamics into structural models of the consumption-saving decision.

At the macroeconomic level, we demonstrate the tradeoff associated with the debt boom. Realizing capital gains expanded the household budget set but it also decreased the resilience of the U.S. household sector as it moved more households closer to critically high mortgage debt service levels that made more households susceptible to financial risk, especially in periods with rising interest rates as recently experienced.

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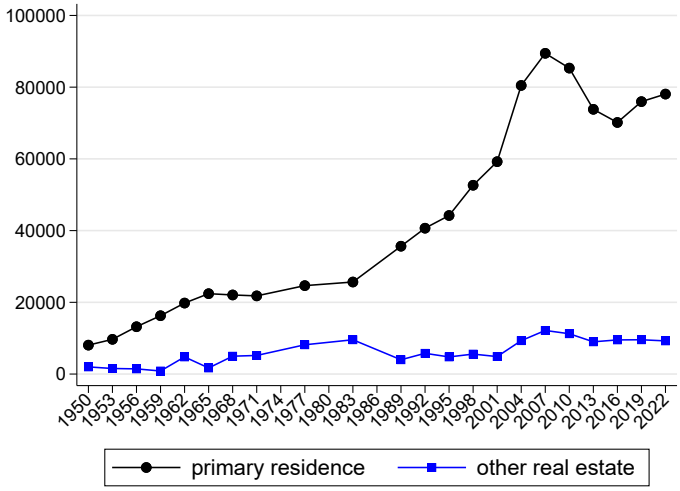
Online Appendix

A Additional results

A.1 Debt on primary residence and other real estate debt

Figure A.1 shows the amount of housing debt on primary residences and other real estate debt. Debt on principal residences is on average eight times larger than the debt on other real estate. The difference is particularly large after 1980.

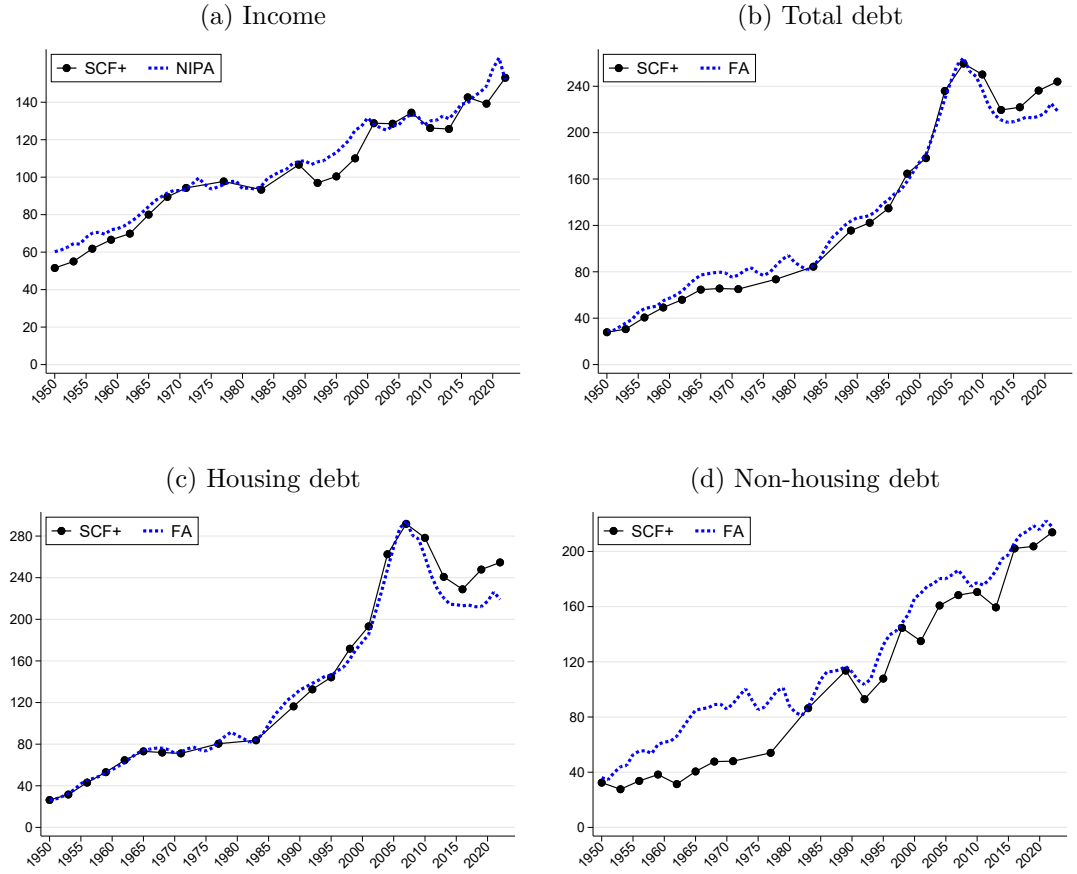
Figure A.1: Other real estate debt



Notes: The graph shows debt on owner-occupied real estate and other real estate debt in the SCF+.

A.2 Aggregate trends in SCF+ and NIPA

Figure A.2: Income and debt in the SCF+ versus NIPA and FA



Notes: The figure shows average income and debt from the SCF+ (black lines with circles) in comparison to income per household from the NIPA and debt per household from the FA (dashed blue lines). All series have been indexed to 1983-1989 = 100. Over the index period, the SCF+ values correspond to 95% of NIPA income, 83% of FA total debt, 85% of FA housing debt, and 78% of FA non-housing debt.

We index the series to 100 in 1983-1989 to abstract from level differences that can be attributed to different measurement concepts and focus on comparing growth trends over time. During the base period 1983-1989, the SCF+ data correspond to 89% of NIPA income and 78% of FA debt in levels.[35]

Figure A.2 shows the comparison of growth trends between the SCF+ and aggregate data for 1950 to 2022. Overall, the aggregate data and the aggregated microdata show very

[35]The income NIPA components are wages and salaries, proprietors' income, rental income, personal income receipts, social security, unemployment insurance, veterans' benefits, other transfers, and the net value of other current transfer receipts from business. Mortgages and consumer credit are included as FA debt components. Henriques and Hsu (2014) and Dettling et al. (2015) provide excellent discussions of the different measurement concepts between SCF, NIPA, and FA data.

similar trends. With respect to housing debt, the SCF+ data and the FA match almost perfectly. Non-housing debt also aligns well with the FA data, albeit there is a certain discrepancy before the 1980s. All in all, the close alignment in growth trends effectively alleviates concerns that the microdata systematically miss parts of the distributional changes underlying the observed macroeconomic growth trends.

A.3 Group stability over time

Table A.1 documents the persistence within income groups in the PSID. It shows how many households were already in the same income group two years ago (Table A.1). The numbers for the 50%-90% and top 10% are 75% and 66%, respectively. When we extend the intervals to six years, the share of households who are in the same group six years later is still 77% for the bottom half, 68% for the middle class, and 53% for the top 10%.

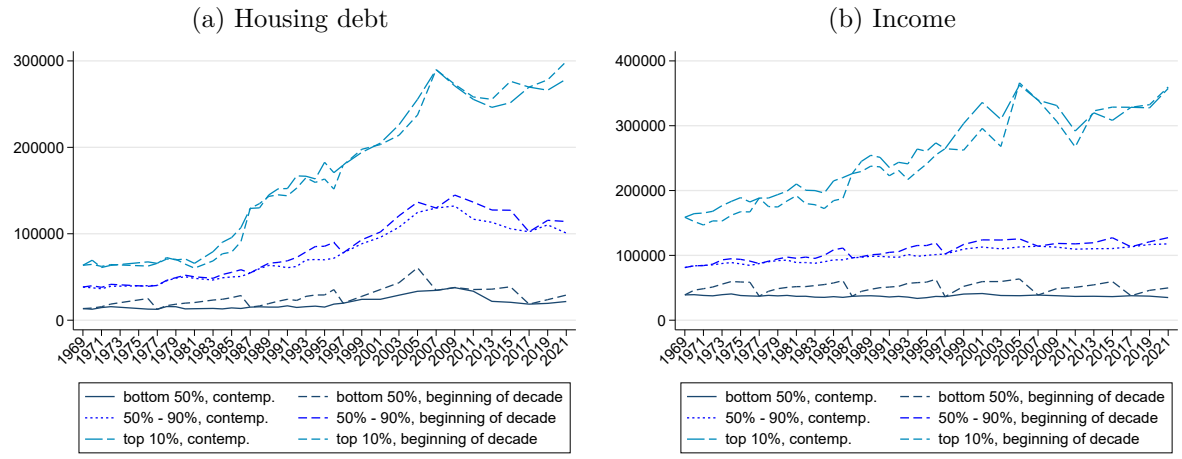
For households aged 25 to 55, Figure A.3 compares the time series for debt and income in the PSID when households are binned into income groups based on their contemporaneous and beginning-of-decade income. The age range is chosen based on the period in life when households typically work and buy houses. The SCF data do not have a panel dimension,

Table A.1: Income group stability

year	B 50%	M40%	T 10%	year	B 50%	M 40%	T 10%
1970	0.85	0.73	0.66	1989	0.85	0.75	0.71
1971	0.85	0.74	0.70	1990	0.86	0.77	0.73
1972	0.86	0.75	0.68	1991	0.86	0.76	0.68
1973	0.86	0.75	0.63	1992	0.84	0.76	0.69
1974	0.85	0.76	0.65	1993	0.83	0.74	0.66
1975	0.85	0.75	0.68	1994	0.83	0.73	0.63
1976	0.84	0.74	0.66	1995	0.84	0.74	0.61
1977	0.85	0.75	0.62	1996	0.82	0.74	0.64
1978	0.85	0.75	0.65	1997	0.82	0.72	0.64
1979	0.86	0.74	0.63	1999	0.83	0.74	0.62
1980	0.86	0.77	0.66	2001	0.81	0.74	0.64
1981	0.86	0.77	0.66	2003	0.83	0.74	0.63
1982	0.85	0.76	0.65	2005	0.84	0.76	0.66
1983	0.84	0.75	0.68	2007	0.85	0.78	0.69
1984	0.85	0.77	0.70	2009	0.84	0.77	0.69
1985	0.84	0.76	0.69	2011	0.86	0.77	0.70
1986	0.85	0.75	0.67	2013	0.86	0.77	0.71
1987	0.83	0.75	0.66	2015	0.86	0.77	0.70
1988	0.84	0.75	0.65	2017	0.85	0.77	0.72

Notes: The table reports, for each wave of PSID, the share of households who stayed in their respective income group since two years ago.

Figure A.3: Sensitivity: housing debt and income by income group



Notes: The graph shows average housing debt (left panel) and income (right panel) by income group for households between ages 30 and 55. We first sort households by their contemporaneous income and show the results as solid lines. For comparison, we sort households by their income at the beginning of each decade (1969, 1977, 1987, 1997, 2007). These results are shown as dashed lines.

so we can only sort households based on their contemporaneous income. Figure A.3 demonstrates that the differences between the two sorting approaches are minor, owing to the high degree of persistence of income groups, as shown in Table A.1.

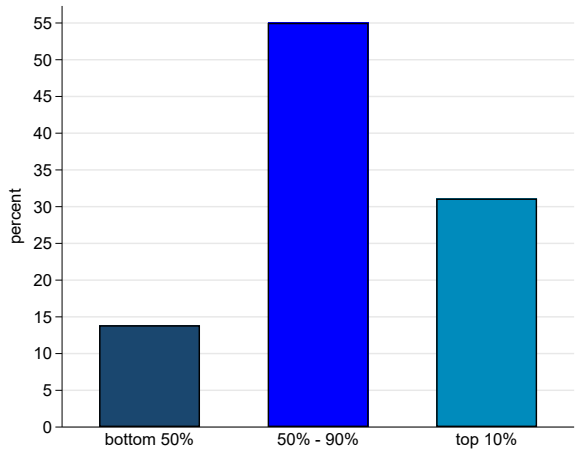
A.4 Further results on debt-to-income ratios

Figure A.4 shows the share of each income group in the total increase of household debt between 1950 and 2007.

