Falling Behind: Has Rising Inequality Fueled the American Debt Boom?

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University of Mannheim

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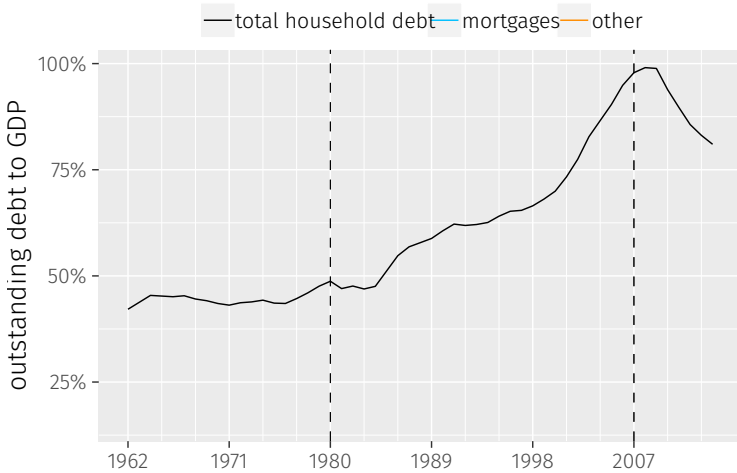
Outline

Facts I: US Household Debt Boom



Source: US Flow of funds

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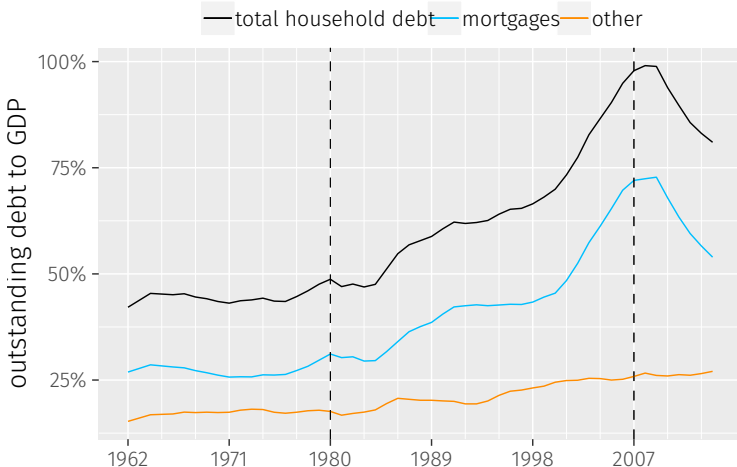

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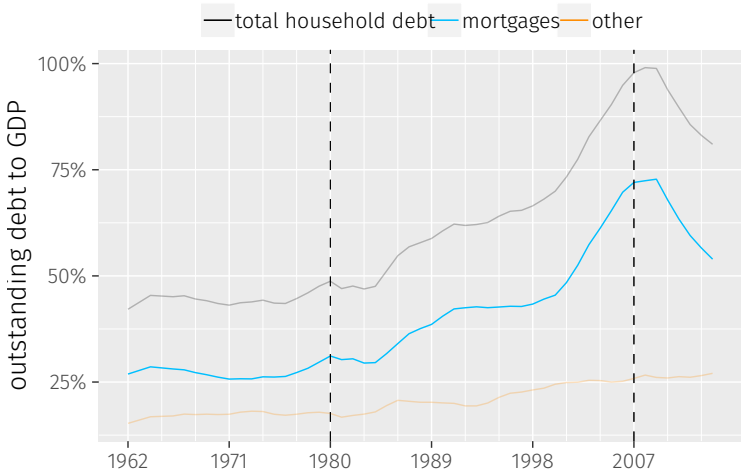

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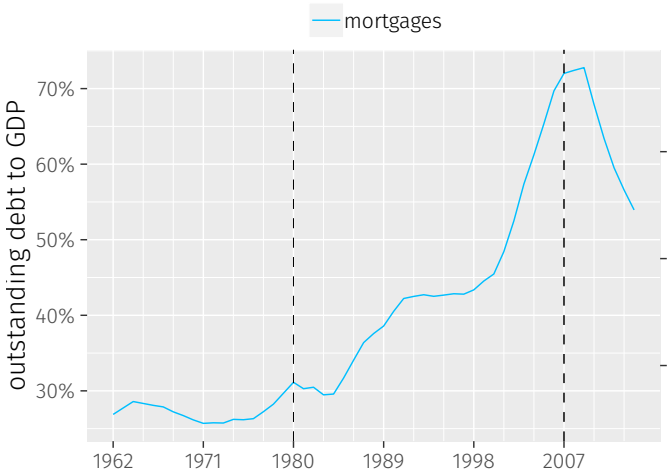
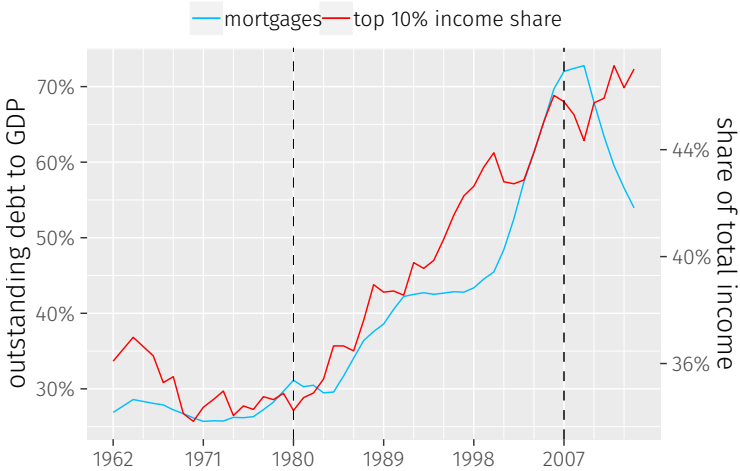


