

# Household leveraging and deleveraging

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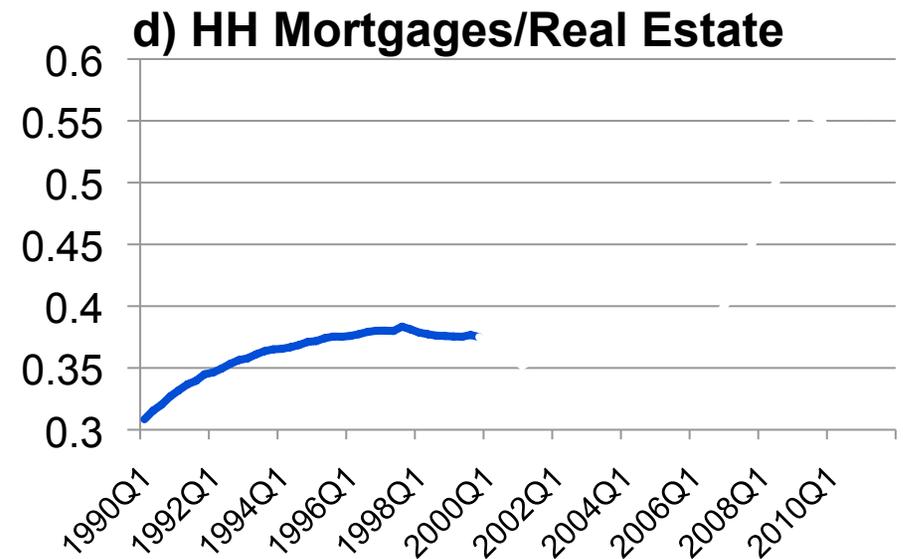
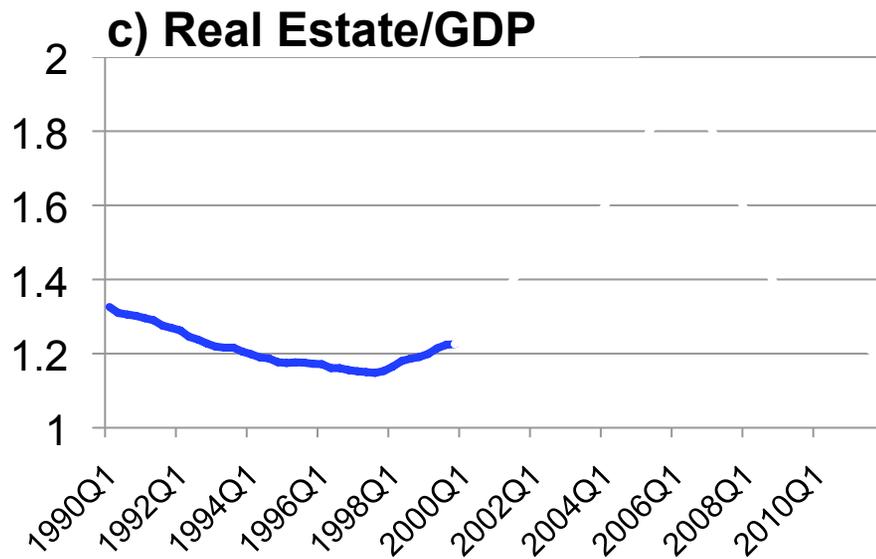
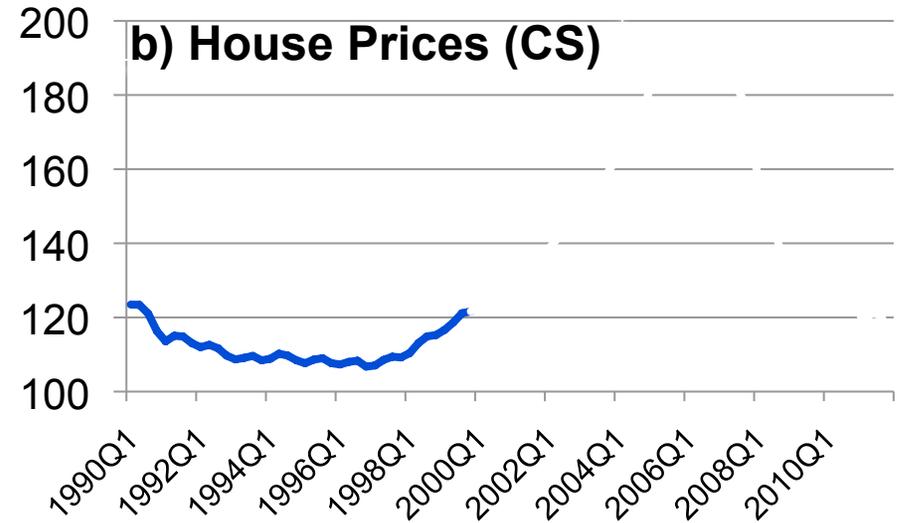
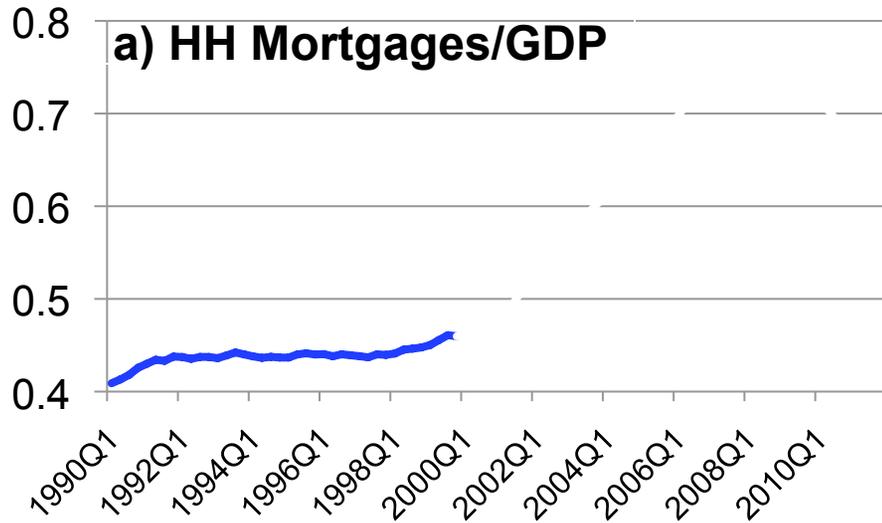
Andrea Tambalotti, Federal Reserve Bank of New York

