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

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University of Mannheim

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Outline

Introduction

Model

Quantitative Results

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Conclusion
Facts I: US Household Debt Boom

Source: US Flow of funds
Facts I: US Household Debt Boom

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Facts I: US Household Debt Boom

Source: US Flow of funds
Facts I: US Household Debt Boom

[outstanding debt to GDP over time]

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.)
Facts II: Real Incomes Rise for Top 50%

Income growth

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

Income growth

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

Research Question

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
Research Question and Method

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

Mechanism
Keeping up with the Joneses

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

1. **Calibrate** model to the US economy in 1980
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2. **Main experiment**: exogenously increase inequality in the permanent component of income to match observed increase (1980-2007)

   *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 Do

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2. **Main experiment**: exogenously increase inequality in the permanent component of income to match observed increase (1980-2007)
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   - exogenous net capital inflow, lower interest rates (Global Saving Glut)
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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 $\Rightarrow$ 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 mortgage
5. higher debt-to-income ratios across the distribution

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

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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)
  \Rightarrow\text{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)
  \Rightarrow\text{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)
  \Rightarrow\text{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)
  \Rightarrow\text{quantify effects on macroeconomic outcomes}

- Network economics e.g. Ballester et al. (2006, Ecma), Ghiglino and Goyal (2010, JEEA)
  \Rightarrow\text{infinite-horizon network model}
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Economic environment

Bewley-Huggett-Aiyagari heterogeneous agents model with housing

1. continuum of households
   - ex-ante identical
   - heterogeneous 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

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

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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Preferences

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

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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

$-a_t \leq \omega p_t h_t$
Households’ problem

• constant mortality rate $m$
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Preferences

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

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Social comparisons

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

- ratio specification (as in Abel, 1990)

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

- $\phi$ 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):

$$\phi = 0.7$$

Reference measure $\bar{h}$

- strongest reaction with respect to the 90th percentile (Bellet, 2019)

- set $\bar{h} = P_{90}$ of housing distribution

Flow utility

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

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

- ratio specification (as in Abel, 1990)
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  s(h, \bar{h}) = \frac{h}{\bar{h}^\phi}
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Reference measure \( \bar{h} \)

- strongest reaction with respect to the 90th percentile (Bellet, 2019)
- set \( \bar{h} = \text{P90 of housing distribution} \)

Flow utility

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

\[
\frac{1 - \gamma}{1 - \gamma}
\]
Production

Construction sector
(from Kaplan et al., 2020)

• inputs: labor $N_h$ and land permits $\bar{L}$
• aggregate productivity $\Theta$
• 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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Consumption good
linear production: $Y_c = \Theta(1 - N_h)$
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Consumption good

linear production: $Y_c = \Theta(1 - N_h)$

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: $\bar{h} = \bar{h}(\mu)$
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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
- \( y_{it} = (1 - \nu_{it}) \exp(\tilde{\alpha}_i + z_{it} + \epsilon_{it}) \)
Earnings process (1)

- Taken from Guvenen et al. (2019)
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  - estimated using administrative data from 1994–2013
- \( y_{it} = (1 - \nu_{it}) \exp(\tilde{\alpha}_i + z_{it} + \epsilon_{it}) \)
  - state-dependent non-employment risk \( \nu_{it} \in \{0, 1\} \)
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  - state-dependent non-employment risk \( \nu_{it} \in \{0, 1\} \)
  - permanent component \( \tilde{\alpha}_i \sim N(\mu_\alpha, \sigma^2_\alpha) \)

- post-tax earnings \( \tilde{y}_{it} = y_{it} - T(y_{it}) \) (Heathcote et al., 2017)
Earnings process (1)

- Taken from Guvenen et al. (2019)
  - Captures both lifetime-inequality and income risk
  - Estimated using administrative data from 1994–2013

\[ y_{it} = (1 - \nu_{it}) \exp(\tilde{\alpha}_i + z_{it} + \epsilon_{it}) \]

- State-dependent non-employment risk \( \nu_{it} \in \{0, 1\} \)
- Permanent component \( \tilde{\alpha}_i \sim N(\mu_\alpha, \sigma^2_\alpha) \)
- Persistent component (think “AR(1)”)
Earnings process (1)

- Taken from Guvenen et al. (2019)
  - Captures both lifetime-inequality and income risk
  - estimated using administrative data from 1994–2013