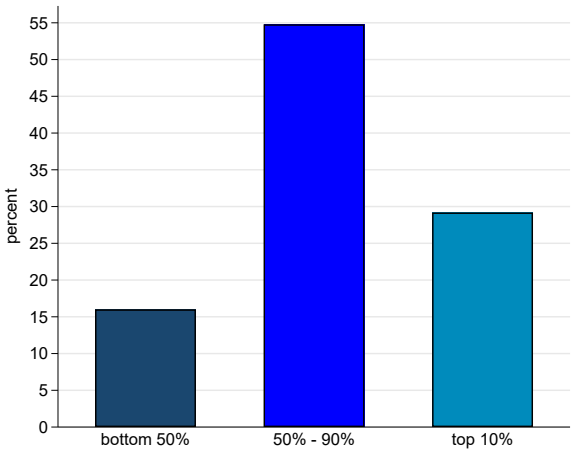
Figure A.5 documents income and debt growth along additional socioeconomic lines. All time series are indexed to their averages over the 1970s. Before the late 1970s, all time series comove closely, but they strongly diverge thereafter.

Figure A.4: Share of increase in debt, 1950-2007

(a) Share of increase in housing debt



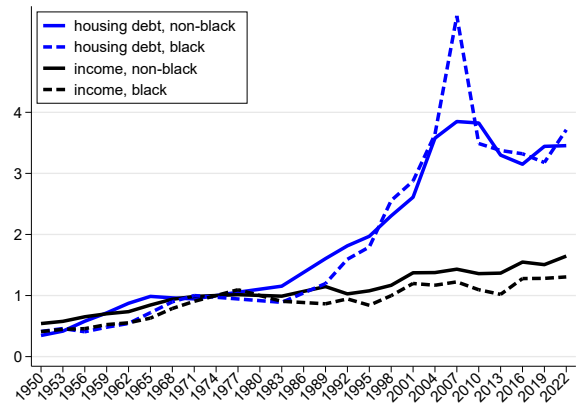
(b) Share of increase in total debt



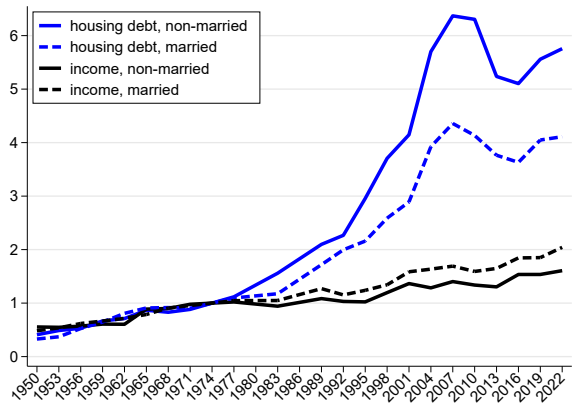
Notes: The graph shows the share of each income group in the increase of housing debt (left panel) and total household debt (right panel) from 1950 to 2007.

Figure A.5: Housing debt and income growth along socioeconomic lines

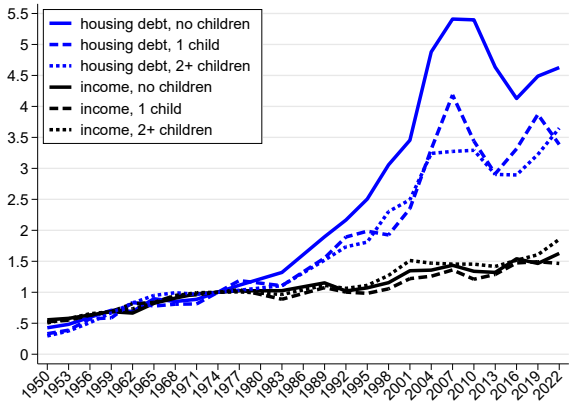
(a) Race



(b) Marital status



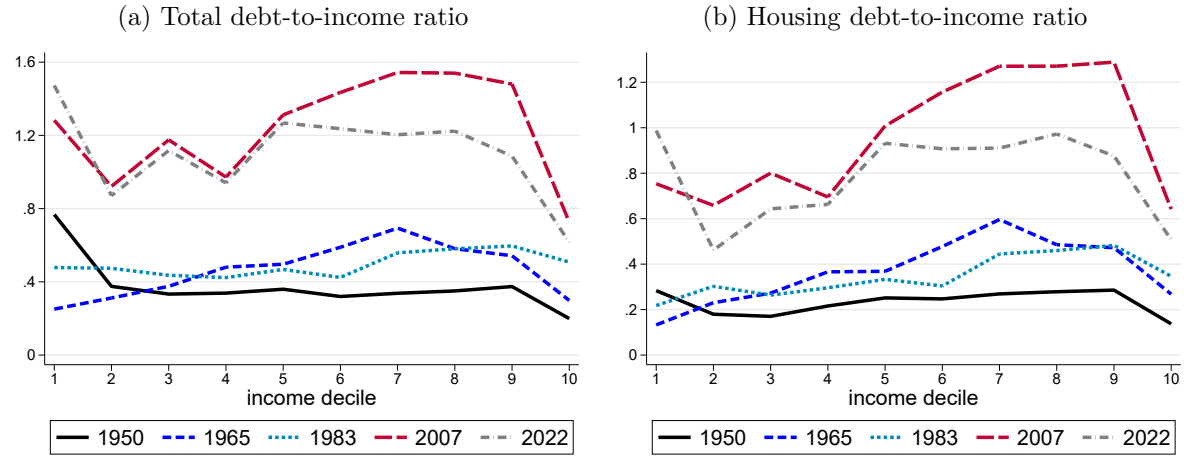
(c) Number of children



Notes: The graph shows the growth of average housing debt and income by race, marital status and number of children, relative to 1970s averages.

Figure A.6 shows the evolution of debt-to-income ratios across the entire income distribution for different survey waves. The left panel shows total debt-to-income, and the right panel shows housing debt-to-income ratios. Debt-to-income ratios were relatively constant in 1950, at less than 50% across most of the income spectrum. By 1983, debt-to-income ratios had increased somewhat, but were not far off their levels in the 1950s. Since then, indebtedness has risen strongly across all income groups, but soaring debt ratios of the middle class stand out. For households between the 50th and 90th percentiles, debt-to-income ratios approximately tripled between the early 1980s and 2007, driven by mortgage debt.

Figure A.6: Debt along the income distribution

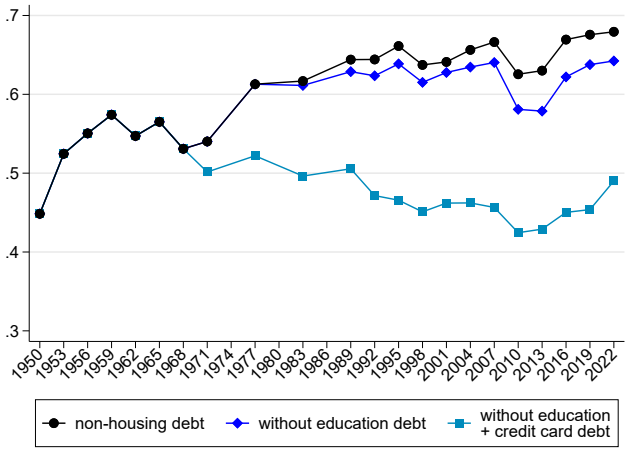


Notes: The graph shows the evolution of average total (left) and housing (right) debt-to-income ratios by deciles of the aggregate income distribution for the SCF+ waves 1950, 1965, 1983, 2007, and 2022. We excluded households with total income below 10% of the annual wage of a household with a single earner receiving the contemporaneous minimum wage.

A.5 Credit cards, education debt, and mortgage types

Figure A.7 decomposes the extensive margin of personal debt over time. It shows the extensive margin for all non-housing debt, for the case when education debt is excluded, and for the case when education debt and credit card debt are excluded. Excluding credit card debt reduces the share of households with personal debt by more than 10 percentage points after 1980. Without credit cards, we do not get an increase in the extensive margin of personal debt since 1970.

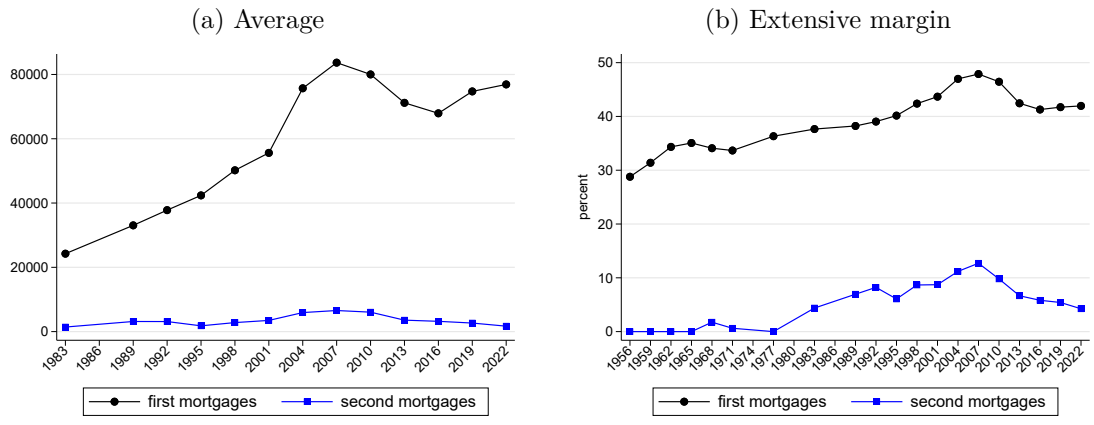
Figure A.7: Personal debt, extensive margin



Notes: The graph shows the extensive margin of personal debt from Figure 4, together with counterfactuals in which credit card and education debt were set to zero.

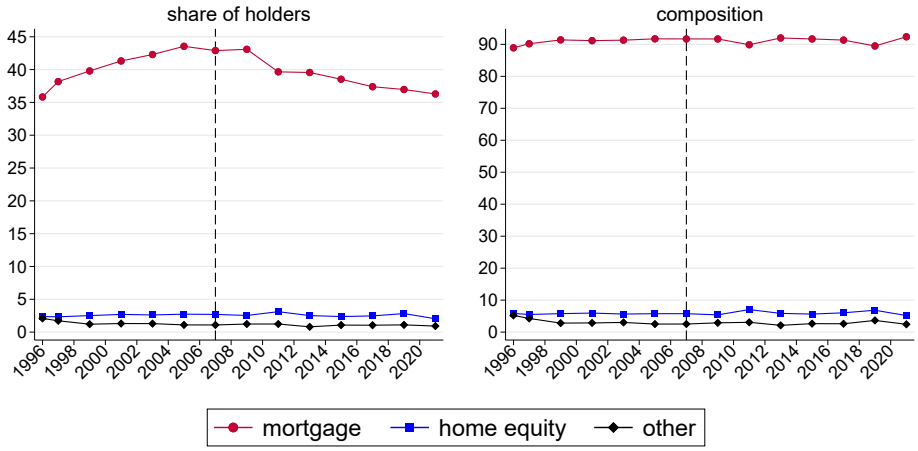
Figure A.8 decomposes housing debt into first and second mortgages. The SCF counts HELOCs separately, whereas the PSID counts them among the second (or if no other mortgage is held, first) mortgages. Therefore, we re-classify HELOCs, which are available in the modern SCFs since 1989, as first mortgages if no other mortgage is available and as second mortgages if only a first mortgage is recorded. HELOCs were only introduced on a relevant scale in the mid-1980s (see Maki 2001). Figure A.8 shows the average amount of debt in first and second mortgages in the SCF data since 1983. It also shows the extensive margin of the two types of mortgages, the share of households having first and second mortgages, respectively, which we observe since 1955 in the SCF data.

Figure A.8: First and second mortgages, SCF+



Notes: The left panel shows average first and second mortgages from the SCF. The right graph shows the share of households who have first or second mortgages. HELOCs are included (see text for details).