RED conference on Money, Credit, and Financial Frictions

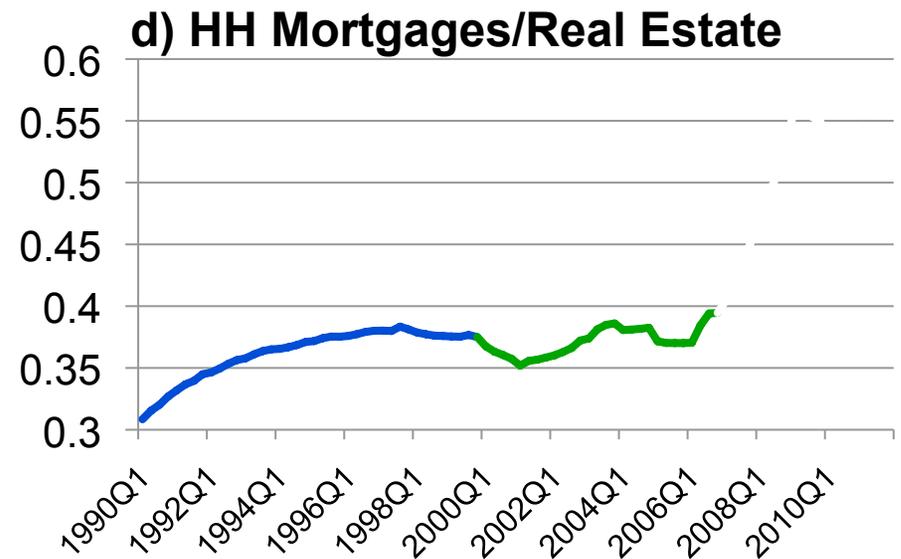
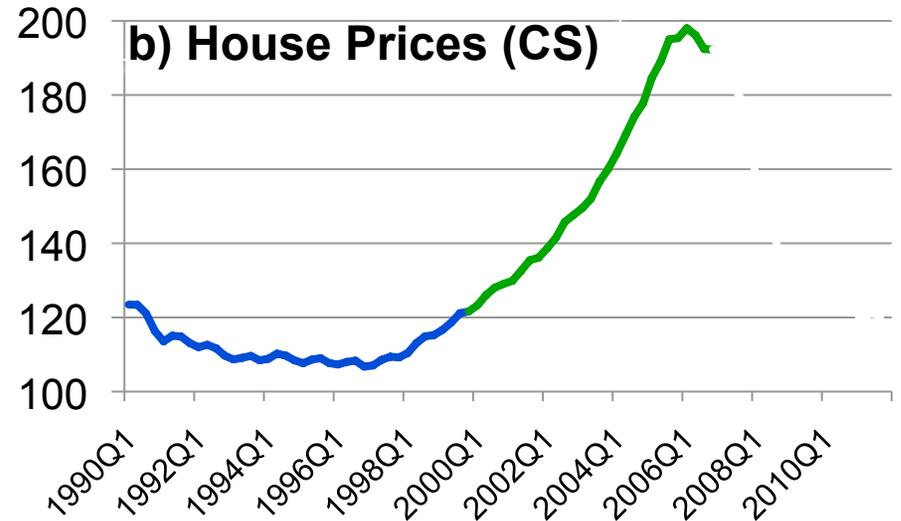
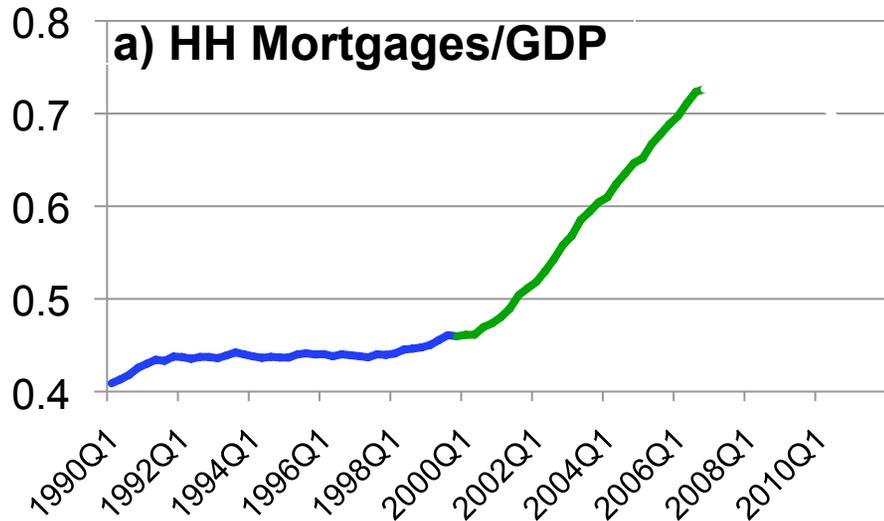
St. Louis Fed

December 6, 2013

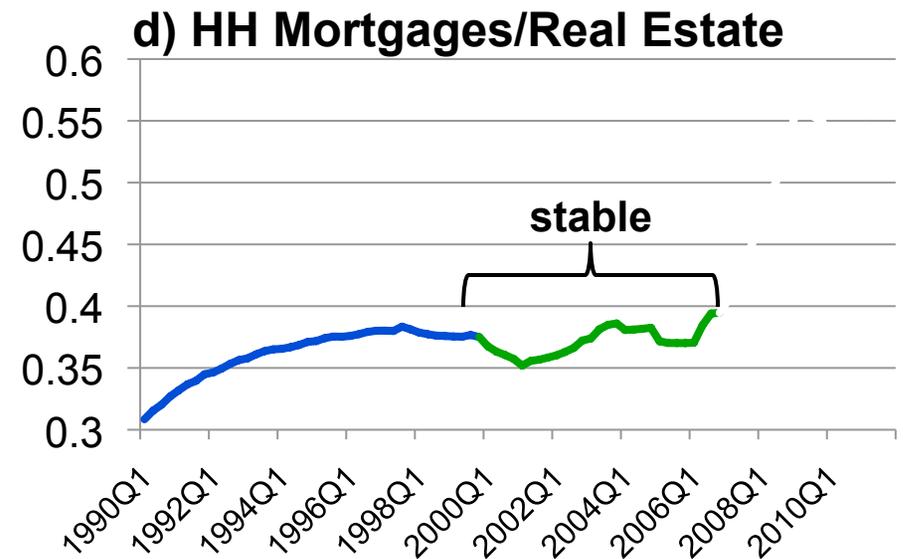
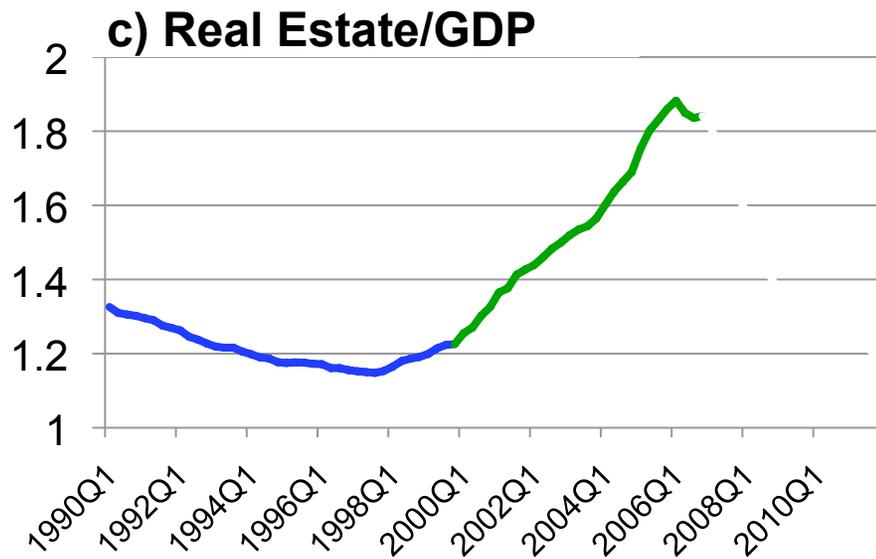
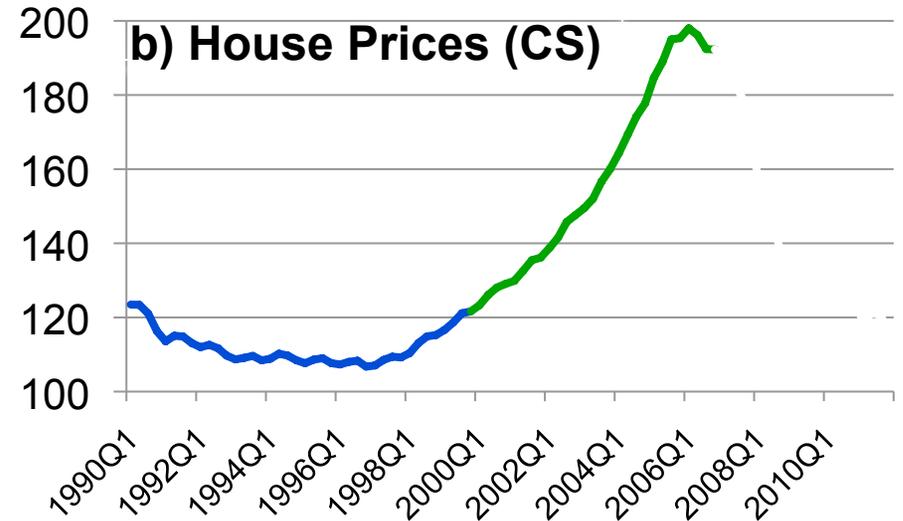
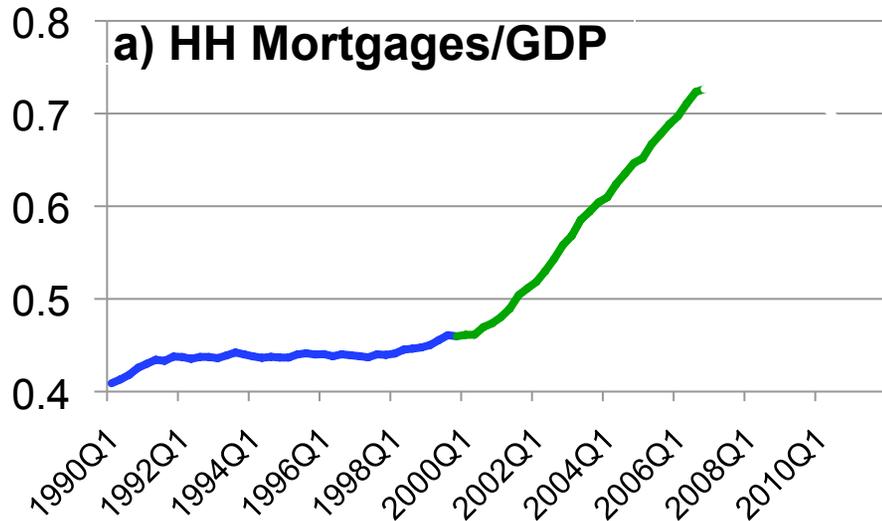
# 1990s: relative stability