Source: US Flow of funds

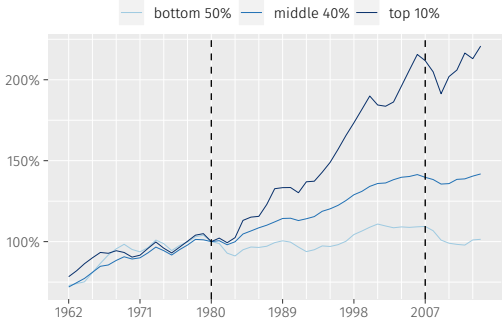
Facts I: US Household Debt Boom and Income Inequality



Source: US Flow of funds and World Inequality Database (Piketty et al.) ▸ alternative inequality measure

Facts II: Real Incomes Rise for Top 50%

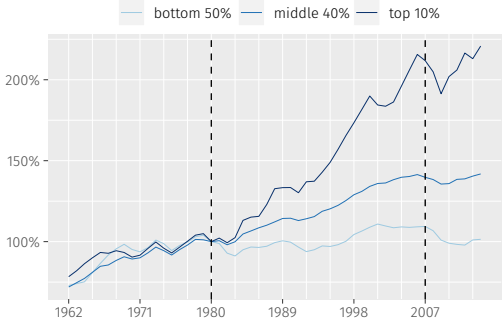
Income growth



Pre-tax incomes in the US. Base year: 1980. Based on Piketty et al. (2018).

Facts II: Real Incomes Rise for Top 50% – Mortgages Rise Across the Distribution

Income growth



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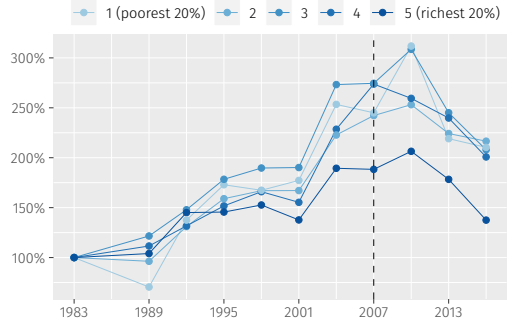
Mortgage debt growth



Mean mortgage debt as a fraction of mean income by income group in the US. Data from Surveys of Consumer Finances (Fed)

Research Question and Method

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Can rising income inequality account for (part of) the boom in mortgage debt and house prices?

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Mechanism

Keeping up with the Joneses

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General Equilibrium Model

- Heterogeneous agents (Bewley-Huggett-Aiyagari)
- durable housing and non-durable consumption, mortgages
- social comparisons
- state-of-the-art income process (Guvenen et al., 2019)

What We Do

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2. Main experiment: exogenously increase inequality in the permanent component of income to match observed increase (1980-2007)
3. Horse race: compare mechanisms with other suggested drivers of the mortgage and house price boom
   - exogenous net capital inflow, lower interest rates (Global Saving Glut)
   - looser collateral constraints (financial innovation/liberalization)

What We Find

Quantitative results

1. Rising inequality and social comparisons generate about 50% of observed mortgage and house price booms
2. Saving glut does not generate strong house price boom

Analytical results

1. individual debt is increasing in the incomes of the reference group
2. aggregate debt-to-income is increasing in top incomes when somebody cares about the rich

How Rising Income Inequality Leads to a Mortgage Boom

rising top inequality $\xrightarrow[\text{with the Joneses}]{\text{Keeping up}}$ mortgage boom

1. rich become richer (exogenously)
2. rich improve their houses, raise reference point
3. non-rich want to keep up with the richer Joneses
4. non-rich improve their houses using a mortage
5. higher debt-to-income ratios across the distribution

Note: non-rich $\approx$ bottom 90 % (almost everyone!)