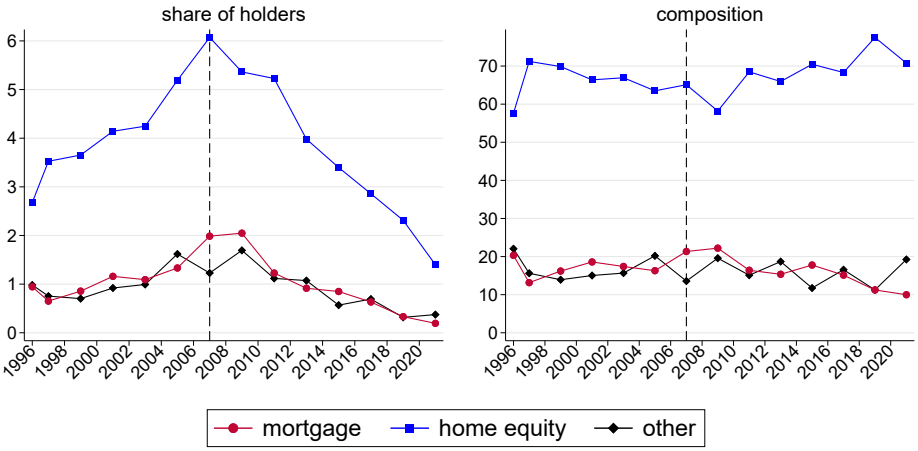
Figure A.9: First mortgages, PSID



Notes: The left panel shows the share of households in the PSID who hold the respective type of mortgage. The right panel shows the share conditional upon having a first mortgage.

Figure A.9 looks at the different types of first mortgages in the PSID data. Around 90% of all first mortgages in the PSID are traditional mortgages. Figure A.10 considers second mortgages in the PSID data that are observed from 1996 on. The share of households with second mortgages increased over time, but even at the peak of the housing boom in 2007, not more than 9% of households had second mortgages. Among second mortgages, typically two-thirds were home equity loans.

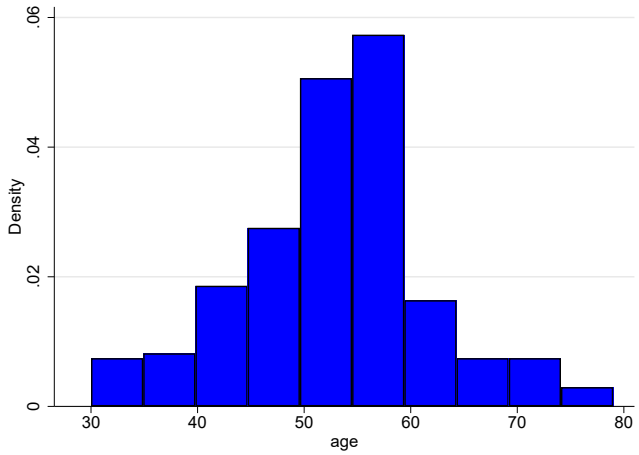
Figure A.10: Second mortgages, PSID



Notes: The left panel shows the share of households in the PSID who hold the respective type of mortgage. The right panel shows the share conditional upon having a second mortgage.

Figure A.11 shows the age distribution of the around 5% of SCF households who stated "health and education" as the purpose for which they extracted home equity.

Figure A.11: Age distribution of withdrawals due to health and education, SCF



Notes: The graph shows the age distribution of households naming "health and education" as the purpose for which they extracted home equity in the SCF.

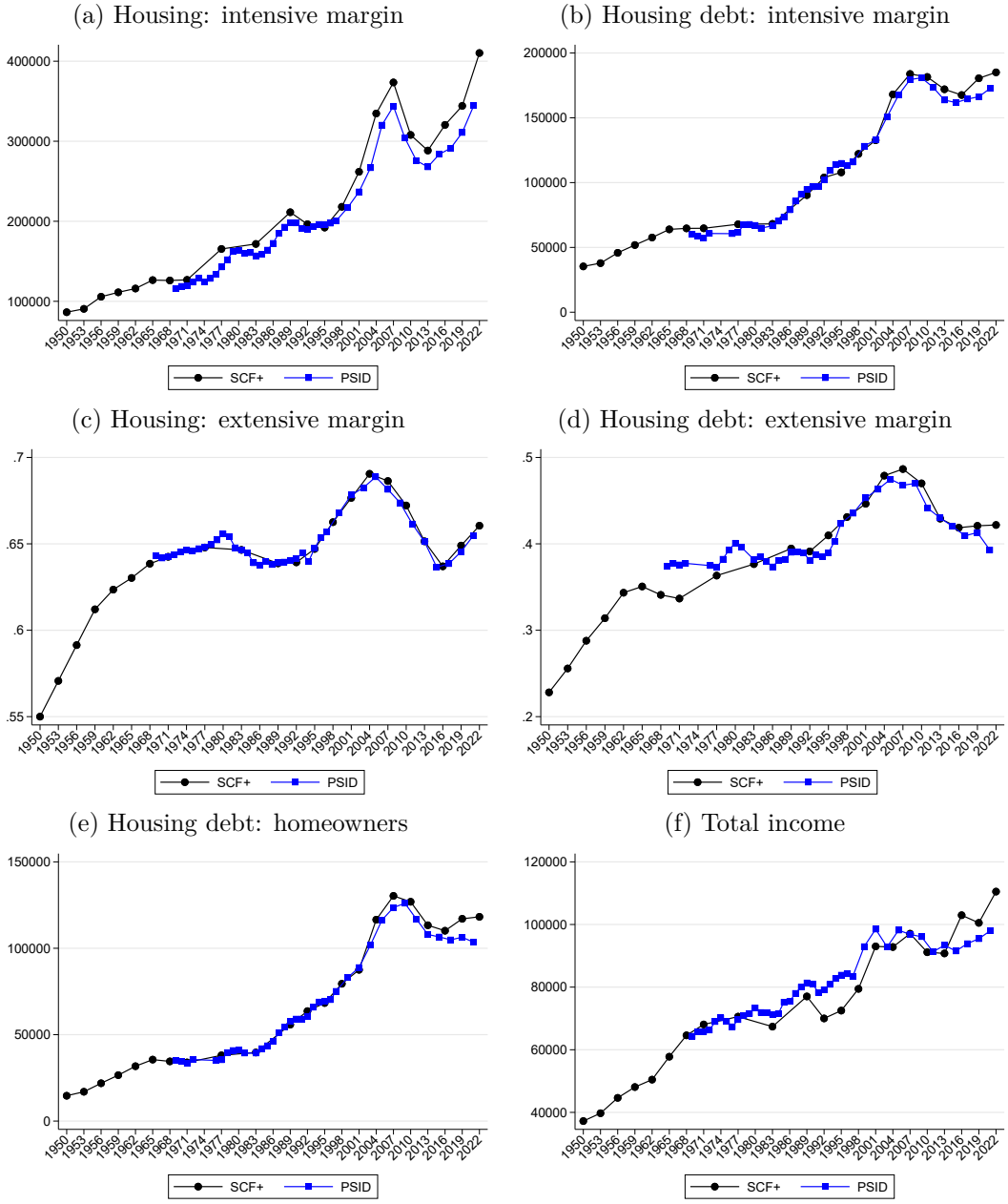
B Comparison of PSID and SCF+ housing data

In this section, we compare the data on the two main variables of interest, housing and housing debt, from the PSID and the SCF+. The SCF+ collects data at the household level, whereas the PSID collects data at the family level. To make the data comparable, we aggregate PSID families living together into one household (cf. Pfeffer et al. 2016).[36] All variables are taken from the two surveys as they are, without further harmonization of income, asset, and debt concepts (cf. Pfeffer et al. 2016 for a comparison of the survey instruments with respect to wealth).

Figure B.1 shows the intensive and extensive margins of housing and housing debt from the two data sources. We find that the two datasets yield very similar results at both margins. The intensive margin for housing is lower in the PSID, consistent with the fact that the SCF provides a better coverage of the right tail of the wealth distribution. The intensive margin of housing debt is matched very closely. There are some differences at the extensive margin for debt, especially during the 1970s and housing during the 2000s, consistent with the results of Pfeffer et al. (2016), who report several differences in asset

[36] To identify the person among families sharing a household who would most likely have been identified as the head in the SCF+, we create scores based on (a) being male, (b) being the oldest person in the household below retirement age (set to 65), (c) having the highest income within the household, and (d) owning the house. Within each household, the person with the highest score is defined to be the head, and his or her demographics are kept. If there is a tie, we choose the homeowner as the head. If there is still a tie, we choose the senior person, and if there is still a tie, we choose the person with the higher income. Income and wealth variables are summed across all families in the household.

Figure B.1: Comparison of average house value and housing debt: PSID vs. SCF+

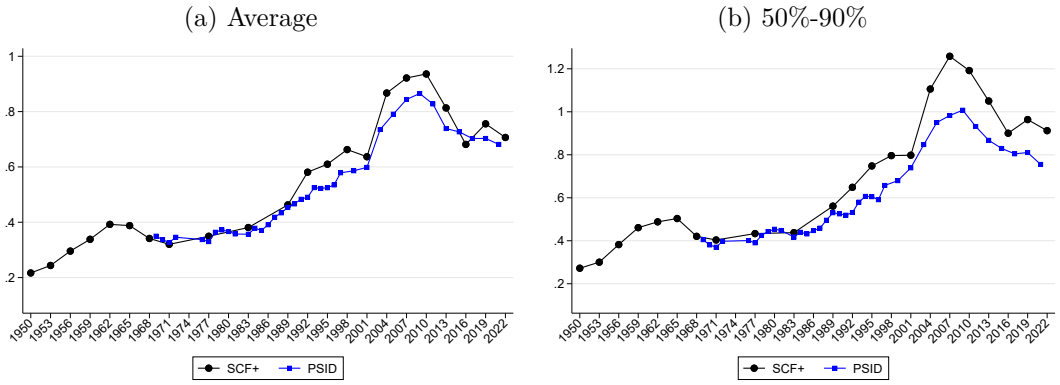


Notes: Panel (a) shows the average value of a house, conditional on being a homeowner. Panel (b) shows the average value of housing debt, conditional on having any housing debt. Panel (c) shows the homeownership rate. Panel (d) shows the share of households with positive housing debt. Panel (e) shows average housing debt in the subsample of homeowners. Panel (f) shows total household income. Black lines with dots show SCF+ data, blue lines with squares show PSID data.

ownership rates between the surveys. Incomes align well between the two datasets.

Figure B.2 shows debt-to-income ratios from the PSID and the SCF+. Both datasets show the secular rise in debt-to-income ratios in the aggregate and for the middle class over time. We find the increase to be slightly more pronounced in the SCF+ data at the aggregate and when focusing on the middle class.

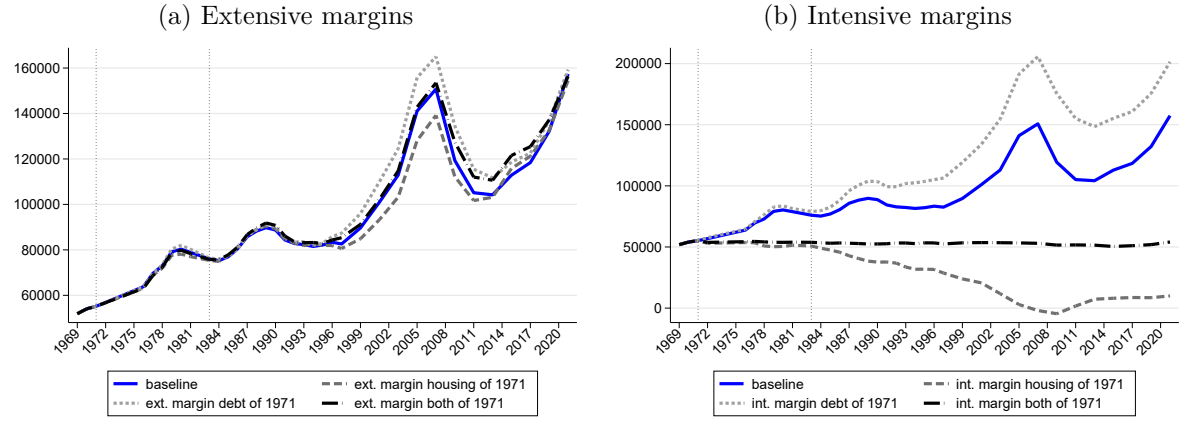
Figure B.2: Housing debt-to-income ratios in the SCF+ and PSID



Notes: The graph shows the housing debt-to-income ratio in the SCF+ and PSID over time. The right panel shows results for households from the 50th to 90th percentiles of the income distribution only.

Figures B.3 presents and analogue to Figure 7 from the main text based on PSID data.