- $y_{it} = (1 - \nu_{it}) \exp(\tilde{\alpha}_i + z_{it} + \epsilon_{it})$
  - state-dependent non-employment risk $\nu_{it} \in \{0, 1\}$
  - permanent component $\tilde{\alpha}_i \sim N(\mu_\alpha, \sigma^2_\alpha)$
  - persistent component (think “AR(1)”)  
  - transitory component (think “iid”)
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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

![Graph showing changes in income distribution](image)

Source: Guvenen et al. (2018)
Earnings process (2): Adjustments for 1980

- take into account changes in cross-sectional income distribution since 1980
- 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 ($\sigma_\alpha^2$) to match difference in P90/P50 ratio between 1980 and 2004

Source: Guvenen et al. (2018)
## Parameterization

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<tr>
<th>Parameter description</th>
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</tr>
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<tbody>
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<td></td>
<td></td>
</tr>
<tr>
<td>( \phi ) strength of keeping up motive</td>
<td>Bellet (2017)</td>
<td>0.7</td>
</tr>
<tr>
<td>( \rho ) discount rate</td>
<td>internal</td>
<td>0.02</td>
</tr>
<tr>
<td>( \xi ) utility weight of housing</td>
<td>internal</td>
<td>0.277</td>
</tr>
<tr>
<td>( \frac{1}{1-\varepsilon} ) intra-temporal elasticity of substitution</td>
<td>Flavin and Nakagawa (2008, AER)</td>
<td>0.15</td>
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<tr>
<td>( \gamma ) inverse intertemporal elasticity of substitution</td>
<td>standard</td>
<td>1.5</td>
</tr>
<tr>
<td>( \frac{1}{m} ) constant mortality rate</td>
<td>45 years worklife</td>
<td>45.0</td>
</tr>
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<td><strong>Housing and financial technology</strong></td>
<td></td>
<td></td>
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<td>( \frac{\alpha}{1-\alpha} ) price elasticity of housing supply</td>
<td>Saiz (2010, QJE)</td>
<td>1.5</td>
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<td>( \delta ) depreciation rate of housing</td>
<td>Bureau of Economic Analysis</td>
<td>0.021</td>
</tr>
<tr>
<td>( \omega ) maximum loan-to-value ratio</td>
<td>P95 of LTV</td>
<td>0.85</td>
</tr>
<tr>
<td>( a^S/y ) exogenous net asset supply</td>
<td>cum. current account</td>
<td>-0.01</td>
</tr>
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<td><strong>Taxation and Unemployment Insurance</strong></td>
<td></td>
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<td>( \tau_0 ) level of taxes</td>
<td>internal</td>
<td>0.932</td>
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<tr>
<td>( \tau_1 ) progressivity</td>
<td>Heathcote et al. (2017)</td>
<td>0.15</td>
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<td>( b ) replacement rate</td>
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Model fit: Targeted moments

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<th>model</th>
<th>data (80/83)</th>
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<tr>
<td>aggregate networth-to-income</td>
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<td>4.6</td>
</tr>
<tr>
<td>tax-revenue-to-income</td>
<td>0.14</td>
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Outline

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Quantitative Results

Analytical Results

Conclusion
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Quantitative Results

  Inequality experiment

  Horse race against alternative mechanisms

Analytical Results

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

- inequality rises

Source: Guvenen et al. (2018)
Rising inequality, mortgages and house prices 1980–2007 (1)

- inequality rises

![Graph showing inequality over time]

- adjust permanent component of incomes ($\sigma^2_\alpha$) to match difference in P90/P50 ratio between 1980 and 2007

- all other parameters are kept constant

Source: Guvenen et al. (2018)
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.
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Horse race against alternative mechanisms

Global Saving Glut

- cumulative current account 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
Horse race against alternative mechanisms

Global Saving Glut

- cumulative current account deficit \( \approx \) net foreign debt position \( = -aS \)
- exogenous rise in net supply of credit \( -aS \) (Justiniano et al., 2014)

Looser borrowing standards

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

Source: US BEA, FRED

Source: SCF
Decomposition of the three mechanisms

Take-away

1. Saving Glut generates stronger debt boom, but weaker house price boom
Decomposition of the three mechanisms

Take-away

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Decomposition of the three mechanisms

Take-away

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Decomposition of the three mechanisms

