Household leveraging and deleveraging

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1990s: relative stability

a) HH Mortgages/GDP

b) House Prices (CS)

c) Real Estate/GDP

d) HH Mortgages/Real Estate
2000-2006: unprecedented leveraging

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2000-2006: unprecedented leveraging
2007-present: deleveraging

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2007-present: deleveraging

- **a)** HH Mortgages/GDP
- **b)** House Prices (CS)
- **c)** Real Estate/GDP
- **d)** HH Mortgages/Real Estate

Spikes
Stylized Facts

- 1990s: stability of household debt and house prices
- 2000s: unprecedented leveraging and then deleveraging, driven by house prices
This paper

- Quantitative model of household borrowing with houses as collateral
- Calibrated to match aggregate and micro data from the Survey of Consumer Finances
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- Quantitative model of household borrowing with houses as collateral

- Calibrated to match aggregate and micro data from the Survey of Consumer Finances

- Laboratory to investigate causes and consequences of HH leveraging-deleveraging cycle
Summary of the results

- Causes of credit cycle
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  - Looser collateral requirements and reversal \( \rightarrow \) very poor fit
    - House prices barely move
    - Debt dynamics at odds with the data
Summary of the results

- **Causes** of credit cycle

  - Looser collateral requirements and reversal ➔ very poor fit
    - House prices barely move
    - Debt dynamics at odds with the data
  
  - **Valuation story** more promising: Change of borrowing constraint through other mechanisms that affect the value of houses
Summary of the results

- **Causes of credit cycle**
  - Looser collateral requirements and reversal ➔ very poor fit
    - House prices barely move
    - Debt dynamics at odds with the data
  - Valuation story more promising: Change of borrowing constraint through other mechanisms that affect the value of houses

- **Macro consequences of credit cycle**: Not very large
  - Credit expansion: Borrowers and lenders behave in opposite ways
  - Credit contraction: Do not hit the ZLB
Outline

- Sketch of the model
- Parameterization
- Results
  - Credit market liberalization and its reversal
  - Valuation experiment
Model
Model

- Build on
  - Iacoviello (2005)
  - Campbell and Hercowitz (2006)
Agents in the model

- 2 groups of households
  - Impatient → Borrowers
  - Patient → Lenders

- Producers of
  - Houses
  - Intermediate goods
  - Final goods

- The government
The problem of the borrowers

\[ E_0 \sum_{t=0}^{\infty} \beta_b^t \left[ \log C_{b,t} + \phi \log H_{b,t} - \varphi \frac{L_{b,t}^{1+\eta}}{1+\eta} \right] \]
The problem of the borrowers

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\[
H_{b,t+1} = (1 - \delta_h)H_{b,t} + \Xi_{b,t}
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\[
P_tC_{b,t} + P_t^h \Xi_{b,t} + P_T T_{b,t} + R_{t-1} D_{b,t-1} \leq W_{b,t} L_{b,t} + D_{b,t}
\]
The collateral constraint

- Debt is limited by a collateral constraint

\[ D_{b,t} \leq \bar{D}_t \]
The collateral constraint

- Debt is limited by a collateral constraint

\[
D_{b,t} \leq \bar{D}_t = \begin{cases} 
\theta_t P_t^h H_{b,t+1} & 
\end{cases}
\]
The collateral constraint

- Debt is limited by a collateral constraint

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D_{b,t} \leq \bar{D}_t = \begin{cases} 
\theta_t P_t^h H_{b,t+1} & \text{loosening}
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The collateral constraint

- Debt is limited by a collateral constraint
  - Asymmetric to mimic mortgages

\[
D_{b,t} \leq \overline{D}_t = \begin{cases} 
\theta_t P_t^h H_{b,t+1} & \text{loosening} \\
(1 - \delta_h)\overline{D}_{t-1} + \theta_t P_t^h \Xi_{b,t} & \text{tightening}
\end{cases}
\]

\[
\Xi_{b,t} = H_{b,t+1} - (1 - \delta_h)H_{b,t}
\]

Newly purchased houses
The problem of the lenders

- Similar to the problem of the borrowers

- Two exceptions
  - Higher discount factor
  - Accumulate capital
Agents in the model