Figure B.3: Decomposition of home equity, PSID



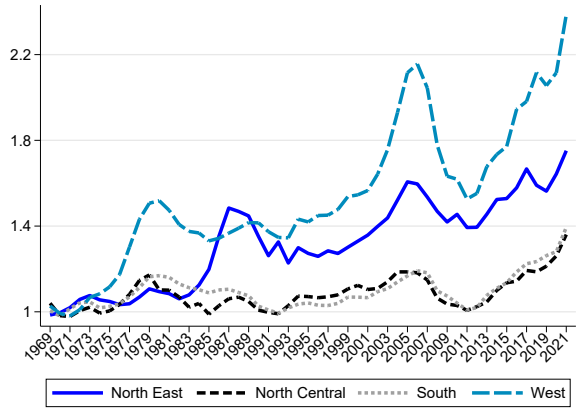
Notes: The graphs shows average home equity from the PSID (blue), along with counterfactuals (gray). The counterfactuals in the left panel hold the extensive margins of housing, housing debt, or both at their 1971 values. The right panel does the same for the intensive margins. The dotted vertical lines indicate the years 1971 and 1983.

The PSID includes information on the state and Census region in which a household resides. Unlike at the state level, house price indices for the four Census regions exist for the whole period covered by the PSID. Figure B.4b shows the change in home equity

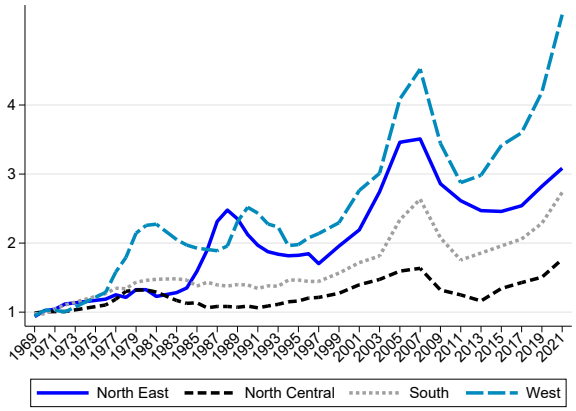
by region, and Figure shows B.4a house price growth by Census region. We can see that home equity increased relatively little in the North Central and South regions until the 1990s. By contrast, it already surged in the mid-1970s in the West, and the early 1980s in the North East. Looking at Figure B.4a, we can see that real house prices also increased substantially in the West from the mid-1970s on and in the North East from the early 1980s on, whereas the price changes were moderate in the other two regions.

Figure B.4: House prices and home equity by Census region

(a) House prices by region

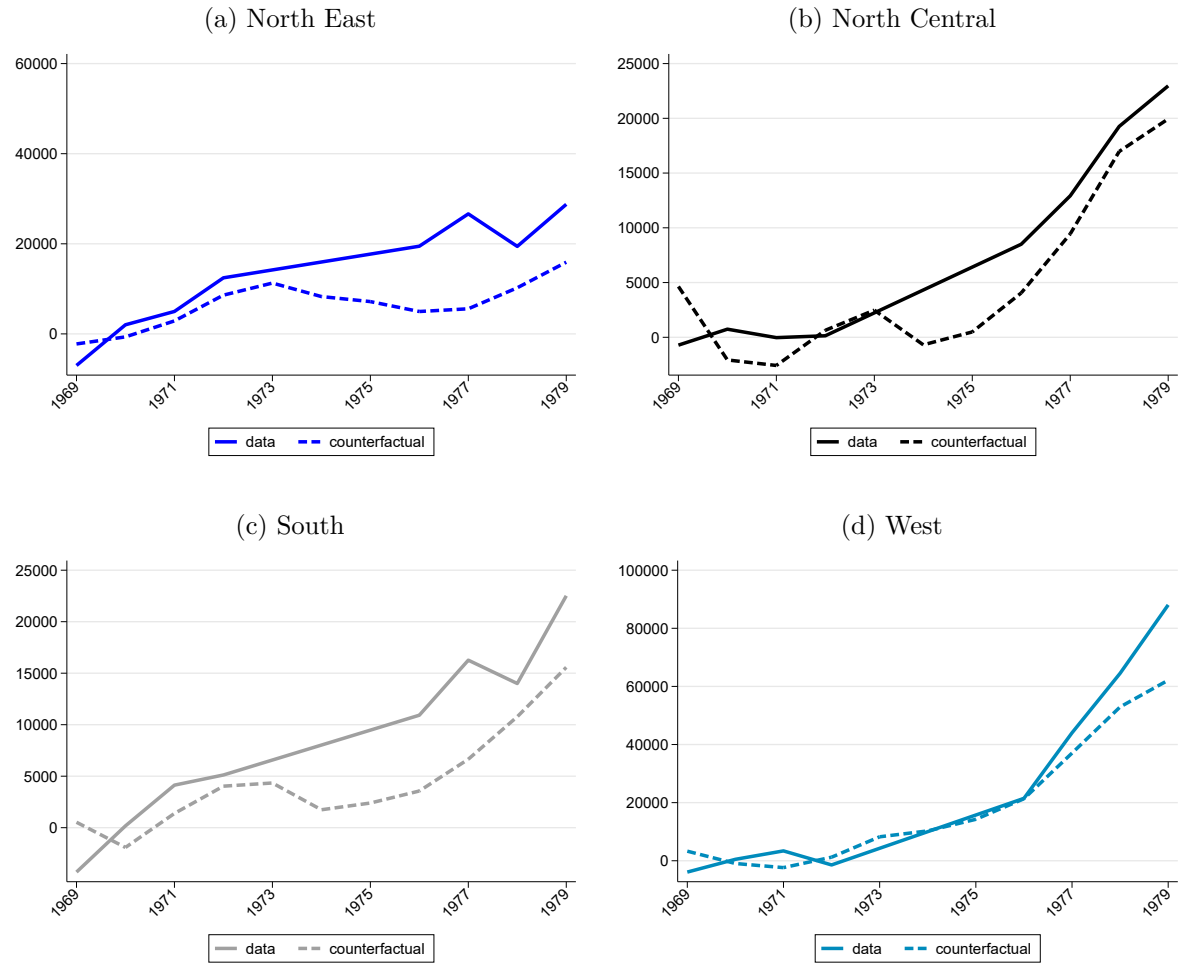


(b) Home equity by region



Notes: The left panel shows real regional house price growth based on the U.S. Census Bureau's indices for new single-family houses sold, including lot value. The left panel shows home equity growth from the PSID by Census region.

Figure B.5: Counterfactuals: homeowners' equity due to house price growth



Notes: The panels show the change in homeowners' home equity by Census region relative to the early 1970s (1969-1971), together with counterfactuals derived from letting initial average house values grow with the respective Census region's house price index for new single-family houses sold (including lot value) from the U.S. Census Bureau, converted to real terms using the CPI.

Figures B.5 shows the actual change in homeowners' home equity for each Census region since the early 1970s, together with a counterfactual derived from letting the average initial housing assets in each region grow with the region's real house price level.

C Further evidence on home equity extraction

C.1 Discussion of previous literature on HEW

Several approaches have been made to quantify the importance of home equity extraction. Bhutta and Keys (2016) estimate that nearly $1 trillion of equity was extracted between

2002 and 2005 via home equity loans, HELOCs, second mortgages, and cash-out refinancings. They exclude the use of funds to move into a more expensive home or buy a second house. According to their calculations, households on average extracted $40,000 between 1999 and 2010. The share of extractors among households with positive mortgage debt holdings varied over time, from 8.5% in 1999 to 18.4% at the peak in 2003. Canner, Dynan, and Passmore (2002) estimate that around $132 billion was extracted via cash-out refinancings from 2001 to early 2002. They estimate that 16%-23% of households with mortgage debt were refinancing, out of which 45% extracted equity.

In the modern SCF, questions on equity extraction via cash-out refinancings and home equity loans have existed since 1995, and the amount has been elicited since 2004. Out of the households surveyed in 2004, 6.4% had extracted equity between 2002 and 2004, which amounts to 13.4% of all households with positive housing debt. Among those households who extracted between the last and the current SCF wave, the average extracted amount across all available years was $41,200 (cf. Table C.1). Extraction information in the SCF refers only to the first mortgage according to the SCF classification. While the PSID counts mortgages consecutively irrespective of their type, the SCF reports HELOCs in a separate variable. The year of origination is reported only for non-HELOC mortgages. Moreover, some households reported having a third mortgage without having a first or second mortgage. Therefore, a comparison of the extensive margin of extraction with the

Table C.1: Average amount extracted

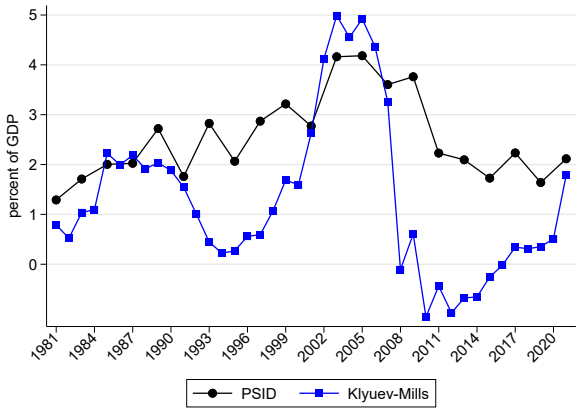
year	PSID	SCF+
1999	34762.01	.
2001	32455.03	.
2003	35793.62	.
2004	.	37566.39
2005	41368.51	.
2007	40496.86	50957.92
2009	42883.29	.
2010	.	37131.83
2011	29222.75	.
2013	34687.66	44624.91
2015	36166.35	.
2016	.	49459.07
2017	43913.91	.
2019	33638.13	61211.32
2021	40111.48	.
2022	.	59229.66

Notes: The table reports the average amount extracted, conditional upon extracting, from the SCF and PSID in 2019 dollars. The SCF measure is based on first mortgages only and refers to households who extracted over the current and previous two years.

PSID is not straightforward. However, the extracted amount conditional on extracting is of a broadly similar magnitude in both surveys.

Greenspan and Kennedy (2008) take a broader perspective, taking into account existing home sales as well. They estimate that on average, HEW generated around $590 billion of free cash per year between 1991 and 2006, out of which two-thirds were accounted for by existing home sales. However, their estimates are based on a so-called mortgage system, which was discontinued after 2008, as it did not adequately capture features of the housing market as experienced in the financial crisis of 2007 and 2008. Klyuev and Mills (2007) obtain slightly lower but similar estimates with a more simple method. They use the difference between all borrowing secured by dwellings (T_H) and the net acquisition of residential assets (T_{D^H}) from the FA as a proxy. The FA mortgage transaction series T_{D^H} includes all kinds of mortgages, except construction loans. The housing transaction series T_H includes gross fixed investment in residential structures, net of depreciation, as well as land sales from other sectors to the household sector. However, this "broad" HEW proxy is a somewhat coarse measure of equity extraction. For instance, if a household buys a new home for $100, and takes out a mortgage for $80, this measure would count it as *negative* equity extraction (equity injection) of $20. We compare this measure to our PSID-based equity extraction measure in Figure C.1.

Figure C.1: Comparison to FA measure of Klyuev and Mills (2007)



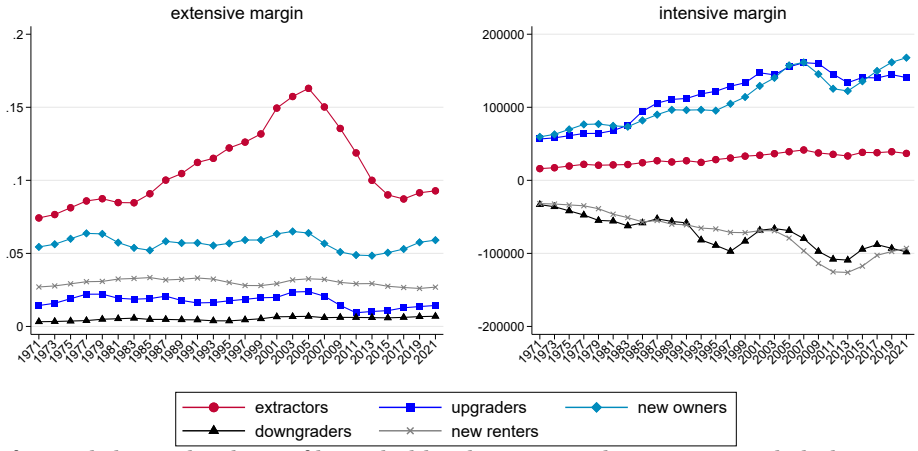
Notes: The figure shows the HEW measure proposed by Klyuev and Mills (2007) and the total amount extracted based on our computations with the PSID, both normalized by NIPA GDP.