Outline

Relation to the Literature

- Macroeconomics with housing and mortgages, housing (debt) boom
  e.g. Kumhof et al. (2015, AER), Favilukis et al. (2017, JPE), Kaplan et al. (2020, JPE), Justiniano et al. (2019, JPE)
  - ⇝ new (demand-side) mechanism, extended time-horizon
- External habits (Keeping up with the Joneses)
  e.g. Abel (1990, AER P&P), Campbell and Cochrane (1999, JPE), Ljungqvist and Uhlig (2000, AER)
  - ⇝ heterogenous agent model, use micro-evidence for parameterization
- "Distributional macroeconomics"
  e.g. Kaplan and Violante (2014, Ecma), Kaplan et al. (2016, AER), Achdou et al. (2015)
  - ⇝ another reason why "inequality matters for macro"
- Empirical consumption externalities
  e.g. De Giorgi et al. (2019, REStud), Bertrand and Morse (2016, REStat), Bellet (2019)
  - ⇝ quantify effects on macroeconomic outcomes
- Network economics e.g. Ballester et al. (2006, Ecma), Ghiglino and Goyal (2010, JEEA)
  - ⇝ infinite-horizon network model

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Economic environment

Bewley-Huggett-Aiyagari heterogenous agents model with housing

1. continuum of households
   - ex-ante identical
   - heterogenous productivity (earnings)
   - constant mortality rate
   - *keeping up with the Joneses* motive
2. borrowing subject to collateral constraint
3. production of final good (linear technology)
4. construction sector

Households' problem

- constant mortality rate m
- risky post-tax earnings $\tilde{y}$
- non-durable consumption c, durable housing h
- asset a (savings device and mortgage)
- social comparisons
  - housing status $s(h, \bar{h})$
  - reference measure $\bar{h}$
- house price p, interest rate r

Preferences

$$\mathbb{E}_0 \int_0^\infty e^{-(\rho+m)t} u(c_t, s(h_t, \bar{h}_t))$$

Endogenous States

$$\dot{a}_t = \tilde{y}_t + r_t a_t - c_t - p_t x_t$$
$$\dot{h}_t = -\delta h_t + x_t$$

Collateral constraint

$$-a_t \leq \omega p_t h_t$$

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Social comparisons

Status function $s(h, \bar{h})$

- ratio specification (as in Abel, 1990)

$$s(h, \bar{h}) = \frac{h}{\bar{h}^{\phi}}$$

- ϕ is the sensitivity w.r.t reference housing

$$\phi = -\frac{\text{elasticity of utility w.r.t } \bar{h}}{\text{elasticity of utility w.r.t } h}$$

- follow estimate by Bellet (2019):

$$\phi = 0.7$$

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Flow utility

$$\frac{\left((1-\xi)c^{\varepsilon} + \xi\left(\frac{h}{\bar{h}^{\phi}}\right)^{\varepsilon}\right)^{\frac{1-\gamma}{\varepsilon}}}{1-\gamma}$$

Production

Construction sector

(from Kaplan et al., 2020)

- inputs: labor N_h and land permits $\bar{L}$
- aggregate productivity Θ
- housing investment
  $I_h = (\Theta N_h)^{\alpha}(\bar{L})^{1-\alpha}$ with $\alpha \in (0, 1)$
- $\max_{N_h} p_t I_h - w N_h$

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Financial markets

- exogenous net supply of assets a^S
- borrowing subject to collateral constraint

Equilibrium

A stationary equilibrium is a joint distribution $\mu(a, h, y)$, policy functions $c(a, h, y, \bar{h})$, $h(a, h, y, \bar{h})$, $a(a, h, y, \bar{h})$, prices (p, r) and a reference measure $\bar{h}$ such that

- policy functions are consistent with agents' optimal choices $(c_t, h_t, a_t)_{t>0}$ given incomes $(y_t)_{t>0}$, prices p, r and reference measure $\bar{h}$
- markets clear
  - asset market: $\int a(a, h, y) d\mu = a^S$
  - housing investment equals housing production
- the reference measure is consistent with choices: $\bar{h} = \bar{h}(\mu)$

Outline

Calibration strategy

1. adapt estimated earnings process (Guvenen et al., 2019)
2. set 10 parameters externally to match 1980 target moments
3. calibrate 3 parameters internally to match 1980 target moments

Earnings process (1)

- Taken from Guvenen et al. (2019)
  - Captures both lifetime-inequality and income risk
  - estimated using administrative data from 1994–2013
- $y_{it} = (1 - \nu_{it}) \exp(\tilde{\alpha}_i + z_{it} + \epsilon_{it})$

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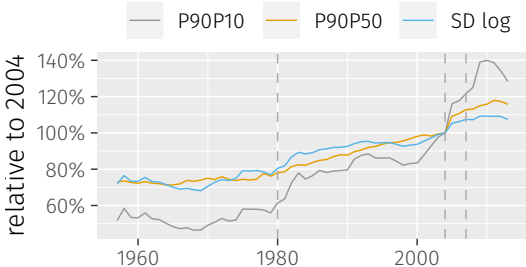
  - transitory component (think "iid")
- post-tax earnings $\tilde{y} = y - T(y)$ (Heathcote et al., 2017)