- 2 groups of households
  - Impatient → Borrowers
  - Patient → Lenders

- Producers of
  - Houses
  - Intermediate goods
  - Final goods

- The government
Parameter values

- Calibrate parameters to match 1990-2000
- Aggregate data: Flow of Funds + NIPA
- Micro data: Survey of Consumer Finances
## Baseline Calibration: key parameters

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- Parameterization

Results
- Credit market liberalization and its reversal
- Valuation experiment
Credit liberalization and its reversal

- Exogenous change in the collateral constraint
Credit liberalization and its reversal

- Exogenous change in the collateral constraint

\[ D_{b,t} \leq \overline{D}_t = \begin{cases} 
\theta_t P_t^h H_{b,t+1} & \text{loosening} \\
(1 - \rho)\overline{D}_{t-1} + \theta_t P_t^h \Xi_{b,t} & \text{tightening}
\end{cases} \]
Evidence on LTV: Duca et al. (2011)

Cumulative LTV for 1st time homebuyers

Dashed blue line reflects estimated effects of the savings and loan bailout, solid blue line nets out estimated effects.

Sources: Flow of Funds, American Housing Survey, Duca et al., (2011) and authors’ calculations.
Credit liberalization and its reversal

- Exogenous change in the collateral constraint
  - $\theta$ from 0.85 progressively to 0.95
  - Back to 0.85 more abruptly
Model solution

- Perfect foresight
- Occasionally binding constraints
- Asymmetry of the collateral constraint
Credit liberalization and its reversal

- Exogenous change in the collateral constraint
- Does not match the data
Credit liberalization and its reversal

- Exogenous change in the collateral constraint
- Does not match the data
  - Interest rate: wrong direction during credit expansion
Credit liberalization and its reversal

- Exogenous change in the collateral constraint

- Does not match the data
  - Interest rate: wrong direction
  - House prices: barely move
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  - Debt-to-GDP: fairly modest response
Credit liberalization and its reversal

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Credit liberalization and its reversal

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  - Debt-to-collateral: increases and falls, not stable and spikes
  - GDP: moderate effects
The role of the asymmetric constraint

(a): $\theta$

(b): House prices

(c): Debt-to-real estate ratio

(d): Debt-to-GDP ratio

(e): GDP

(f): Nominal interest rate (annualized)
Valuation experiment

- To get macro dynamics right need house prices to go up
Valuation experiment

- To get macro dynamics right need house prices to go up

- Shortcut: change in demand for houses

  - Iacoviello and Neri (2010); Liu, Wang, Zha (2011)
  - **NOT** an explanation of U.S. house prices
  - Highlight transmission of changes in collateral values
Valuation experiment

- To get macro dynamics right need house prices to go up
- Shortcut: change in demand for houses
  - Iacoviello and Neri (2010); Liu, Wang, Zha (2011)
  - NOT an explanation of U.S. house prices
  - Highlight transmission of changes in collateral values
Valuation Experiment

- Real estate & debt variables in line with data
Valuation Experiment

- GDP & interest rates
  - Relatively small effects
  - Similar to credit cycle experiment
Conclusions

- Quantitative model of household borrowing
- Calibrated to match aggregate and SCF data

We find:

- Causes of leveraging-deleveraging cycle
  - Not loosener collateral requirements and reversal
  - Valuation story more promising

- Macro consequences of leveraging-deleveraging cycle
  - Not very large
Still missing...

- Model of the extensive margin
  - Ortalo-Magne and Rady (2006)
  - Piazzesi and Schneider (2012)

- Why did house prices increased so much?
  - Geanakoplos (various)
  - Burnside, Eichenbaum and Rebelo (2011)
  - Low interest rates
  - Non-fundamental stories
Production of houses

- Competitive producers transform final goods into houses

\[
\Xi_t = \left(1 - S_h\left(\frac{I^h_t}{I^h_{t-1}}\right)\right) I^h_t
\]

- Adjustment costs for changing housing investment
  - Determine elasticity of housing supply

- Fixed or sluggish supply of houses
Related literature

- **Housing and HH debt**
  - Iacoviello (2005)
  - Campbell and Hercowitz (2006)