C.2 Additional results on decomposition of post-80s debt boom

Figure C.2 reports the extensive and intensive margins for all household types based on the observed debt dynamics in the PSID panel data: extractors, upgraders, new owners,

downgraders, and new renters.

Figure C.2: Intensive and extensive margin by type

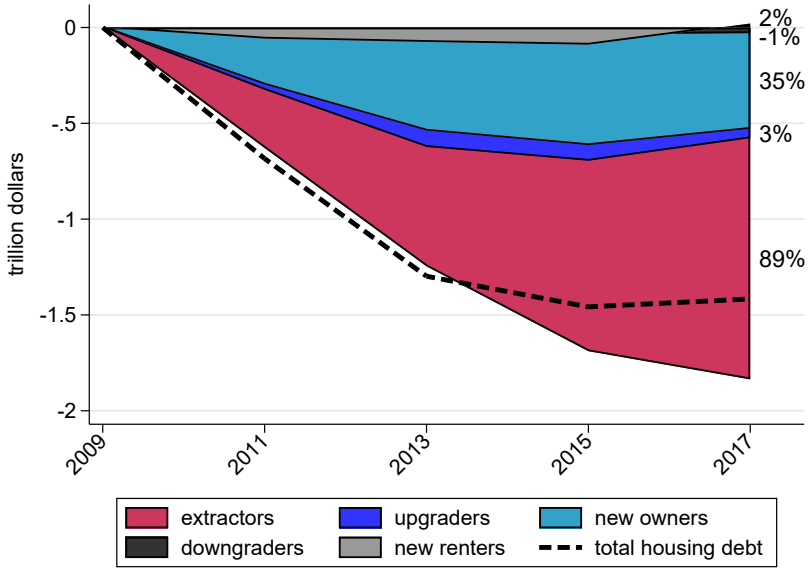


Notes: The left panel shows the share of households who extracted equity, upgraded, downgraded, bought a new home, or sold their home to become a renter. The right panel shows the average debt increase of these households. The series were smoothed by taking a moving average across three neighboring waves.

Figure C.3 a decomposition analogous to Figure 9 from the main text for debt reduction period from after the Global Financial Crisis. We chose 2017 as the end year, as housing debt slowly started to increase again after the 2017 survey (cf. Figure B.1). We see that the debt reduction period was almost exclusively driven by reductions in new ownership and extraction. [37]

[37] After 2013, our accounting exercise predicts more debt reduction than we actually see in the data. A possible explanation might be a slowdown in regular debt repayments.

Figure C.3: Decomposition of the housing debt boom



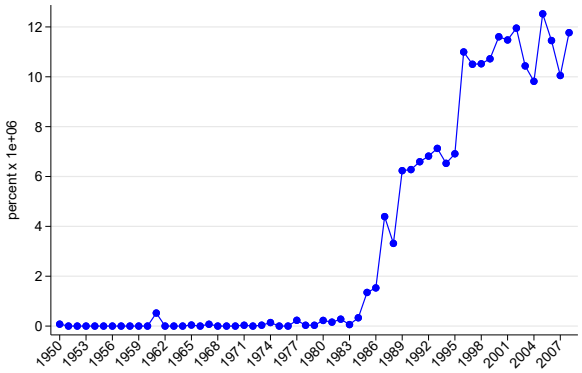
Notes: The graph presents a decomposition analogous to Figure 9 for the debt reduction period from 2009-2017.

C.3 Additional evidence on the drivers of equity extraction

In Figure C.4, we show how mentions of the term "home equity loan" in American books have evolved over time. Until 1982, the term was hardly mentioned at all. The share of mentions rose steeply in 1986, reached a plateau in the late 1980s and surged rapidly again in 1995, when house prices and homeownership rates went on a steep hike.

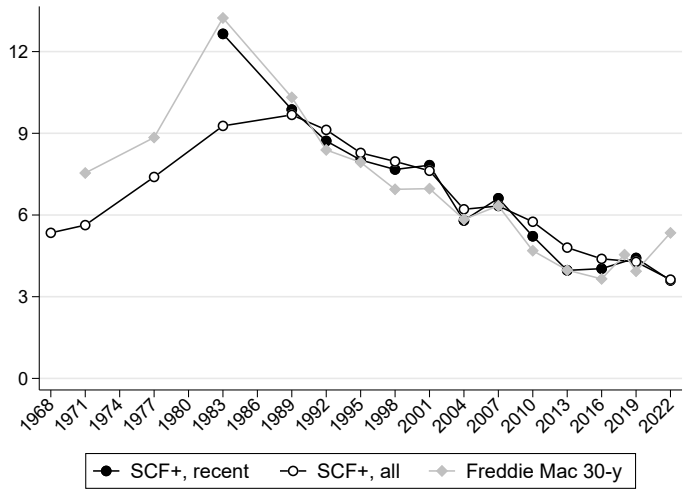
From the mid-1990s on, house prices were surging particularly fast (Figure B.4a). Rising

Figure C.4: Google Books Ngram Viewer for "home equity loan"



Notes: The graph shows how mentions on the 3-gram "home equity loan" have evolved over time. The figure is based on data from the Google Books Ngram Viewer. The y-axis shows the share of this 3-gram among all 3-grams contained in the Google sample of books written in English and published in the United States. The Google data are normalized with the total number of books published in each year.

Figure C.5: Mortgage interest rates

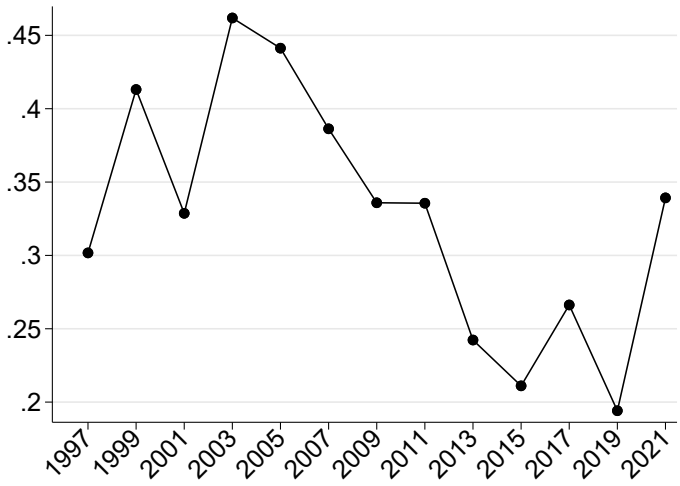


Notes: The graph shows nominal mortgage interest rates over time. The black lines with filled (hollow) dots show average interest rates on first mortgages in the SCF+ among households who bought their home during the current or previous year (all households). As a comparison, the light gray line with diamonds shows the Freddie Mac 30-year fixed rate.

house prices can induce households to increase their mortgage borrowing by relaxing collateral and liquidity constraints (Aladangady 2017, Cloyne et al. 2019, Andersen and Leth-Petersen 2021) and lead to an increase in borrowing via wealth effects (Berger et al. 2018). The idea is that rising house prices ceteris paribus increase the value of home equity on the household balance sheet. If households expect this increase in house prices to be persistent, they want to extract the capital gains to smooth their lifetime consumption. However, given that houses cannot easily be divided, the only option of doing so without having to sell the house and move to a less expensive home is to extract equity. In Section E, we provide a detailed summary of the theoretical literature, discussing under which circumstances such wealth effects may arise, and show in a stylized model framework how they translate into additional mortgage borrowing. Equity extraction is particularly attractive if interest rates fall (Bhutta and Keys, 2016).

This was the case in the 1980s (Figure C.5). The lower rates provided strong incentives for households to refinance, and many of them extracted home equity on the way (Di Maggio, Kermani, and Palmer 2019). Figure C.5 shows SCF+ data both for all households and for recent movers. The more "old" fixed-rate mortgages there are in the data, the further apart will the two series lie, as the series for all households is a weighted average of interest rates from different origination years. The two series converge in the 1990s, suggesting a larger share of recently originated or refinanced mortgages. Bhutta and Keys (2016) show that cash-outs accounted for the largest share of equity extraction between the early 2000s and the crisis in 2008, followed by HELOCs and second mortgages. Correspondingly,

Figure C.6: Extraction and refinancing



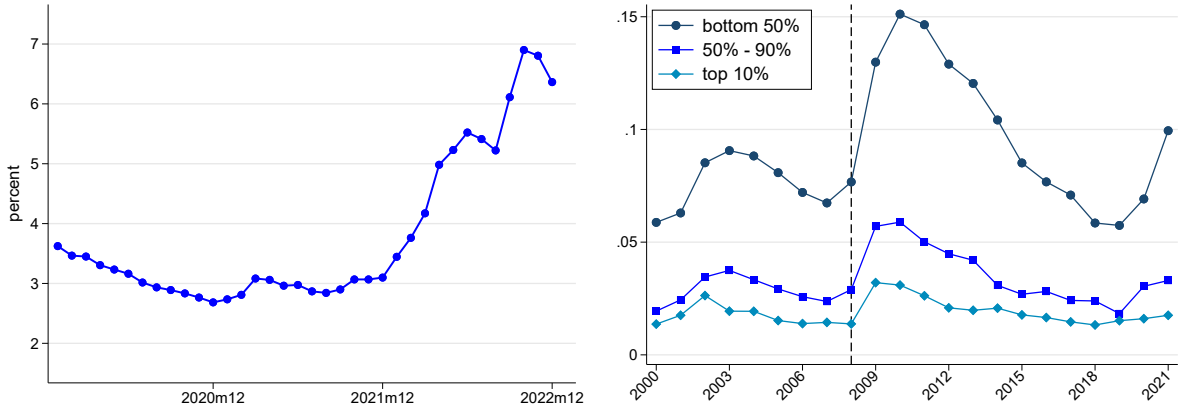
Notes: The graph shows the pairwise correlation of our indicator for equity extraction and the PSID indicator for refinancing of first mortgages, which is available since 1996, over time.

our measure of equity extraction is correlated with refinancing (Figure C.6), and the correlation increases in years which have been identified as periods of refinancing booms in the literature like 1998 and 2003 (Bhutta and Keys, 2016; LaCour-Little, Rosenblatt, and Yao, 2010).

Figure C.7: Inputs stress tests

(a) Increases in mortgage interest rates in 2022

(b) Share of households with unemployed head



Notes: The left panel shows the evolution of the average 30-year fixed rate (MORTGAGE30US) from FRED between January 2021 and December 2022. The right panel shows the share of households with an unemployed head (out of the total population, not just the labor force) from the CPS by income group over time.

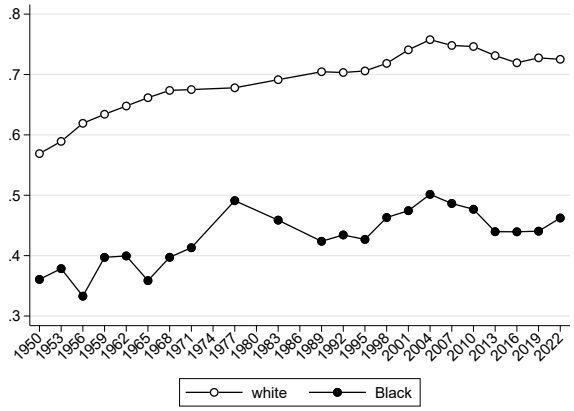
D Supplementary results on debt and demographics

D.1 Debt by race

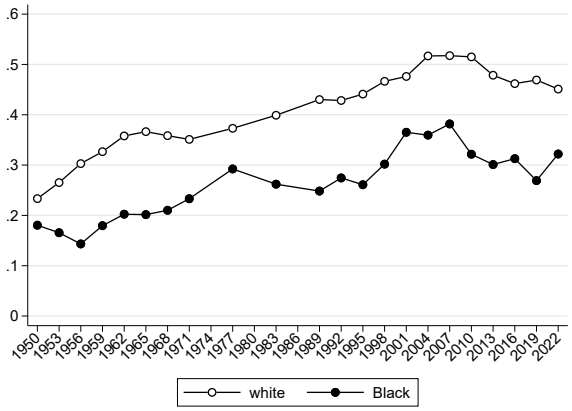
Figure D.2a shows the housing-to-income (HTI) and housing-debt-to-income (HDTI) ratios of Black and white households, conditional on having mortgage debt, over time. Table D.1 shows average portfolio shares of black and white households by decade.