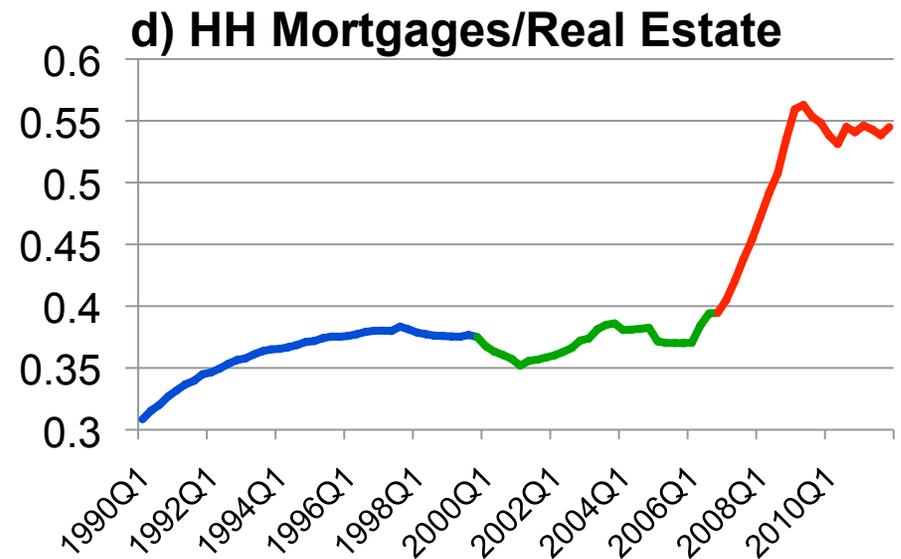
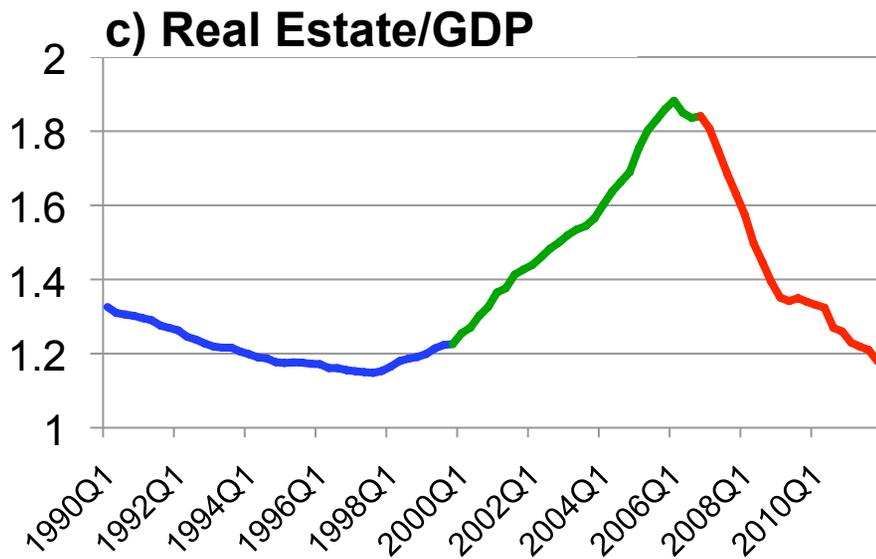
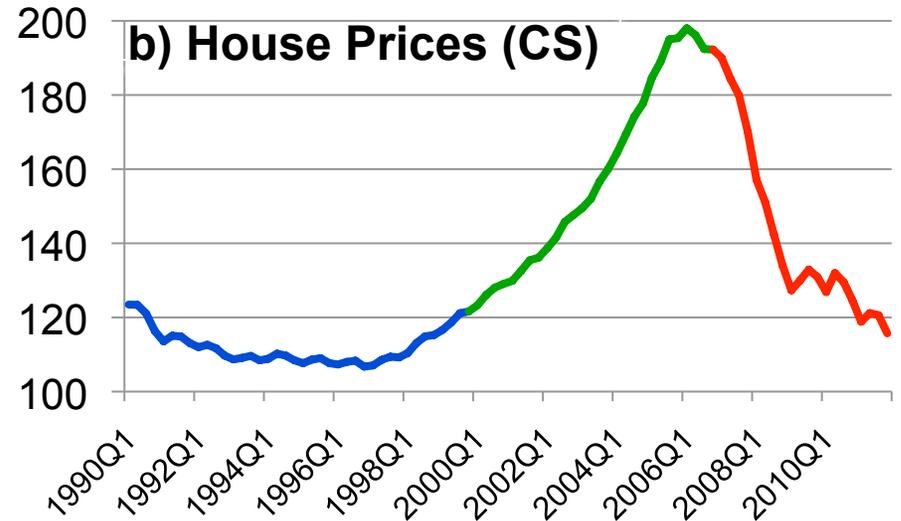
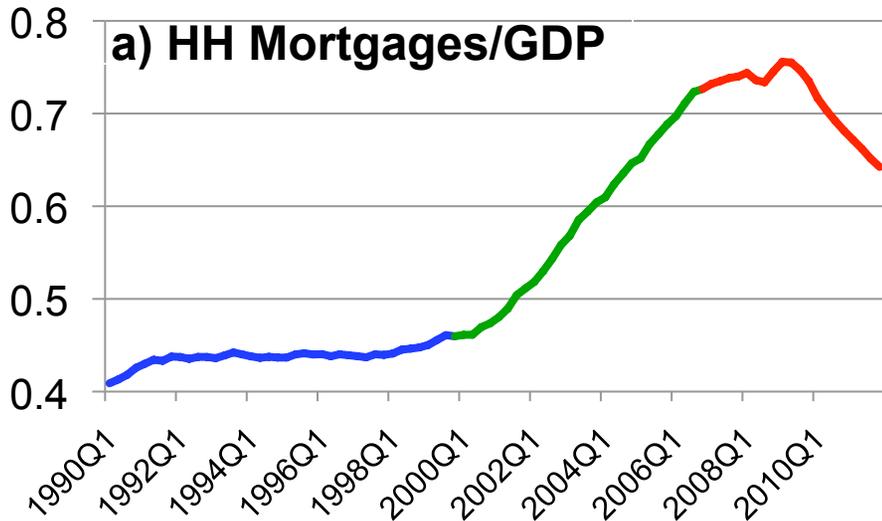
# 2000-2006: unprecedented leveraging