Earnings process (2): Adjustments for 1980

- take into account changes in cross-sectional income distribution since 1980



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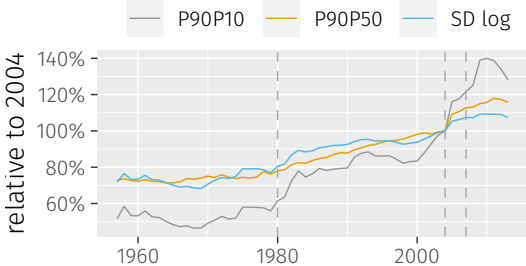

Source: Guvenen et al. (2018)

- most of the increase in cross-sectional variation due to increase in permanent component (Kopczuk et al., 2010; Guvenen et al., 2014)
- adjust permanent component of incomes (σ_α^2) to match difference in P90/P50 ratio between 1980 and 2004

Parameterization

Parameter description		Source	Value
Preferences			
ϕ	strength of keeping up motive	Bellet (2017)	0.7
ρ	discount rate	internal	0.02
ξ	utility weight of housing	internal	0.277
$\frac{1}{1-\varepsilon}$	intra-temporal elasticity of substitution	Flavin and Nakagawa (2008, AER)	0.15
γ	inverse intertemporal elasticity of substitution	standard	1.5
$\frac{1}{m}$	constant mortality rate	45 years worklife	45.0
Housing and financial technogy			
$\frac{\alpha}{1-\alpha}$	price elasticity of housing supply	Saiz (2010, QJE)	1.5
δ	depreciation rate of housing	Bureau of Economic Analysis	0.021
ω	maximum loan-to-value ratio	P95 of LTV	0.85
$a^S/\bar{y}$	exogenous net asst supply	cum. current account	-0.01
Taxation and Unemployment Insurance			
τ_0	level of taxes	internal	0.932
τ_1	progressivity	Heathcote et al. (2017)	0.15
b	replacement rate	Dept of Labor	0.32

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$a^S/\bar{y}$	exogenous net asst supply	cum. current account	-0.01
Taxation and Unemployment Insurance			
τ_0	level of taxes	internal	0.932
τ_1	progressivity	Heathcote et al. (2017)	0.15
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Parameterization

Parameter description		Source	Value
Preferences			
ϕ	strength of keeping up motive	Bellet (2017)	0.7
ρ	discount rate	internal	0.02
ξ	utility weight of housing	internal	0.277
$\frac{1}{1-\varepsilon}$	intra-temporal elasticity of substitution	Flavin and Nakagawa (2008, AER)	0.15
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Model fit: Targeted moments

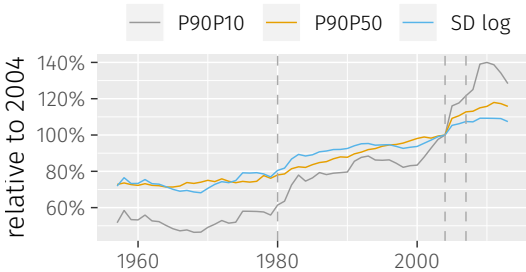
moment	model	data (80/83)
aggregate loan-to-value	0.24	0.24
aggregate networth-to-income	4.63	4.6
tax-revenue-to-income	0.14	0.14

Outline

Outline

Rising inequality, mortgages and house prices 1980–2007 (1)

- inequality rises



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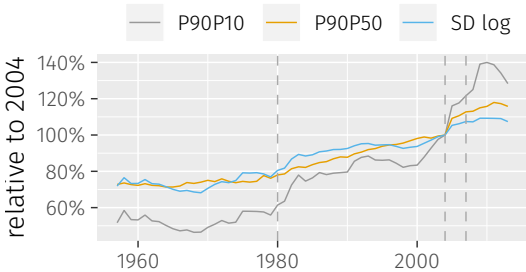

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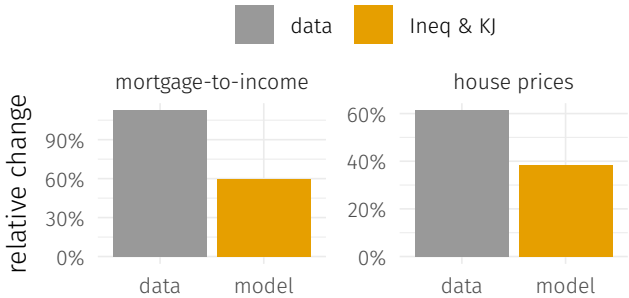
- adjust permanent component of incomes (σ_α^2) to match difference in P90/P50 ratio between 1980 and 2007
- all other parameters are kept constant

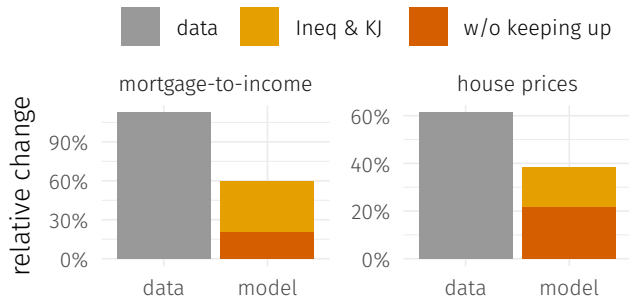
Rising inequality, mortgages and house prices 1980–2007 (2)



Take-away: Inequality & keeping up with the Joneses generate

- 40% of the observed mortgage boom
- 55% of the observed house price boom

Social Comparisons are an Important Amplifier — Rising Inequality is not Enough



Note: Keeping reference measure $\bar{h}$ constant at $\bar{h}_{1980}$.