Figure D.1: Racial gaps in homeownership and mortgage borrowing

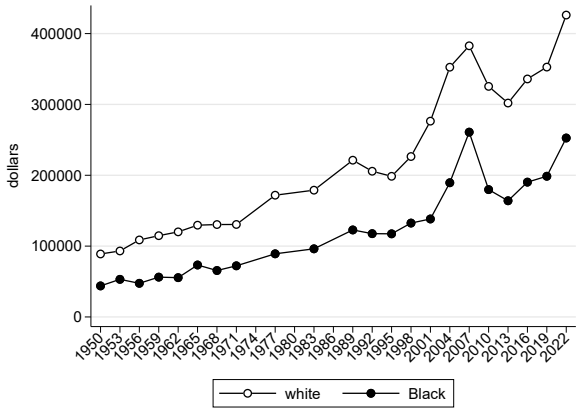
(a) Black-white homeownership gap



(b) Black-white mortgage borrowing gap



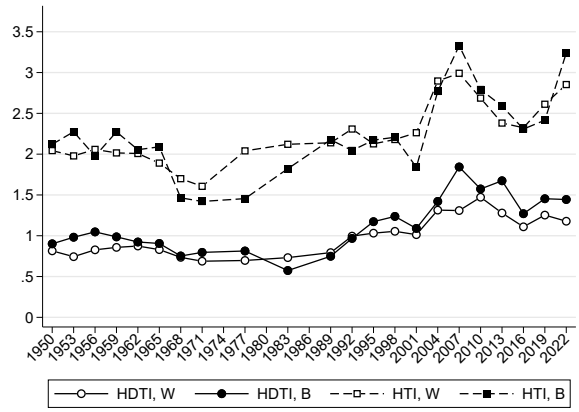
(c) Black-white housing asset gap



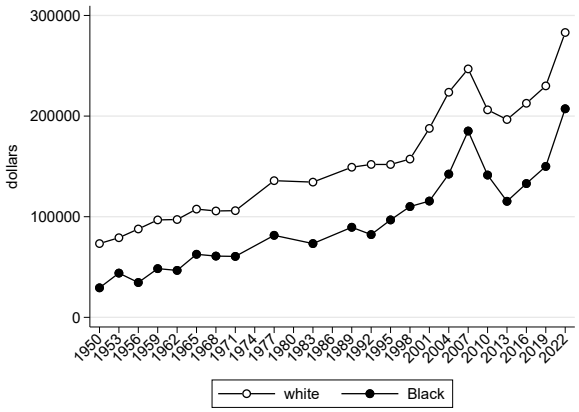
Notes: Panel (a) shows the shares of Black and white households owning houses over time. Panel (b) shows the shares of Black and white households holding mortgages over time. Panel (c) shows the average housing assets of Black and white households, conditional on owning a home, over time. All series are based on the SCF+ data.

Figure D.2: Racial gaps in homeownership and mortgage borrowing

(a) Black-white HTI and HDTI gap



(b) Black-white housing asset gap at median



Notes: Panel (a) shows the housing-to-income (HTI) and housing-debt-to-income (HDTI) ratios of Black and white households, conditional on having a house or mortgage, over time. Panel (b) shows the median housing assets of Black and white households, conditional on owning a home, over time. All series are based on the SCF+ data.

Table D.1: Portfolio shares by decade and race

decade	housing	equity + business	liq. assets + bonds	other	housing debt	personal debt
			black			
1950	63.9	28.9	6.2	0.9	65.5	34.5
1960	70.4	19.8	8.2	1.6	70.8	29.2
1970	65.6	15.1	11.4	7.8	71.8	28.2
1980	64.9	7.0	6.8	21.3	62.9	37.1
1990	55.1	12.5	5.9	26.4	74.3	25.7
2000	58.2	12.5	5.2	24.0	77.7	22.3
2010	54.0	14.9	6.1	25.0	67.2	32.8
2020	55.2	15.4	5.3	24.0	60.8	39.2
			white			
1950	41.3	44.7	13.5	0.6	77.5	22.5
1960	50.5	35.3	13.6	0.7	83.7	16.3
1970	50.4	32.0	14.8	2.8	81.5	18.5
1980	43.8	30.0	12.7	13.4	74.6	25.4
1990	39.2	32.2	9.9	18.7	78.9	21.1
2000	39.7	34.2	7.8	18.2	82.4	17.6
2010	35.3	36.8	7.4	20.6	80.4	19.6
2020	32.9	39.9	6.9	20.3	78.8	21.2

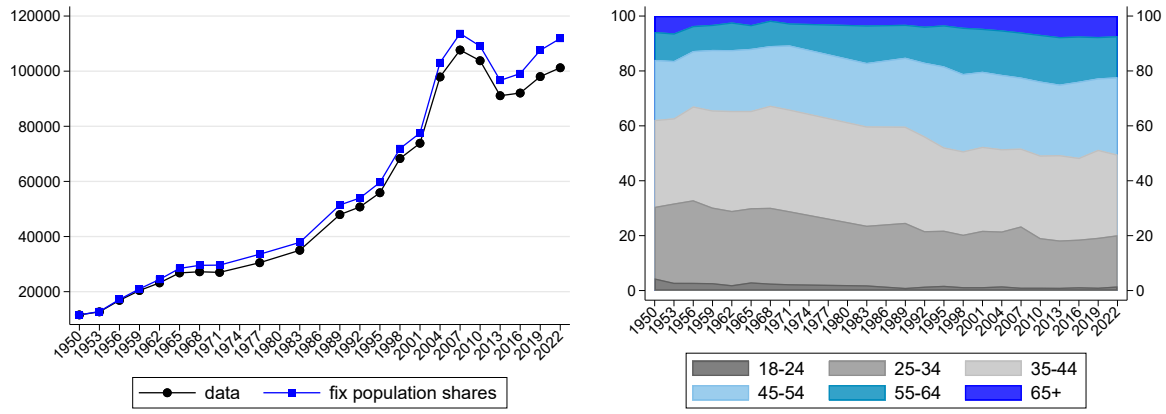
Notes: The table shows the shares of several forms of assets in total assets (columns 2-5) and of debt in total debt (columns 6-7) by decade and race.

D.2 Debt and net wealth shares with age structure of 1950

Figure D.3: Counterfactual debt and wealth shares with age composition of 1950

(a) Debt with 1950 population composition

(b) Debt shares with age composition of 1950



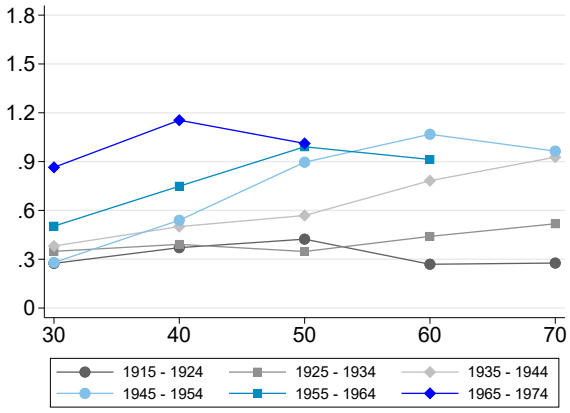
Notes: The left panel shows shows a counterfactual for average total household debt, keeping the population composition fix as in 1950. The right panel shows counterfactual debt shares of each age group when keeping the age composition of the population as it was in 1950.

Figure D.3a shows a counterfactual for average total household debt, keeping the population composition fix as in 1950. Figure D.3b shows the counterfactual shares of each age group in total debt when fixing the age distribution at 1950 population shares for each age group.

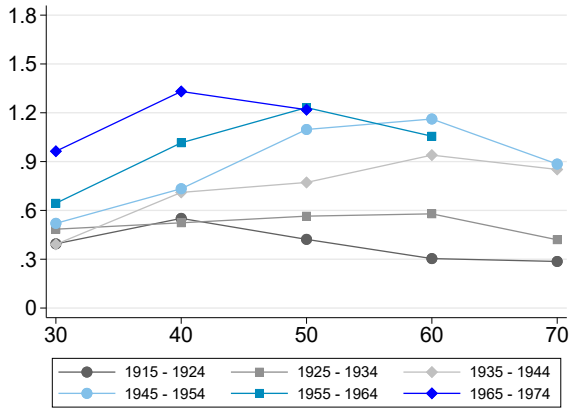
Figure D.4 shows versions of Figure 13a for different income and wealth groups. Given that income and wealth systematically vary over the life cycle, we stratified households by *within-age* income and net wealth, respectively. In order to assure a sufficient number of observations in each group, we formed three equally sized groups (bottom third, middle third, and top third). While the shifting and tilting occurs for all three income and wealth groups, it is clearest and most pronounced for the middle groups. This confirms that the debt boom was concentrated in the middle class.

Figure D.4: Changes in life-cycle debt dynamics by within-age wealth groups

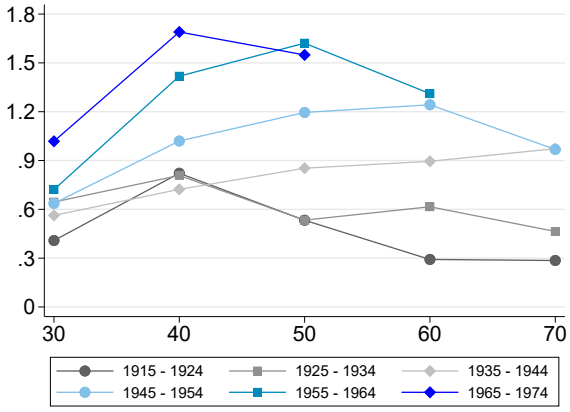
(a) DTI ratios by cohort: bottom third, wealth



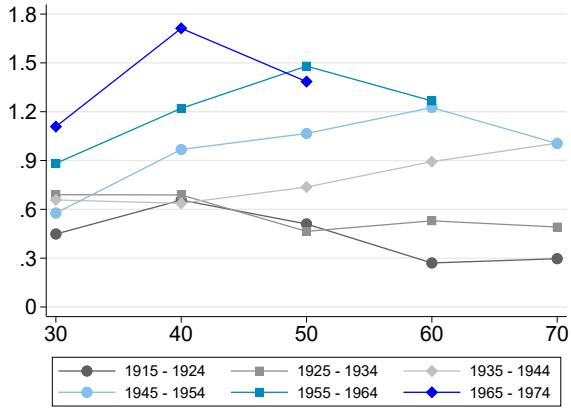
(b) DTI ratios by cohort: bottom third, income



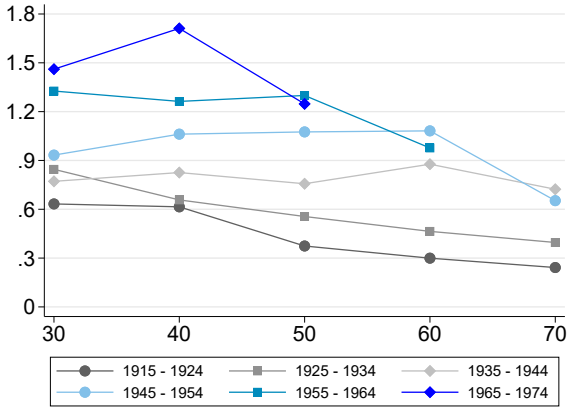
(c) DTI ratios by cohort: middle third, wealth



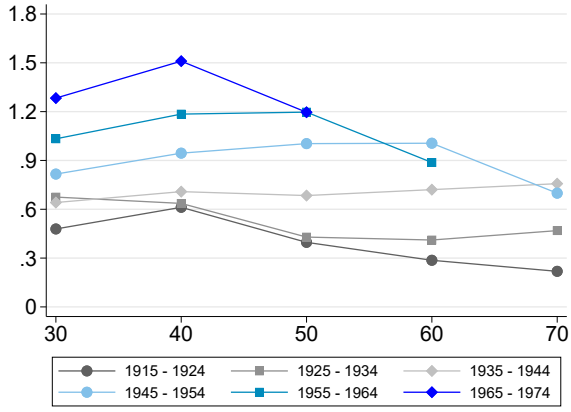
(d) DTI ratios by cohort: middle third, income