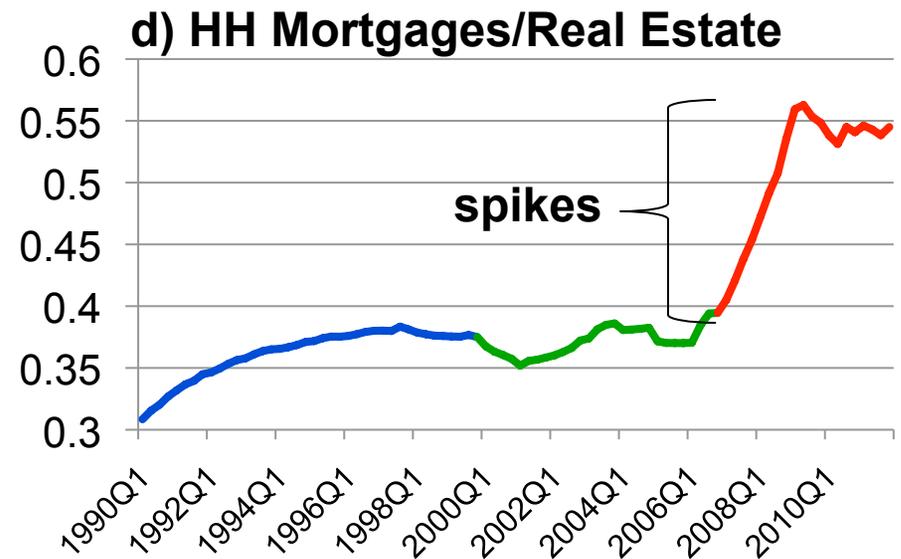
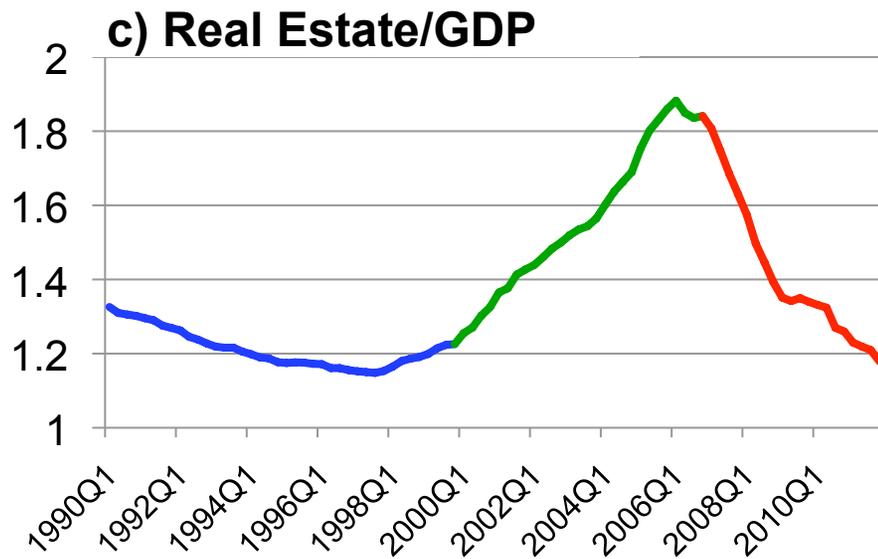
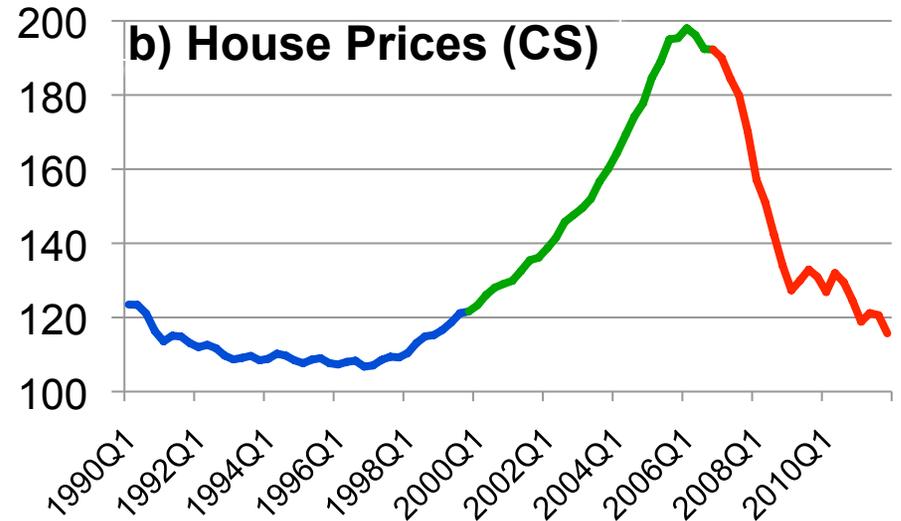
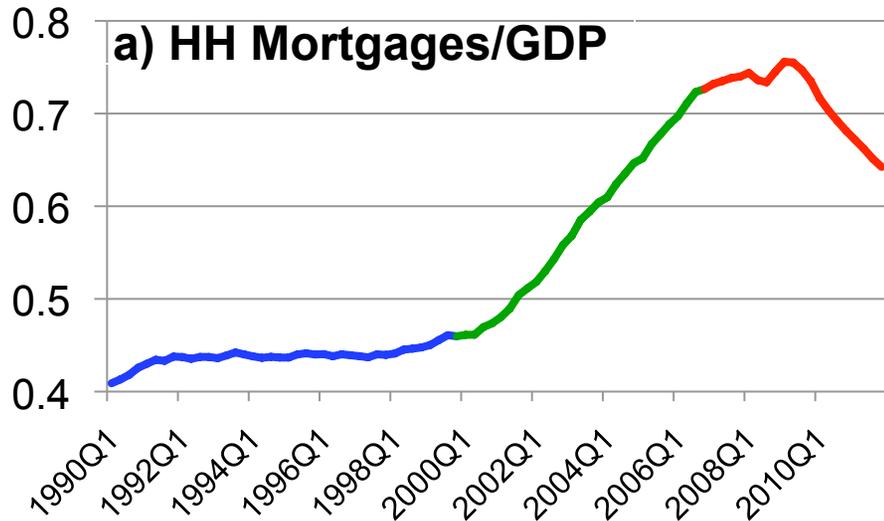
# 2000-2006: unprecedented leveraging



# 2007-present: deleveraging



# 2007-present: deleveraging



# Stylized Facts

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

# This paper

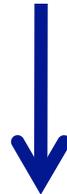


- Quantitative model of household borrowing with houses as collateral
- Calibrated to match aggregate and micro data from the Survey of Consumer Finances

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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

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- **Causes** of credit cycle

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    - House prices barely move
    - Debt dynamics at odds with the data

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- **Valuation story** more promising: Change of borrowing constraint through other mechanisms that affect the value of houses

# Summary of the results

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- **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

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

# Model



# Model

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- Build on
  - Iacoviello (2005)
  - Campbell and Hercowitz (2006)

# Agents in the model

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- 2 groups of households
  - Impatient → Borrowers
  - Patient → Lenders
  
- Producers of
  - Houses
  - Intermediate goods
  - Final goods
  
- The government

# The problem of the borrowers

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

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$$P_t C_{b,t} + P_t^h \Xi_{b,t} + P_t T_{b,t} + R_{t-1} D_{b,t-1} \leq W_{b,t} L_{b,t} + D_{b,t}$$

# The collateral constraint

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- Debt is limited by a collateral constraint

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$$D_{b,t} \leq \bar{D}_t = \left\{ \begin{array}{l} \theta_t P_t^h H_{b,t+1} \end{array} \right. \quad \textit{loosening}$$

# The collateral constraint

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

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



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

Newly purchased houses

# The problem of the lenders

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- 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
  