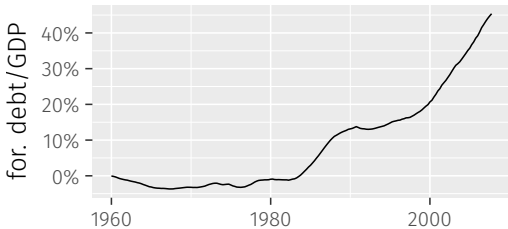
Take-away: Keeping up with the Joneses contributes 61% of the mortgage debt increase and 30% of the house price increase

Outline

Horse race against alternative mechanisms

Global Saving Glut

- cumulative current accout deficit $\approx$ net foreign debt position $= -a^S$
- exogenous rise in net supply of credit $-a^S$ (Justiniano et al., 2014)



Source: US BEA, FRED

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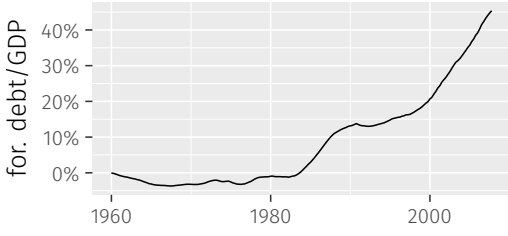

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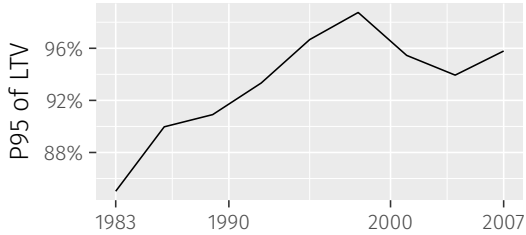
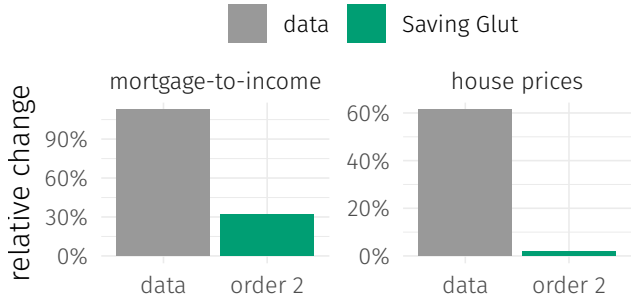
Looser borrowing standards

- loosening of collateral constraints
- result of financial liberalization (e.g. Favilukis et al., 2017)
- proxy ω with P95 of LTV distribution



Source: SCF

Decomposition of the three mechanisms



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1. Saving Glut generates stronger debt boom, but weaker house price boom

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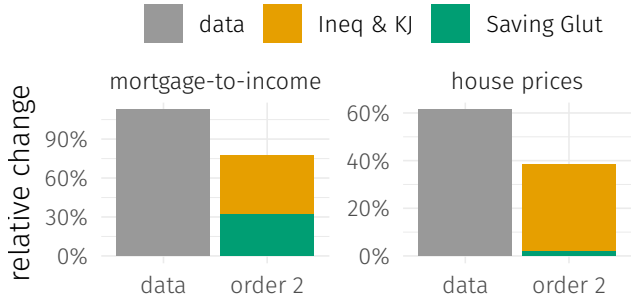

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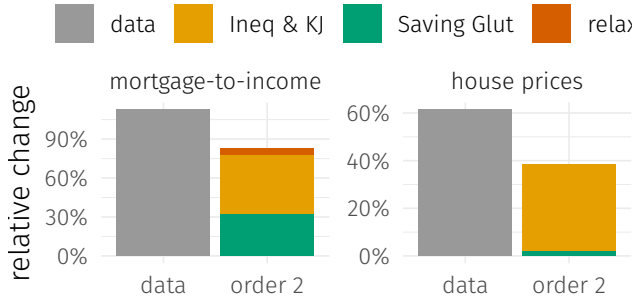