- **Credit market liberalization (mostly in open economy)**
  - Kiyotaki, Michaelides and Nikolov (2010)
  - Favilukis, Ludvigson and Van Nieuwerburgh (2012)
  - Garriga, Manuelli and Peralta-Alva (2012)
  - Boz and Mendoza (2011)

- **Macro consequences of deleveraging**
  - Eggertsson and Krugman (2012)
  - Guerrieri and Lorenzoni (2012)
  - Midrigan and Philippon (2011)
Production of goods

- Producers of intermediate goods

$$Y_{i,t} = A_t K_{i,t}^{\alpha} \left[ \left( \psi L_{b,i,t} \right)^{\nu} \left( (1 - \psi) L_{l.i,t} \right)^{1-\nu} \right]^{1-\alpha}$$

- Monopolistically competitive markets & sticky prices
Production of goods

- Producers of intermediate goods

\[ Y_{i,t} = A_t K_{i,t}^\alpha \left[ \left( \psi L_{b,i,t} \right)^\nu \left( (1 - \psi) L_{l,i,t} \right)^{1-\nu} \right]^{1-\alpha} \]

- Monopolistically competitive markets & sticky prices

- Producers of final goods \( Y_t \)

  - Dixit-Stiglitz aggregators
  - Perfectly competitive markets
  - Consumption, investment goods or inputs production of houses
The government

- Balances its budget

- Taylor rule

\[
\frac{R_t}{R} = \max \left\{ \frac{1}{R} ; \left( \frac{R_{t-1}}{R} \right)^{\rho_R} \left[ \left( \frac{\bar{\pi}_{t-3,t}}{\pi} \right)^{\tau_\pi} \left( \frac{Y_t}{Y^*_t} \right)^{\tau_y} \right]^{1-\rho_R} \right\}
\]
## Baseline Calibration: other parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity of labor supply ($\eta$)</td>
<td>1</td>
</tr>
<tr>
<td>SS growth ($\gamma$)</td>
<td>0.005</td>
</tr>
<tr>
<td>Share of capital income ($\alpha$)</td>
<td>0.3</td>
</tr>
<tr>
<td>Probability of non re-optimizing prices ($\xi$)</td>
<td>0.75</td>
</tr>
<tr>
<td>Depreciations ($\delta_k$ and $\delta_H$)</td>
<td>0.025 and 0.003</td>
</tr>
<tr>
<td>Investment adjustment costs ($\zeta_k$)</td>
<td>2</td>
</tr>
<tr>
<td>Monetary policy ($\rho_R$, $\tau_\pi$ and $\tau_y$)</td>
<td>0.8, 2 and 0.125</td>
</tr>
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</table>
Borrowers:

\[ P_t^h = \frac{1 - \xi_t}{1 - \xi_t \theta} \cdot \frac{1}{R_t} \left[ MRS_{b,t+1}^h + (1 - \delta_t)P_{t+1}^h \right] \]

Lenders:

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Credit liberalization and its reversal

- Borrowers and lenders
Credit liberalization and its reversal

- Exogenous change in the collateral constraint

- Does not match the data
  - Interest rate: wrong direction!
  - House prices: barely move
  - Debt-to-GDP: fairly modest response
  - Debt-to-collateral: increases and falls, not stable and spikes
  - GDP: moderate effects
  - In the data house prices down before tightening of credit standards
Senior Loan Officer Opinion Survey

Net Percentage of Domestic Respondents Tightening Standards for Residential Mortgage Loans

Percent

2007-Q1

All residential

Prime
Nontraditional
Subprime

Percent
Credit liberalization and its reversal: extreme calibration

- Consider
  - Larger change in LTV ($\theta$): from 0.75 to 0.95
  - Greater borrower impatience: $\beta_b = 0.98$
  - 50% decline in amortization rate
Credit liberalization and its reversal: extreme calibration

- Results

  - Larger effect on house prices (20%), Debt/GDP doubles, but...
Credit liberalization and its reversal: extreme calibration

Results

- Larger effect on house prices (20%), Debt/GDP doubles, but...

- Debt/Real Estate dynamics still falls short

- Problems with GDP, nominal interest rate exacerbated

- Matching calibration targets → ratio real estate holdings of borrowers to lenders: model 1.23 vs. data 0.5
Credit liberalization and its reversal: extreme calibration