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# Parameter values

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

# Baseline Calibration: key parameters

Parameter	Value	Source/Target
Discount factor lender ( $\beta_l$ )	<b>0.998</b>	3% real interest rate
Discount factor borrower ( $\beta_b$ )	<b>0.99</b>	Krusell & Smith (1998), Campbell & Hercowitz (2006)
Share of borrowers ( $\psi$ )	<b>0.61</b>	Share of credit constrained agents in SCF (Kaplan & Violante, 2012)
Production function par ( $\nu$ )	<b>0.5</b>	Relative wages of borrowers and lenders (59%)
Preference for houses ( $\phi$ )	<b>0.1</b>	Real estate / GDP (120%)
Loan to value ratio ( $\theta$ )	<b>0.85</b>	Debt / GDP (44%) Evidence from Duca et al. (2012)

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- Model
- Parameterization
- **Results**
  - **Credit market liberalization and its reversal**
  - **Valuation experiment**

# Credit liberalization and its reversal

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- Exogenous change in the collateral constraint

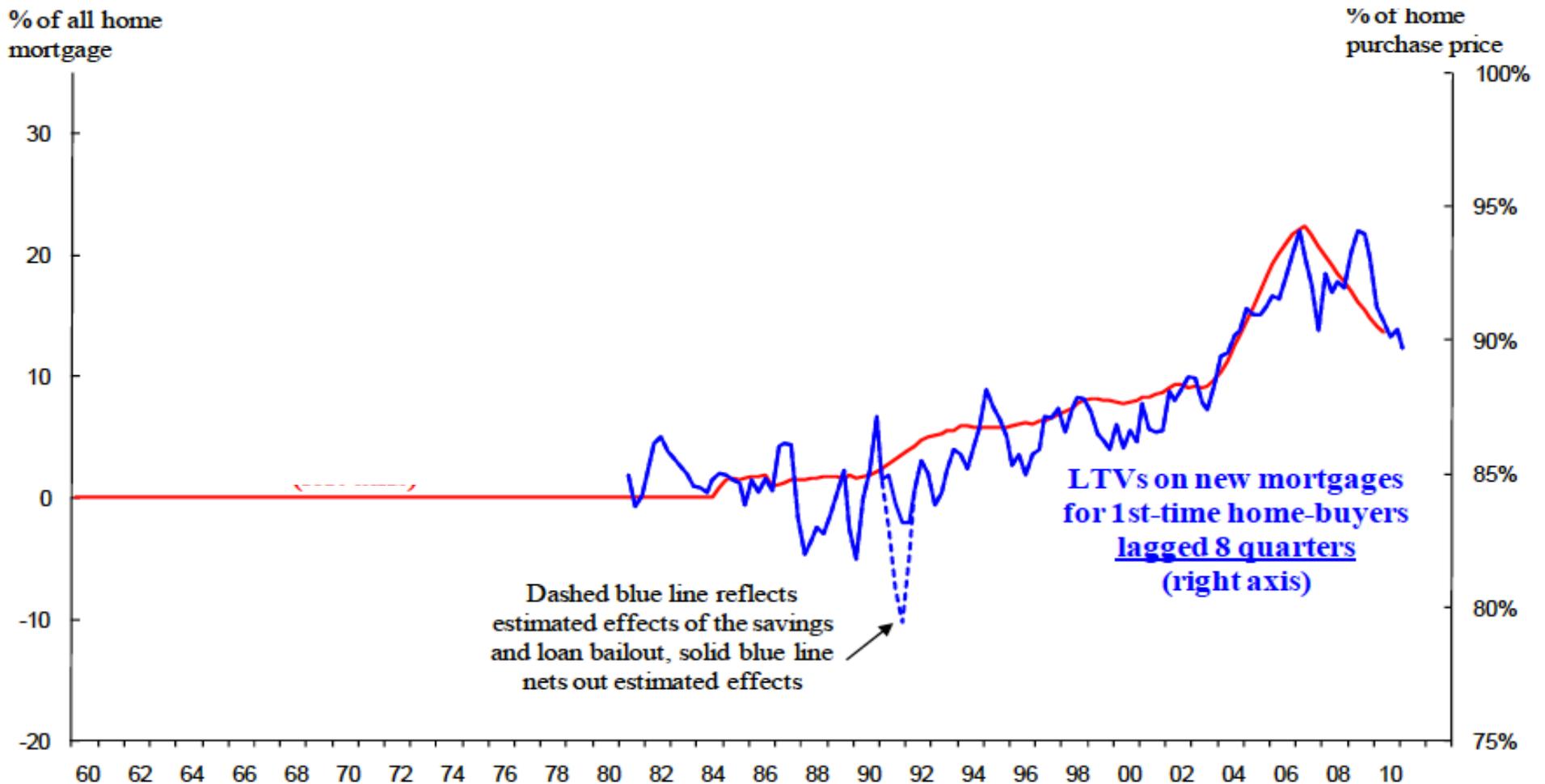
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# Evidence on LTV: Duca et al. (2011)

## Cumulative LTV for 1<sup>st</sup> time homebuyers



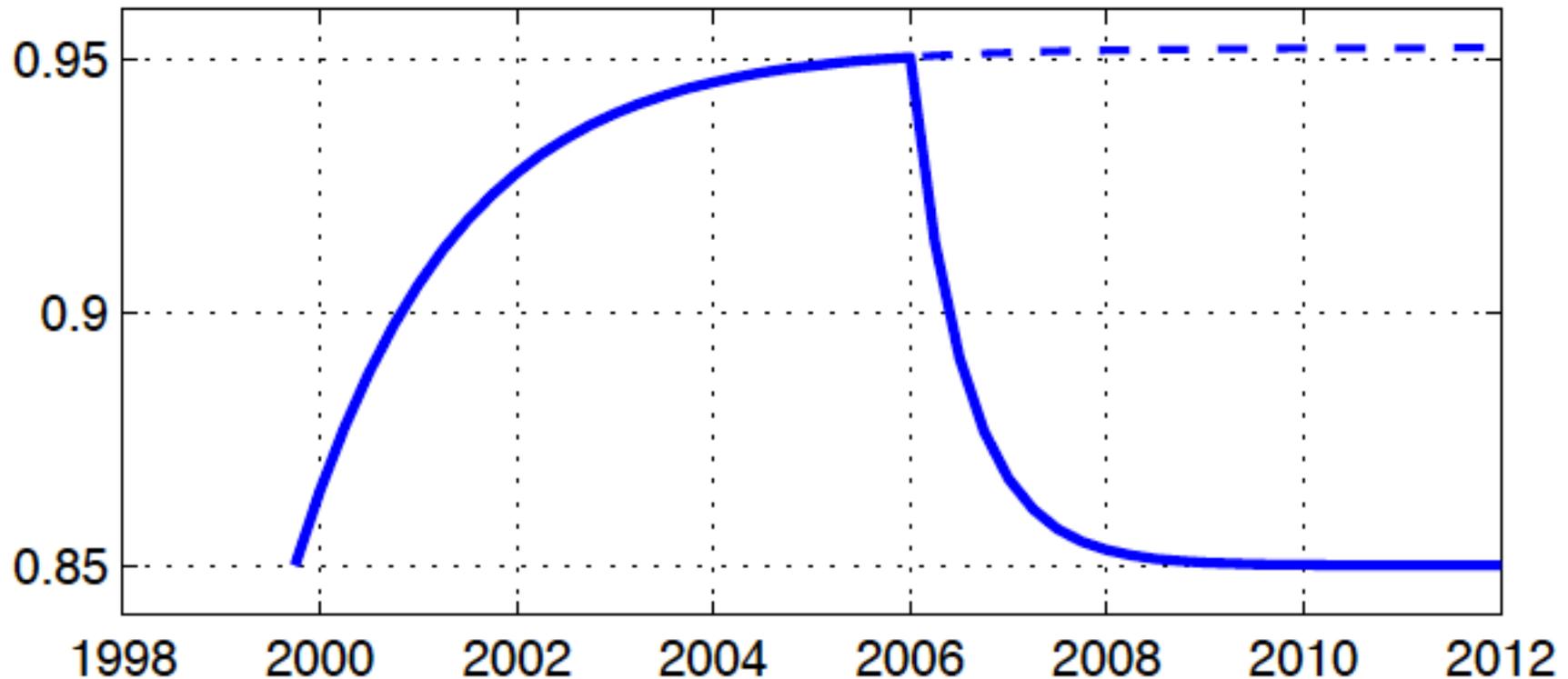
Sources: Flow of Funds, American Housing Survey, Duca *et al.*, (2011) and authors' calculations.