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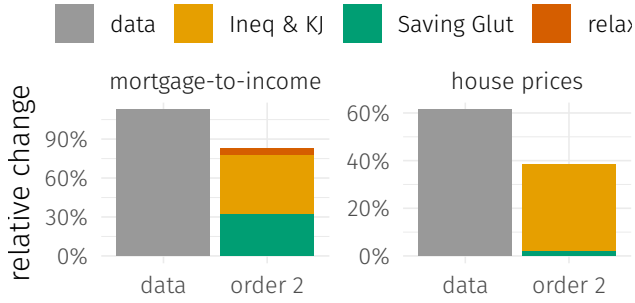
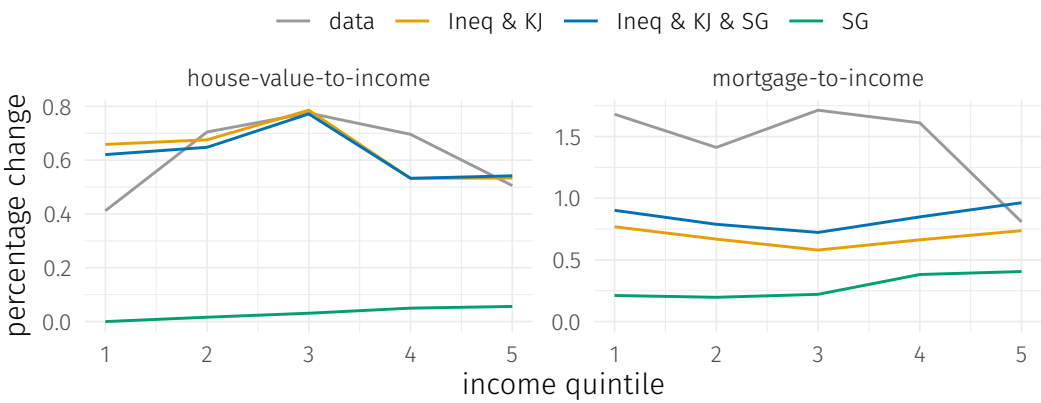


Take-away

1. Saving Glut generates stronger debt boom, but weaker house price boom
2. inequality and keeping up with the Joneses contributes about 50% to mortgages and 95% of to prices

Changes over the income distribution



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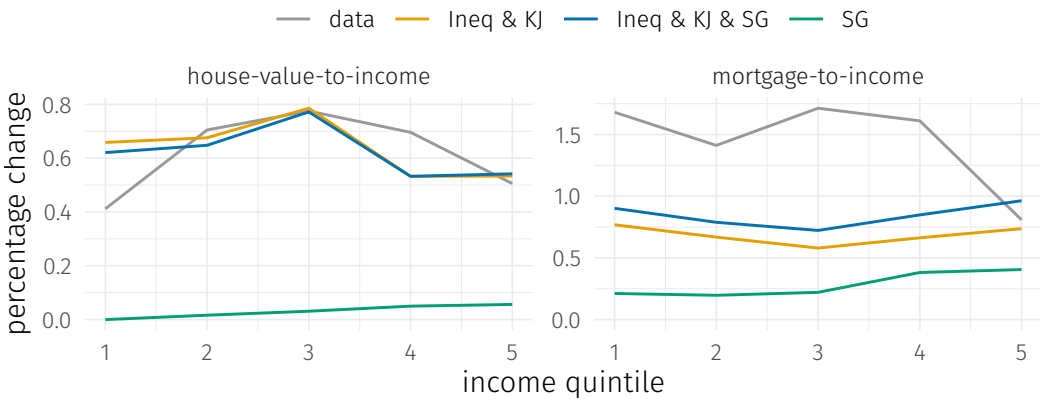

Take-away

Inequality and keeping up with the Joneses gets the inverse-U for house value

Outline

Stylized Version of the Model: No Income Risk

- finite number of types j
- constant incomes y^j
- flexible reference groups $\bar{h} = Gh$

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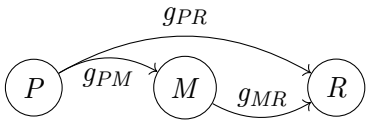

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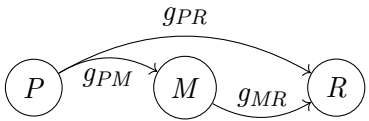

- $u(c, s(h, \bar{h})) = u(c, h - \phi\bar{h})$
- house price p, interest rate $r = \rho$ fixed
- life-time budget constraint
- for convenience: $a_0 = \delta = m = 0$

General Result

Lemma
Equilibrium debt (given p, r) is

$$-\begin{pmatrix} a_1 \\ \vdots \\ a_N \end{pmatrix} = \kappa_1 \begin{pmatrix} y_1 \\ \vdots \\ y_N \end{pmatrix} + \kappa_2 \phi \underbrace{\left(\sum_{i=1}^{\infty} \kappa_3^i G^i \right)}_{\text{Leontief inverse of } G} \begin{pmatrix} y_1 \\ \vdots \\ y_N \end{pmatrix},$$

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Proposition
Total debt-to-income is increasing in type k's income as long as some other type cares about k. The total effect depends on the in-centrality of k.

Result: Example with three income types

Let $\begin{pmatrix} \bar{h}_P \\ \bar{h}_M \\ \bar{h}_R \end{pmatrix} = \underbrace{\begin{pmatrix} 0 & g_{PM} & g_{PR} \\ 0 & 0 & g_{MR} \\ 0 & 0 & 0 \end{pmatrix}}_{G} \begin{pmatrix} h_P \\ h_M \\ h_R \end{pmatrix}$

then equilibrium debt (given p, r) is

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where $\tilde{\phi} = \kappa_3 \phi$, $\kappa_1, \kappa_2 > 0$, $\kappa_3 \in (0, 1)$.