(e) DTI ratios by cohort: top third, wealth

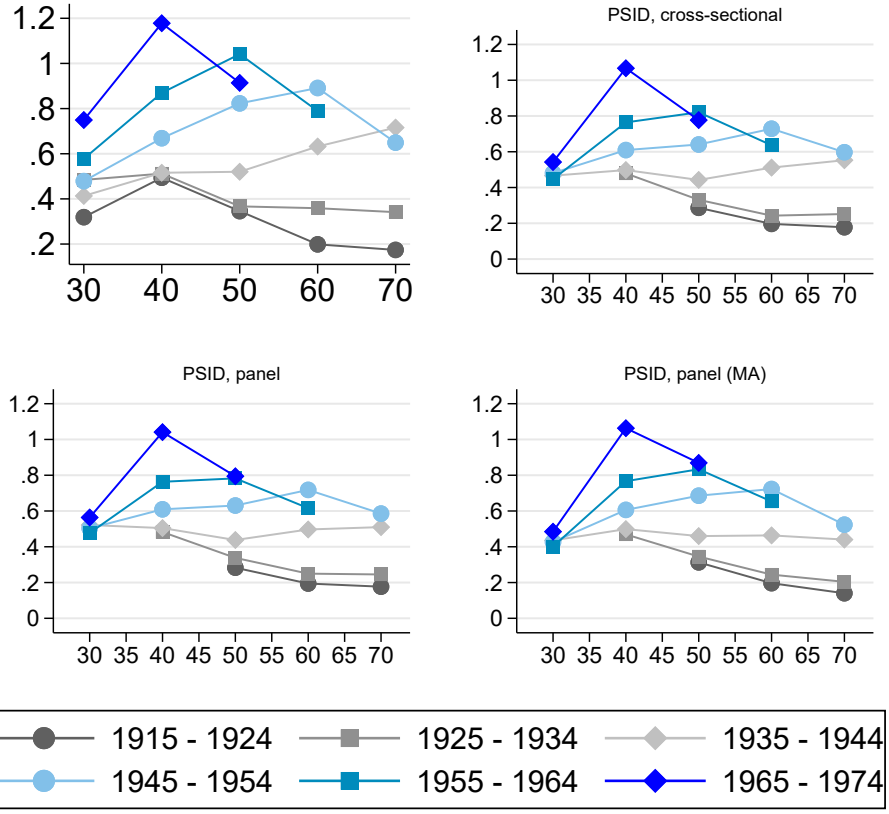


(f) DTI ratios by cohort: top third, income



Notes: The figure shows the life-cycle profiles of total debt-to-income (DTI) ratios for our synthetic cohorts, stratified by within-age net wealth (left panels) and income (right panels) groups. The upper panels show results for the bottom third of each distribution, middle panels results for the middle third, and bottom panels show results for the top third. DTI ratios were winsorized at the 99th percentile within each year.

Figure D.5: Comparison of life-cycle housing debt-to-income profiles



Notes: The graph shows life-cycle housing debt-to-income (HDTI) profiles for different cohorts. The upper left panel shows the SCF+ data, the upper right panel shows PSID data when treating the data as cross-sectional, and the lower left panel shows PSID data when exploiting the panel dimension by including household fixed effects. The lower right panel uses a three-year moving average of total household income in the denominator. HDTI ratios were winsorized at the 99th percentile within each year.

D.3 Life cycle debt patterns in the PSID

Figure D.5 shows life-cycle housing debt-to-income profiles obtained by regressing individual housing debt-to-income ratios on six age group dummies (25-34, 35-44, 45-54, 55-64, 65-74, and 75-85 years). We focus on housing debt, as non-housing debt is only available in recent waves of the PSID. Note that the SCF+ data start in 1950, whereas the PSID data only begin in 1969.[38]

The upper left panel is based on the SCF+ data. The upper right panel shows PSID data treated analogously to the SCF+ data, and the lower left panel shows results that exploit the panel dimension of the PSID by including household fixed effects. In the lower

[38]The first PSID wave from 1968 was excluded, as many important variables are still missing in this year.

right panel, we exploit the PSID's panel dimension to replace income by its three-year moving average (MA) within each household. This step helps to avoid extreme values due to temporary income fluctuations. The results are quantitatively and qualitatively similar across both datasets and all specifications. Housing debt-to-income ratios have both shifted and turned upward conspicuously. We see a shift in slopes around 1980 for all cohorts, no matter whether they were 40, 50, or 60 years at this point. The shift is most pronounced for households around age 40 in 1980. The results are very similar when controlling for household fixed effects in the PSID, which confirms that the results obtained with the SCF+ are not artifacts of working with synthetic cohorts.

E Wealth effects in a simple life-cycle model

A common argument against housing wealth effects is that when house prices rise, future housing consumption becomes more expensive and households effectively do not get wealthier. This intuition is derived by Sinai and Souleles (2005) in an infinite-horizon model with fixed housing consumption.[39] Key to their "neutrality" result for house price changes is the infinite housing tenure of agents. Introducing finite lifetimes will imply that rising housing wealth triggers consumption responses of homeowners also in their model. This can be seen intuitively when taking a *Modigliani perspective* with a life-cycle model without bequests (Modigliani and Brumberg, 1954). In such a model, households will reduce housing consumption to zero at the end of their life, such that they will always realize capital gains from house price changes, and the wealth effect arises naturally.

In recent work, Fagereng et al. (2022) provide an analysis of the *welfare* consequences of changing asset prices, combining economic theory with Norwegian microdata. They derive a sufficient statistic for the welfare consequences of asset price changes and measure asset-price redistribution in their data. The idea is that asset transactions after price changes lead to expanding and contracting budget sets of the sellers and buyers. Fagereng et al. (2022) show that, if scaled by the marginal utility of consumption, it is only these realized capital gains or losses from trading that will be welfare relevant. Effectively, trades after an asset price change redistribute resources between buyers and sellers. Considering only marginal asset price changes, the behavioral response of asset price changes does not affect welfare up to first order and their sufficient statistic captures the welfare effects of asset price redistribution. Infra-marginal asset-price changes will further induce changes in trading that are not captured by their sufficient statistic.[40]

[39] This view is also prominently discussed in Case, Glaeser, and Parker (2000).

[40] Their measurement relies on the assumption that any observed asset trade over the sample period that

Home equity extraction differs qualitatively from the trading behavior considered in Fagereng et al. (2022). To see the connection between home-equity extraction and realizing capital gains from house prices, it is important to realize that housing is at the same time a durable consumption good of households. Rising house prices lead to (expected) capital gains on the household portfolio at the point of selling the house in the future. As housing is also indivisible, it will mean that all capital gains are realized at once and can then only be smoothed going forward if invested in a liquid asset. Home equity extraction mitigates this intertemporal consumption smoothing problem, as borrowing allows to smooth these future expected capital gains in the housing market even before the realization of the capital gain. Home equity extraction therefore constitutes standard optimal life-cycle smoothing behavior.

To see the implications of life-cycle dynamics, we consider a life-cycle version of the 2-period model in Fagereng et al. (2022), where N_0 constitutes the initial endowment of assets and life-cycle dynamics are captured by the additional term $N_1 P$ that captures the selling of all assets in the last period of life

$$\begin{aligned} \max_{\{C_0, C_1, N_1\}} \quad & U(C_0) + \beta U(C_1) \\ s.t. \quad & C_0 = Y_0 - (N_1 - N_0)P \\ & C_1 = N_1 D + Y_1 + N_1 P \\ & N_0 \geq 0 \text{ given.} \end{aligned} \tag{E.1}$$

The "life-cycle" term $N_1 P$ is not present in the 2-period and infinite-horizon models of Fagereng et al. (2022) and changes the model qualitatively, as now there will always be trading of the asset in the last period. If the asset price P rises, we see immediately that the budget constraint in the first period expands if the household is selling the asset ($N_1 < N_0$) and contracts if the household is buying the asset ($N_1 > N_0$). [41] This is the asset-price redistribution discussed in Fagereng et al. (2022). Considering life-cycle dynamics, there is an additional effect of the asset price change in the second period $N_1 P$. Even if households do not trade in the first period ($N_0 = N_1$), their lifetime budget constraint changes from an endowment effect. This endowment effect will directly affect the available resources in the second period, but will be smoothed by optimal behavior described by the Euler equation (absent borrowing constraints)

enters into their measured capital gains and losses is independent of the observed price changes over the sample period.

[41] Note that we assume that price changes are permanent. If prices change over time, then the expected persistence of the price change will be relevant for the change in the life-cycle budget constraint.

$$U'(C_0) = \frac{P+D}{P}\beta U'(C_1). \tag{E.2}$$

This smoothing of future capital gains over time will be done by the consumption-saving decision, but in a richer model with debt and utility from housing it will be achieved via home equity extraction. Hence, with life-cycle dynamics, households who expect future capital gains from selling their house will use debt for equity extraction today to smooth out asset-price induced fluctuations in their balance sheet. We derive this result analytically in the following.

We rely on a life-cycle model adapted from Berger et al. (2018). To keep the model analytically tractable and focus on the life-cycle aspect, we abstract from idiosyncratic income risk, borrowing constraints, and trading costs. Households live for $J+1$ periods, have an exogenous income profile $\{y_j\}_{j=0}^{J}$, and aim at maximizing their lifetime utility from consumption. Instead of considering (net) household wealth, we split household wealth into housing assets h and financial assets (mortgage debt) d, of which households receive fixed initial endowments h_{-1} and d_0. Housing can be traded without frictions at price p_h each period and depreciates at rate δ. The mortgage interest rate is denoted by r. We abstract from bequests and assume that at the end of life, households sell their homes, repay their debt, and consume all available resources.

We assume that at each age j, households have a time-separable log utility function over a Cobb-Douglas composite of housing h_j and non-housing consumption c_j, $u(c,h) = \rho\log(c)+(1-\rho)\log(h)$. In this case, the household problem has a well-known solution with a constant expenditure share ρ for non-housing consumption and an optimal consumption path $c_j^* = c_0^*(\beta(1+r))^j$, where β denotes the time discount factor. The derivations are summarized in Section E.2. The level of the consumption path c_0^* is determined by total household wealth W, which is the sum of human capital Y, equal to the discounted incomes y_j at all ages j, and initial home equity E,

$$W = E + Y \qquad \text{with } Y = \sum_{j=0}^{J} y_j(1+r)^{-j} \text{ and } E = (1-\delta)p_h h_{-1} - (1+r)d_0, \tag{E.3}$$

multiplied by the MPC α and the optimal expenditure share ρ,

$$c_0^* = \alpha\rho W \qquad \text{with } \alpha = \frac{1-\beta}{1-\beta^{J+1}}. \tag{E.4}$$

It follows immediately that any change in home equity E from higher house prices p_h or lower debt levels d_0 will lead to an upward shift in the consumption profile. The optimal

consumption dynamics will however remain unaffected, as they only depend on the wedge between the time discount factor β and the interest rate r.[42]

Deriving the elasticity of the optimal consumption level c_0^* with respect to a persistent increase in house price p_h, we get a simple, intuitive expression (see equation (A.1) in Berger et al. 2018):

$$\frac{\partial c_0^*}{\partial p_h}\frac{p_h}{c_0^*} = \frac{(1-\delta)p_h h_{-1}}{W} = \theta_h, \tag{E.5}$$

where θ_h denotes the portfolio share of housing $(1-\delta)p_h h_{-1}$ in total wealth W. This elasticity for house price changes keeps human capital constant when changing the house price, thereby capturing a situation with rising house prices and stagnant incomes. Note that the formula applies to each point in the life cycle if lifetime J represents the *remaining* lifetime and the current period is interpreted as $j = 0$.

This simple expression for the elasticity states that the larger the exposure of household wealth W to house prices, the higher the elasticity of consumption with respect to house price shocks. Exposure to house prices in the model is determined by the portfolio share of housing in total wealth θ_h. This implies that the elasticity of consumption with respect to house price shocks is increasing in leverage, as leverage reduces W while leaving housing assets $(1-\delta)p_h h_{-1}$ unaffected so that θ_h increases.[43] Equation (E.5) therefore explains why households with a large exposure to the housing market (those in the middle class) responds more strongly to house price shocks.