# 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

(a):  $\theta$



# Model solution

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- Perfect foresight
- Occasionally binding constraints
- Asymmetry of the collateral constraint

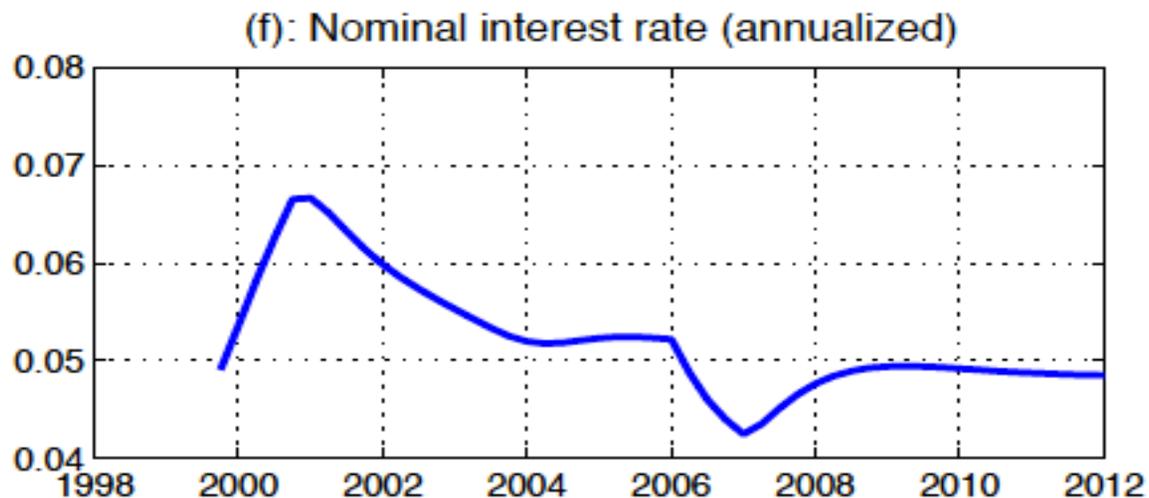
# Credit liberalization and its reversal

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- Exogenous change in the collateral constraint
- Does not match the data

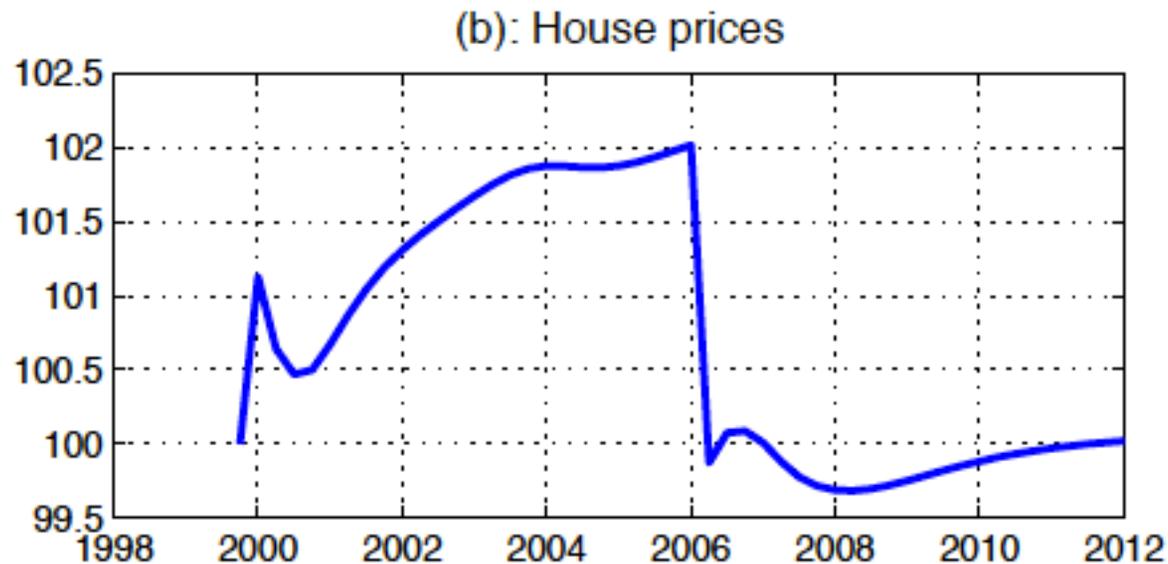
# Credit liberalization and its reversal

- Exogenous change in the collateral constraint
- Does not match the data
  - Interest rate: wrong direction during credit expansion



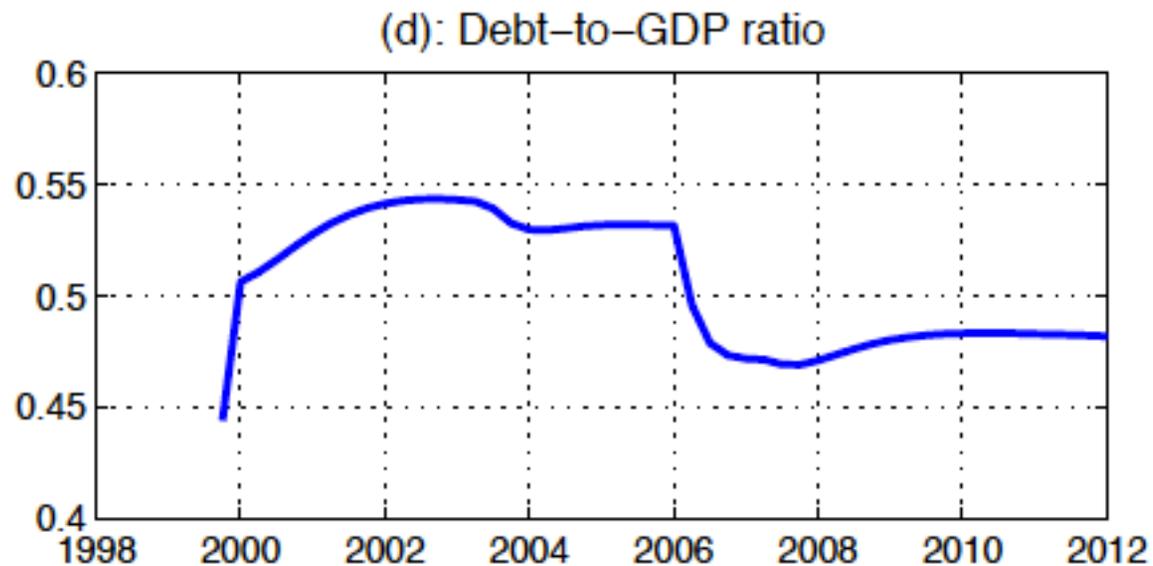
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  - **House prices: barely move**