$\rightsquigarrow$ Households need not be directly linked! (effects trickle-down)

Why Is Debt Increasing in Others' Incomes?

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$$h = c\left(\frac{\xi}{(1-\xi)rp}\right)^{\frac{1}{1-\varepsilon}} + \phi\bar{h}$$

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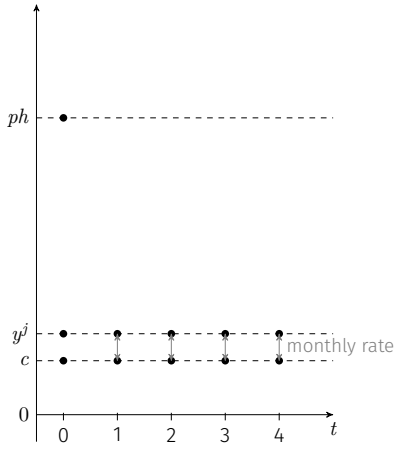
   - use debt to smooth payments



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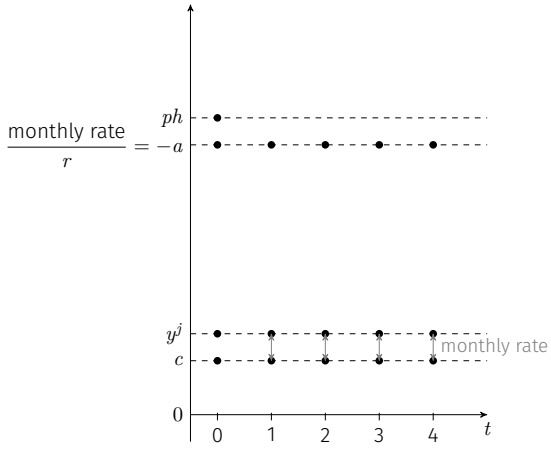

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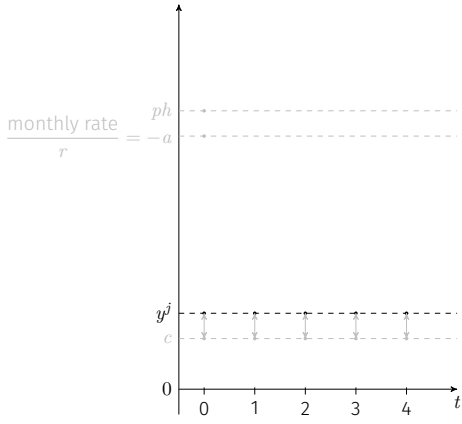

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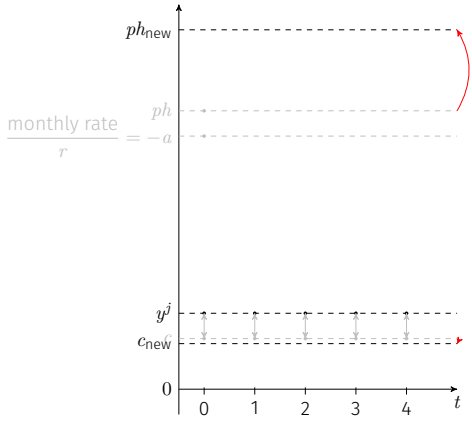

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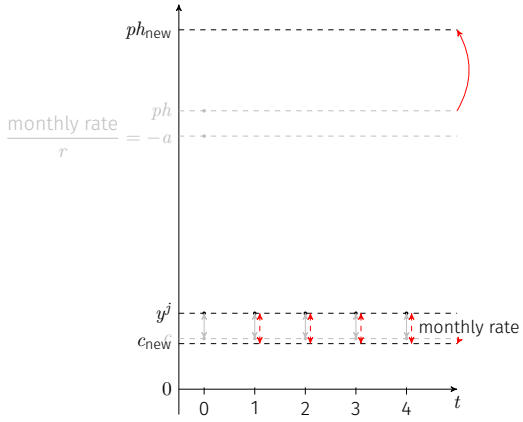

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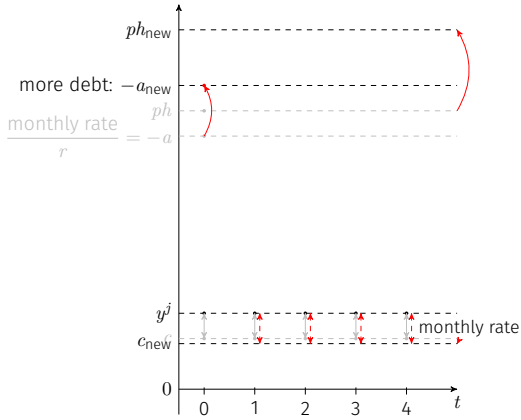

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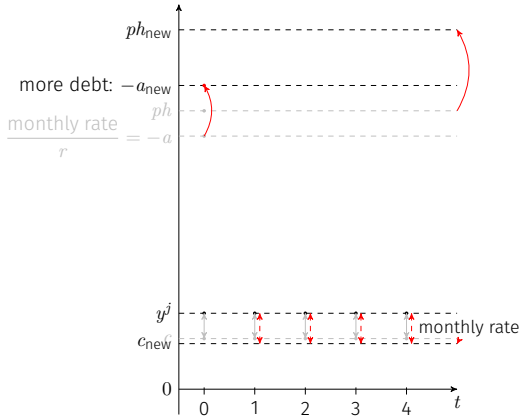

$\rightsquigarrow$ Own credit demand is increasing in others' income!