The consumption dynamics induce corresponding debt dynamics according to the law of motion $d_{j+1} = (1+r)d_j - (y_j - c_j) + p_h(h_j - (1-\delta)h_{j-1})$. Future debt d_{j+1} depends positively on the current level of debt d_j, the current repayment $(y_j - c_j > 0)$ or extraction flow $(y_j - c_j < 0)$, and adjustments to the housing stock including depreciation $p_h(h_j - (1-\delta)h_{j-1})$. Iterating the law of motion forward, we get that, at any age $j+1$, the current debt level is simply the initial debt level d_0 plus the accumulated sum of repayment and extraction flows, housing adjustments, and accrued interest payments:

$$d_{j+1} = (1+r)^{j+1}d_0 + \sum_{s=0}^{j}(1+r)^{j-s}(c_s - y_s) + \sum_{s=0}^{j}(1+r)^{j-s}p_h(h_s - (1-\delta)h_{s-1}). \tag{E.6}$$

It is important to acknowledge that our model is very stylized. In the following, we discuss the simplifying assumptions made and how they might be relaxed.

[42] Key for this result is that we rule out potentially binding borrowing constraints.
[43] This may not extend to extreme cases such as underwater borrowers (Ganong and Noel 2020).

E.1 Discussion

In the model, households will reduce housing consumption after a positive house price shock, but housing wealth $(1-\delta)p_h h$ will increase nonetheless.[44] This result implies that our stylized model predicts that households will not upgrade to larger/better houses after a positive house price shock. A key reason is that the stylized model abstracts from borrowing constraints and adjustment costs.[45] In turn, the model predicts too much *downgrading*: households buy less/worse housing after a positive house price shock. Introducing trading and adjustment costs would allow us to more closely match the empirically observed patterns.

Moreover, the model abstracts from renters. Current renters constitute the pool of potential new owners who are affected by rising house prices. When house prices rise, households who switch from renting to owning have to pay more for a home of a given size. Hence, new homeowners will have to rely on additional debt to finance their home, buy a smaller house, or postpone homeownership. The data suggest that during the housing boom, many new homeowners relied on additional debt to finance their new home.

In our stylized environment, we do not consider ways in which extracted equity could be used other than for non-durable consumption. Empirical studies have found that home equity is also used for home improvements, the repayment of personal debt, or the foundation of a business (see Mian and Sufi 2011, Cloyne et al. 2019, Greenspan and Kennedy 2008). Finally, it should be noted that we abstract from other factors beyond house prices that have likely contributed to an increase in debt financing since the 1980s, such as lower mortgage interest rates and higher inflation, which raised the attractiveness of debt financing, falling mortgage transaction costs, the disappearing of mortgage prepayment penalties, or the rising costs of financing children's education (see, for example, Bhutta and Keys 2016, Canner, Dynan, and Passmore 2002, Greenspan and Kennedy 2008, Cooper 2010). Yet despite its simplicity, this stylized model shows that a *Modigliani perspective* can rationalize home equity extraction against rising house prices.

[44] The elasticity of housing with respect to prices is $\frac{\partial h}{\partial p_h}\frac{p_h}{h} = \theta_h - 1$, so $\frac{\partial (p_h h)}{\partial p_h}\frac{p_h}{p_h h} = \theta_h$.

[45] Without borrowing constraints and adjustment costs, households react immediately to a positive shock to house prices and substitute away from housing. If, however, households are constrained, a shock that increases home equity slackens the constraint and allows them to upgrade. That upgrading households use (part of) their equity gain for the down payment of a new home has been discussed, for example, in Genesove and Mayer (1997) and Loewenstein (2018).

E.2 Derivations

The agent's problem reads

$$\begin{aligned} \max_{\{c_j,h_j,d_{j+1}\}_{j=0}^{J}} \quad & \sum_{j=0}^{J} \beta^j \Big(\rho \log(c_j) + (1-\rho) \log(h_j) \Big) \\ s.t. \quad & c_j + p_h h_j - d_{j+1} = y_j - (1+r) d_j + (1-\delta) h_{j-1} p_h \\ & h_{-1},\ d_0 \qquad \text{given} \end{aligned} \tag{E.7}$$

First-order conditions deliver

$$\frac{1}{c_j} \rho p_h = (1-\rho) \frac{1}{h_j} + \beta \rho (1-\delta) p_h \frac{1}{c_{j+1}} \tag{E.8}$$

$$\frac{1}{c_j} = \beta (1+r) \frac{1}{c_{j+1}}. \tag{E.9}$$

From equation (E.9), we get the optimal path of consumption growth,

$$c_j = (\beta(1+r))^j c_0. \tag{E.10}$$

Using the Euler equation (E.9) in equation (E.8) delivers

$$\begin{aligned} \rho p_h &= (1-\rho) \frac{c_j}{h_j} + \beta \rho (1-\delta) p_h \frac{c_j}{c_{j+1}} \\ 1 &= \frac{1-\rho}{\rho} \frac{c_j}{p_h h_j} + \beta (1-\delta) (\beta(1+r))^{-1} \\ p_h h_j &= \frac{1-\rho}{\rho} c_j + \frac{1-\delta}{1+r} p_h h_j \\ p_h h_j &= \frac{1+r}{r+\delta} \frac{1-\rho}{\rho} c_j \end{aligned} \tag{E.11}$$

with the standard constant expenditure share result. Note that expenditures for housing are the user costs $\frac{r+\delta}{1+r} p_h h_j$. Combining equation (E.11) with the Euler equation delivers

$$p_h h_j = \frac{1+r}{r+\delta} \frac{1-\rho}{\rho} (\beta(1+r))^j c_0. \tag{E.12}$$

The law of motion for the debt level is

$$d_{j+1} = c_j - y_j + p_h h_j + (1+r) d_j - (1-\delta) h_{j-1} p_h. \tag{E.13}$$

Using this law of motion and plugging in recursively delivers

$$d_{j+1} = \sum_{s=0}^{j} (c_s - y_s)(1+r)^{j-s} + p_h h_j + \sum_{s=0}^{j-1} p_h h_s (r+\delta)(1+r)^{j-1-s} - (1+r)^j ((1-\delta) h_{-1} p_h - (1+r) d_0). \tag{E.14}$$

For $j = J$, we get

$$d_{J+1} = \sum_{s=0}^{J}(c_s - y_s)(1+r)^{J-s} + p_h h_J + \sum_{s=0}^{J-1} p_h h_s (r+\delta)(1+r)^{J-1-s} - (1+r)^J((1-\delta)h_{-1}p_h - (1+r)d_0). \tag{E.15}$$

Now we multiply both sides by $(1+r)$ and subtract $(1-\delta)p_h h_J$:

$$\begin{aligned}
d_{J+1}(1+r) - (1-\delta)p_h h_J &= (1+r)^{J+1}\left(\sum_{s=0}^{J}\frac{c_j - y_j}{(1+r)^s} + \frac{(1+r)p_h h_J - (1-\delta)p_h h_J}{(1+r)^{J+1}}\right. \\
&\quad \left. + \frac{1}{1+r}\sum_{s=0}^{J-1}\frac{p_h h_s}{(1+r)^s}(r+\delta) - \Big((1-\delta)h_{-1}p_h - (1+r)d_0\Big)\right) \\
\frac{d_{J+1}(1+r) - (1-\delta)p_h h_J}{(1+r)^{J+1}} &= \sum_{s=0}^{J}\frac{c_j - y_j}{(1+r)^s} + \frac{(r+\delta)p_h h_J}{(1+r)^{J+1}} \\
&\quad + \frac{r+\delta}{1+r}\sum_{s=0}^{J-1}\frac{p_h h_s}{(1+r)^s} - \Big((1-\delta)h_{-1}p_h - (1+r)d_0\Big) \\
\frac{d_{J+1}(1+r) - (1-\delta)p_h h_J}{(1+r)^{J+1}} &= \sum_{s=0}^{J}\frac{c_j}{(1+r)^s} - \overbrace{\sum_{s=0}^{J}\frac{y_j}{(1+r)^s}}^{=Y} \\
&\quad + \frac{r+\delta}{1+r}\sum_{s=0}^{J}\frac{p_h h_s}{(1+r)^s} - \underbrace{\Big((1-\delta)h_{-1}p_h - (1+r)d_0\Big)}_{=E} \\
\frac{d_{J+1}(1+r) - (1-\delta)p_h h_J}{(1+r)^{J+1}} &= \sum_{s=0}^{J}\frac{c_j}{(1+r)^s} + \frac{r+\delta}{1+r}\sum_{s=0}^{J}\frac{p_h h_s}{(1+r)^s} - (E+Y).
\end{aligned} \tag{E.16}$$

Under the optimal policy, it is always optimal that all resources are consumed in the last period, so that equity at the end of the life cycle is zero: $E' = (1-\delta)p_h h_J - d_{J+1}(1+r) = 0$. This implies that the left-hand side of equation (E.16) must be zero for the solution to be optimal, and we obtain

$$E + Y = \sum_{s=0}^{J}\frac{c_j}{(1+r)^s} + \frac{r+\delta}{1+r}\sum_{s=0}^{J}\frac{p_h h_s}{(1+r)^s}. \tag{E.17}$$

Now we plug in equations (E.10) and (E.12) and obtain

$$\begin{aligned}
\underbrace{E+Y}_{=W} &= \sum_{s=0}^{J}\frac{c_0(\beta(1+r))^s}{(1+r)^s} + \frac{r+\delta}{1+r}\sum_{s=0}^{J}\frac{\frac{1+r}{r+\delta}\frac{1-\rho}{\rho}(\beta(1+r))^s c_0}{(1+r)^s} \\
W &= c_0\sum_{s=0}^{J}\beta^s + \frac{1-\rho}{\rho}c_0\sum_{s=0}^{J}\beta^s \\
W &= c_0\frac{1-\beta^{J+1}}{1-\beta} + \frac{1-\rho}{\rho}c_0\frac{1-\beta^{J+1}}{1-\beta} \\
\underbrace{\frac{1-\beta}{1-\beta^{J+1}}}_{=\alpha}W &= \frac{1}{\rho}c_0 \\
\rho\alpha W &= c_0^*.
\end{aligned} \tag{E.18}$$

The law of motion from equation (E.6) follows directly from iterating equation (E.13):

$$d_{j+1} = \sum_{s=0}^{j}(c_s - y_s)(1+r)^{j-s} + \sum_{s=0}^{j}(p_h h_s - (1-\delta)p_h h_{s-1})(1+r)^{j-s} + (1+r)^{j+1}d_0. \quad \text{(E.19)}$$

Rearranging terms, we get the expression from equation (E.14) and plug in the result for the constant expenditure shares to obtain

$$\begin{aligned}
d_{j+1} &= \underbrace{\sum_{s=0}^{j} c_s(1+r)^{j-s}}_{\text{consumption costs}} - \underbrace{\sum_{s=0}^{j} y_s(1+r)^{j-s}}_{\text{income}} + \underbrace{p_h h_j}_{\text{current housing}} \\
&\quad + \underbrace{\sum_{s=0}^{j-1} p_h h_s \frac{r+\delta}{1+r}(1+r)^{j-s}}_{\text{user costs}} - (1+r)^j \underbrace{\left((1-\delta)h_{-1}p_h - (1+r)d_0\right)}_{\text{initial endowment}} \\
d_{j+1} &= \sum_{s=0}^{j} c_s(1+r)^{j-s} - \sum_{s=0}^{j} y_s(1+r)^{j-s} + p_h h_j - (1+r)^j(1-\delta)h_{-1}p_h \\
&\quad + \sum_{s=0}^{j-1} \frac{1-\rho}{\rho} c_s(1+r)^{j-s} + (1+r)^{j+1}d_0 \\
\underbrace{\frac{d_{j+1}}{(1+r)^j}}_{\substack{\text{present value} \\ \text{of debt}}} &= \overbrace{\sum_{s=0}^{j} \frac{c_s}{(1+r)^s} + \sum_{s=0}^{j-1} \frac{1-\rho}{\rho}\frac{c_s}{(1+r)^s}}^{\substack{\text{present value of} \\ \text{total expenditures}}} - \overbrace{\sum_{s=0}^{j} \frac{y_s}{(1+r)^s}}^{\substack{\text{present value} \\ \text{of income}}} \\
&\quad + \underbrace{\left(\frac{p_h h_j}{(1+r)^j} - (1-\delta)h_{-1}p_h\right)}_{\substack{\text{present value of} \\ \text{housing adjustments}}} + \underbrace{(1+r)d_0}_{\substack{\text{(present value)} \\ \text{initial debt}}} .
\end{aligned} \quad \text{(E.20)}$$