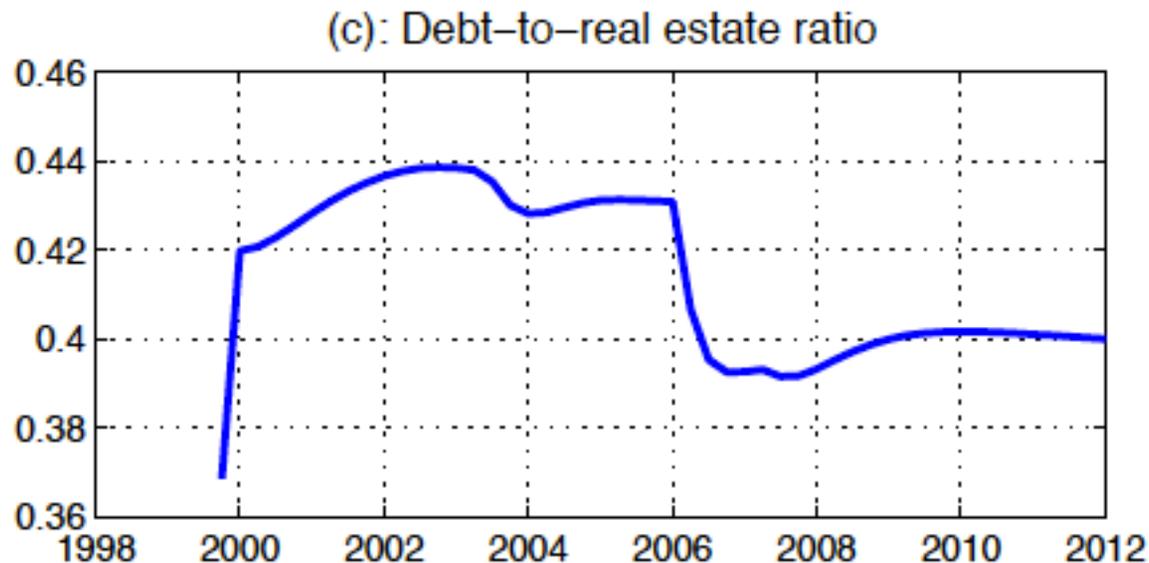
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  - **Debt-to-GDP: fairly modest response**



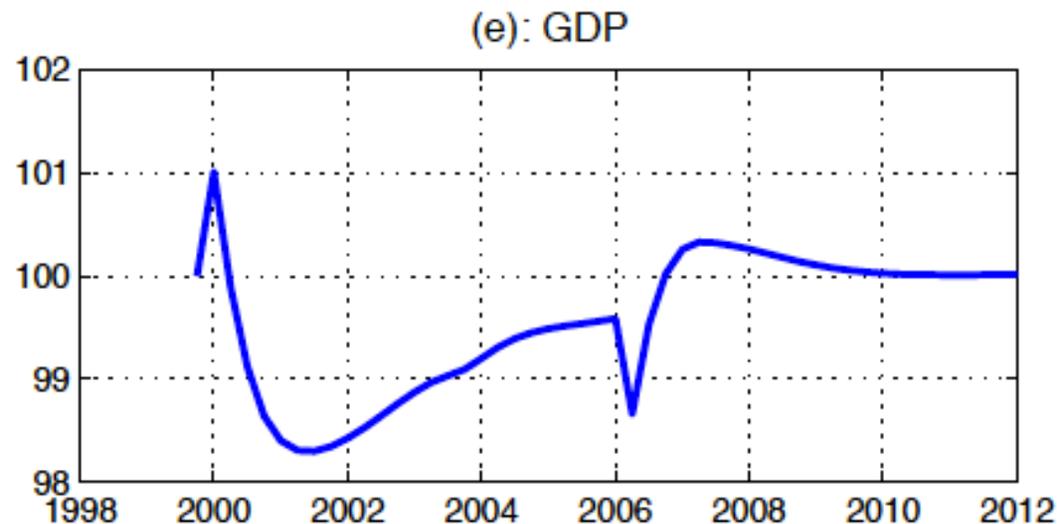
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  - **Debt-to-collateral: increases and falls, not stable and spikes**

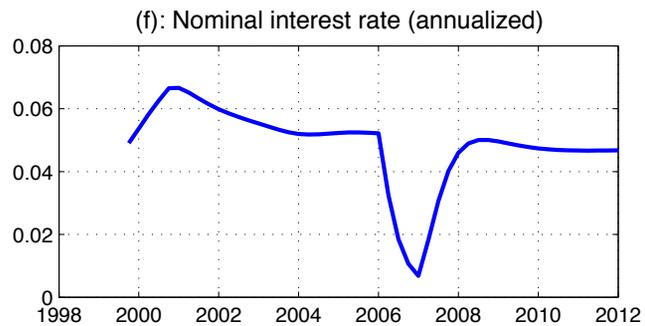
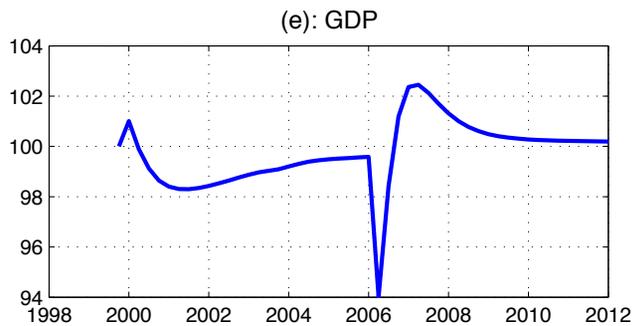
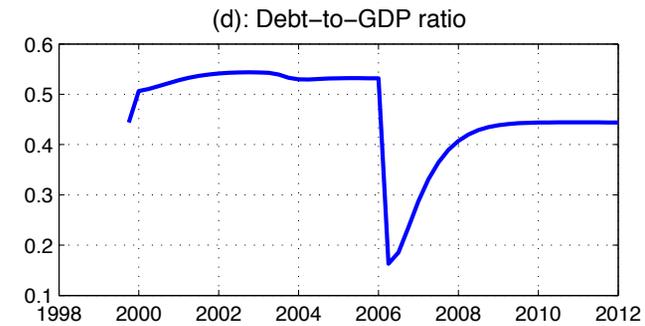
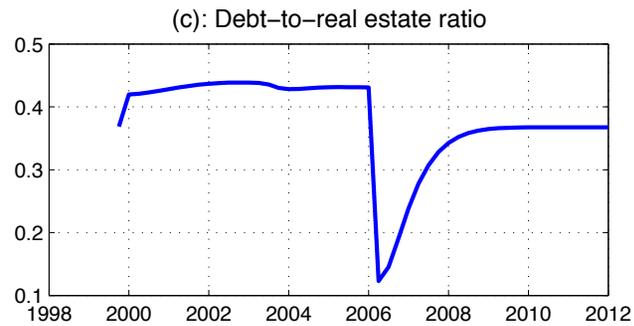
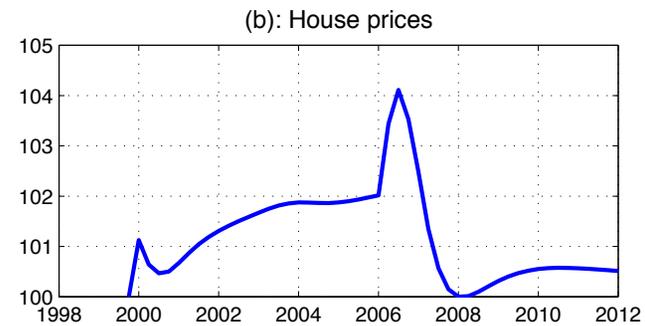
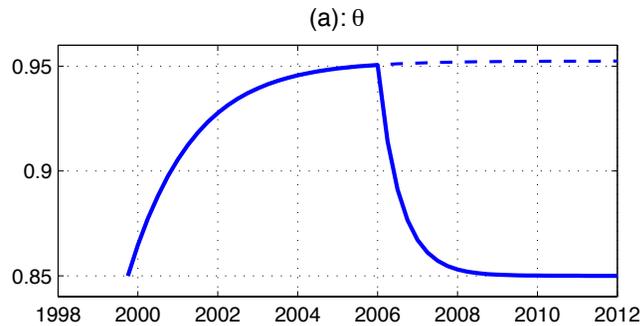


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  - Interest rate: wrong direction
  - House prices: barely move
  - Debt-to-GDP: fairly modest response
  - Debt-to-collateral: increases and falls, not stable and spikes
  - **GDP: moderate effects**