Outline

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We formalize a causal link between rising top incomes and the debt boom based on “keeping up with the richer Joneses”

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Analytical results

1. that individual debt is increasing in the incomes of the reference group
2. that aggregate debt-to-income ratio is increasing in top incomes when somebody cares about the rich

Thank you!

References i

Abel, A. B. (1990): "Asset Prices under Habit Formation and Catching Up with the Joneses," *American Economic Review*, 80, 38–42.

Achdou, Y., J. Han, J.-M. Lasry, P.-L. Lions, and B. Moll (2015): "Heterogeneous Agent Models in Continuous Time," .

Ballester, C., A. Calvó-Armengol, and Y. Zenou (2006): "Who's Who in Networks. Wanted: The Key Player," *Econometrica*, 74, 1403–1417.

Bellet, C. (2017): "The Paradox of the Joneses - Superstar Houses and Mortgage Frenzy in Suburban America," CEP Discussion Paper 1462, Center for Economic Performance.

——— (2019): "The McMansion Effect: Top Size Inequality, House Satisfaction and Home Improvement in US Suburbs," .

Bertrand, M. and A. Morse (2016): "Trickle-down Consumption," *Review of Economics and Statistics*.

References ii

Campbell, J. Y. and J. H. Cochrane (1999): "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior," *Journal of Political Economy*, 107, 205–251.

De Giorgi, G., A. Frederiksen, and L. Pistaferri (2019): "Consumption Network Effects," *The Review of Economic Studies*.

Favilukis, J., S. C. Ludvigson, and S. van Nieuwerburgh (2017): "The macroeconomic effects of housing wealth, housing finance, and limited risk sharing in general equilibrium," *Journal of Political Economy*, 125, 140–223.

Flavin, M. and S. Nakagawa (2008): "A model of housing in the presence of adjustment costs: A structural interpretation of habit persistence," *American Economic Review*, 98, 474–95.

Ghiglino, C. and S. Goyal (2010): "Keeping up with the Neighbors: Social Interaction in a Market Economy," *Journal of the European Economic Association*, 8, 90–119.

Guvenen, F., G. Kaplan, J. Song, and J. Weidner (2018): "Lifetime incomes in the United States over six decades," .

References iii

Guvenen, F., F. Karahan, S. Ozkan, and J. Song (2019): "What Do Data on Millions of U.S. Workers Reveal About Life-Cycle Earnings Dynamics?" Tech. rep.

Guvenen, F., S. Ozkan, and J. Song (2014): "The Nature of Countercyclical Income Risk," *Journal of Political Economy*, 122, 621–660.

Heathcote, J., K. Storesletten, and G. L. Violante (2017): "Optimal tax progressivity: An analytical framework," *The Quarterly Journal of Economics*, 132, 1693–1754.

Justiniano, A., G. E. Primiceri, and A. Tambalotti (2014): "The effects of the saving and banking glut on the US economy," *Journal of International Economics*, 92, S52–S67.

——— (2019): "Credit Supply and the Housing Boom," *Journal of Political Economy*, 127, 1317–1350.

Kaplan, G., K. Mitman, and G. L. Violante (2020): "The housing boom and bust: Model meets evidence," *Journal of Poltical Economy*.

Kaplan, G., B. Moll, and G. L. Violante (2016): "Monetary Policy According to HANK," Working Paper 21897, National Bureau of Economic Research.

References iv

Kaplan, G. and G. L. Violante (2014): "A Model of the Consumption Response to Fiscal Stimulus Payments," *Econometrica*, 82, 1199–1239.

Kopczuk, W., E. Saez, and J. Song (2010): "Earnings Inequality and Mobility in the United States: Evidence from Social Security Data since 1937," *The Quarterly Journal of Economics*, 125, 91–128.

Kumhof, M., R. Rancière, and P. Winant (2015): "Inequality, Leverage, and Crises," *American Economic Review*, 105, 1217–45.

Ljungqvist, L. and H. Uhlig (2000): "Tax policy and aggregate demand management under catching up with the Joneses," *American Economic Review*, 356–366.

Piketty, T., E. Saez, and G. Zucman (2018): "Distributional National Accounts: Methods and Estimates for the United States," *The Quarterly Journal of Economics*, qjx043.

Saiz, A. (2010): "The geographic determinants of housing supply," *The Quarterly Journal of Economics*, 125, 1253–1296.