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

Take-away

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

- **Data**
- **Ineq & KJ**
- **Ineq & KJ & SG**
- **SG**

**House-value-to-income**

- Income quintile: 1, 2, 3, 4, 5
- Percentage change: 0.0, 0.2, 0.4, 0.6, 0.8

**Mortgage-to-income**

- Income quintile: 1, 2, 3, 4, 5
- Percentage change: 0.0, 0.2, 0.4, 0.6, 0.8
Changes over the income distribution

- **House-value-to-income**
  - Data
  - Ineq & KJ
  - Ineq & KJ & SG
  - SG

- **Mortgage-to-income**
  - Data
  - Ineq & KJ
  - Ineq & KJ & SG
  - SG

**Take-away**

Inequality and keeping up with the Joneses gets the inverse-U for house value
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Stylized Version of the Model: No Income Risk

- finite number of types \( j \)
- constant incomes \( y^j \)
- flexible reference groups \( \bar{h} = Gh \)
Stylized Version of the Model: No Income Risk

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

e.g.
\[
\begin{pmatrix}
\bar{h}_P \\
\bar{h}_M \\
\bar{h}_R
\end{pmatrix}
= \begin{pmatrix}
0 & g_{PM} & g_{PR} \\
0 & 0 & g_{MR} \\
0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
{h}_P \\
{h}_M \\
{h}_R
\end{pmatrix}
\]
Stylized Version of the Model: No Income Risk

- finite number of types $j$
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For example:

\[
\begin{pmatrix}
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\bar{h}_M \\
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0 & 0 & g_{MR} \\
0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
h_P \\
h_M \\
h_R
\end{pmatrix}
\]

\[
G
\]

\[
\begin{array}{c}
P \\
M \\
R
\end{array}
\]

- house price $p$
- interest rate $r = \rho$
- life-time budget constraint
- for convenience: $a_0 = \delta = m = 0$
Stylized Version of the Model: No Income Risk

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    h_R
  \end{pmatrix}$

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

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

where $\kappa_1, \kappa_2 > 0, \kappa_3 \in (0, 1)$. 
General Result

Lemma
Equilibrium debt (given \( p, r \)) is

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Proposition
Type \( j \)'s debt is increasing in type \( k \)'s income as long as \( j \) cares about \( k \) (directly or indirectly).
General Result

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Proposition
Type $j$’s debt is increasing in type $k$’s income as long as $j$ cares about $k$ (directly or indirectly).

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 $k$. 

25/31
Result: Example with three income types

Let

\[
\begin{pmatrix}
\bar{h}_P \\
\bar{h}_M \\
\bar{h}_R
\end{pmatrix} = \begin{pmatrix}
0 & g_{PM} & g_{PR} \\
0 & 0 & g_{MR} \\
0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
h_P \\
h_M \\
h_R
\end{pmatrix}
\]

\[
G
\]

then equilibrium debt (given \( p, r \)) is

\[
-\begin{pmatrix}
a_P \\
a_M \\
a_R
\end{pmatrix} = \kappa_1 \begin{pmatrix}
y_P \\
y_M \\
y_R
\end{pmatrix} + \kappa_2 \tilde{\phi} \begin{pmatrix}
0 & \tilde{\phi} \cdot g_{PM} & \tilde{\phi} \cdot g_{PR} + \tilde{\phi}^2 \cdot g_{PM} \cdot g_{MR} \\
0 & 0 & \tilde{\phi} \cdot g_{MR} \\
0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
y_P \\
y_M \\
y_R
\end{pmatrix}
\]

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

\(~\) Households need not be directly linked! (effects trickle-down)
Why Is Debt Increasing in Others’ Incomes?

1. others’ houses (and $\bar{h}$)
   increase in others’ incomes
Why Is Debt Increasing in Others’ Incomes?

1. others’ houses (and $\bar{h}$) increase in others’ incomes

2. own house increases with others’ houses

$$h = c \left( \frac{\xi}{(1 - \xi)rp} \right)^{\frac{1}{1-\varepsilon}} + \phi \bar{h}$$
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3. bigger house means more debt
   - use debt to smooth payments
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\[
\frac{\text{monthly rate}}{r} = -a
\]

Own credit demand is increasing in others’ income!
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$\Rightarrow$ Own credit demand is increasing in others’ income!
Conclusion

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

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3. in a decomposition, inequality and keeping up with the Joneses account for about half the of total debt boom and 95% of total house price boom

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!