# The role of the asymmetric constraint



# Valuation experiment

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

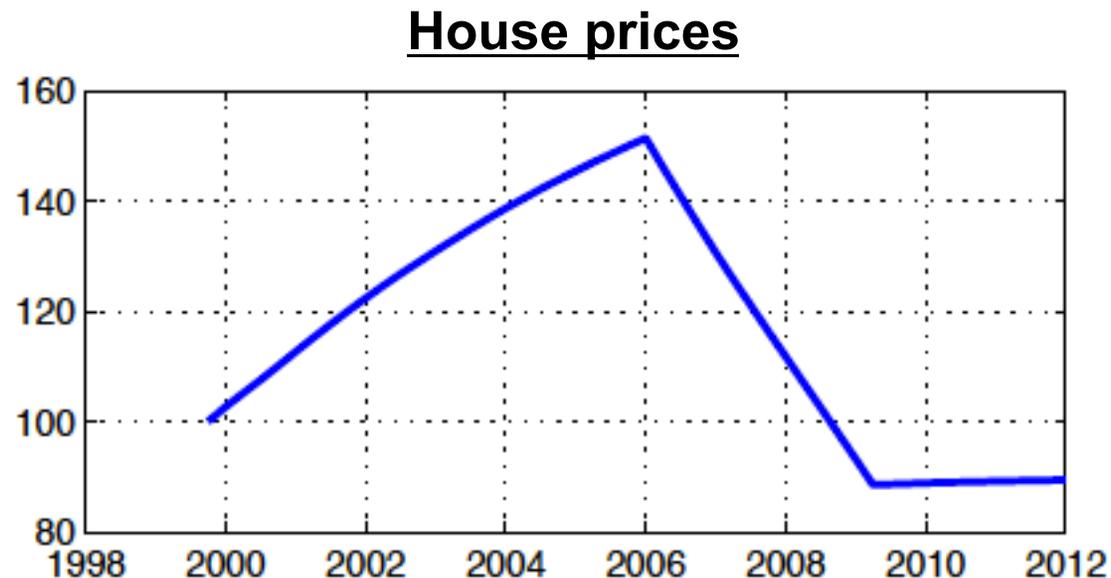
# Valuation experiment

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- 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

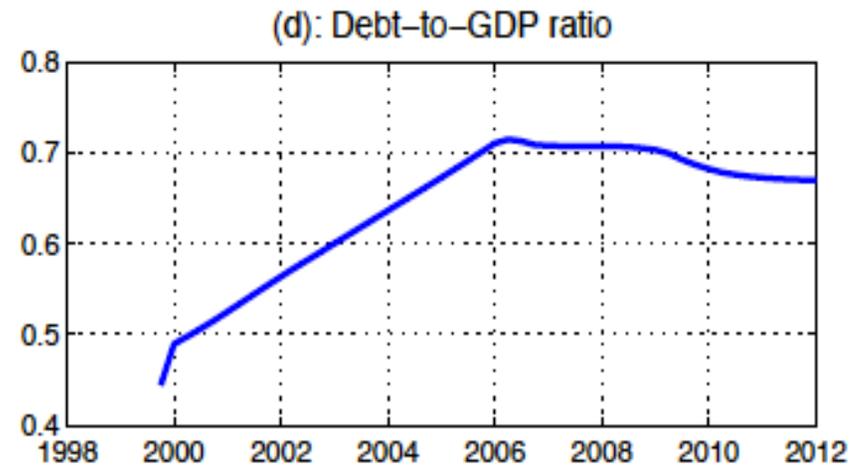
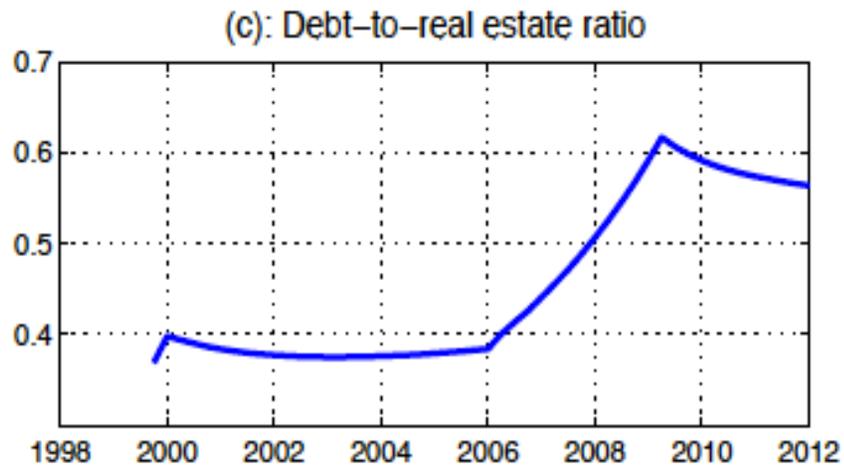
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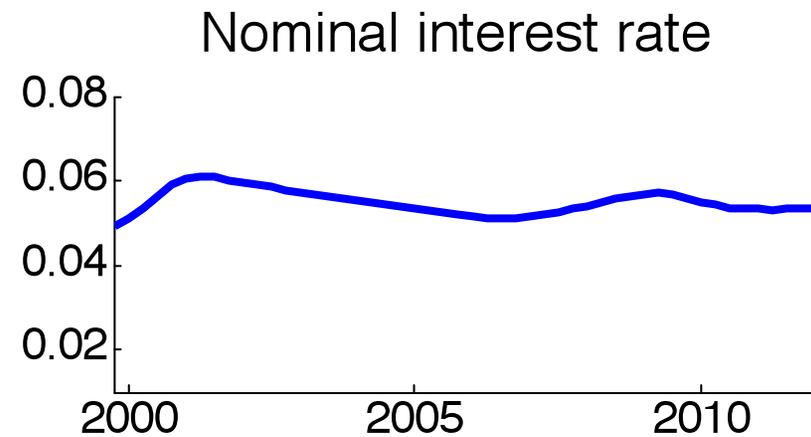
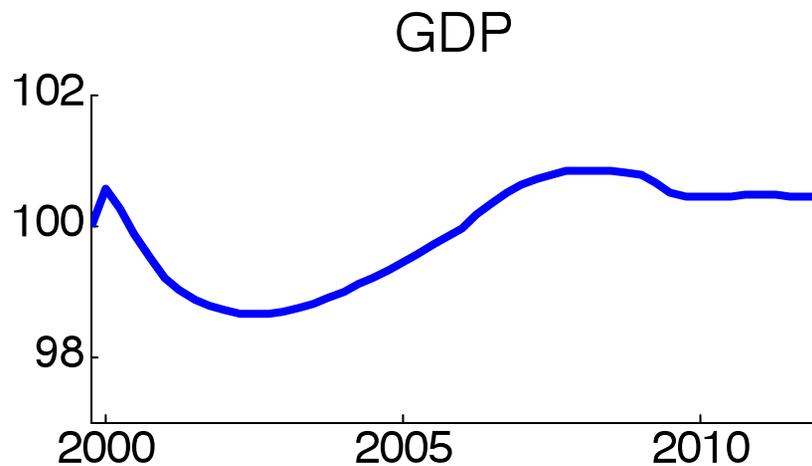
# Valuation Experiment

- Real estate & debt variables in line with data



# Valuation Experiment

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



# Conclusions

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- Quantitative model of household borrowing
- Calibrated to match aggregate and SCF data
- We find:
  - **Causes** of leveraging-deleveraging cycle
    - **Not** looser collateral requirements and reversal
    - Valuation story more promising
  - Macro **consequences** of leveraging-deleveraging cycle
    - Not very large

# Still missing...

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- 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

$$\Xi_t = \left( 1 - S_h \left( \frac{I_t^h}{I_{t-1}^h} \right) \right) I_t^h$$

- Adjustment costs for changing housing investment
  - Determine elasticity of housing supply
- Fixed or sluggish supply of houses

# Related literature

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## ■ 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

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

- Monopolistically competitive markets & sticky prices

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- 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

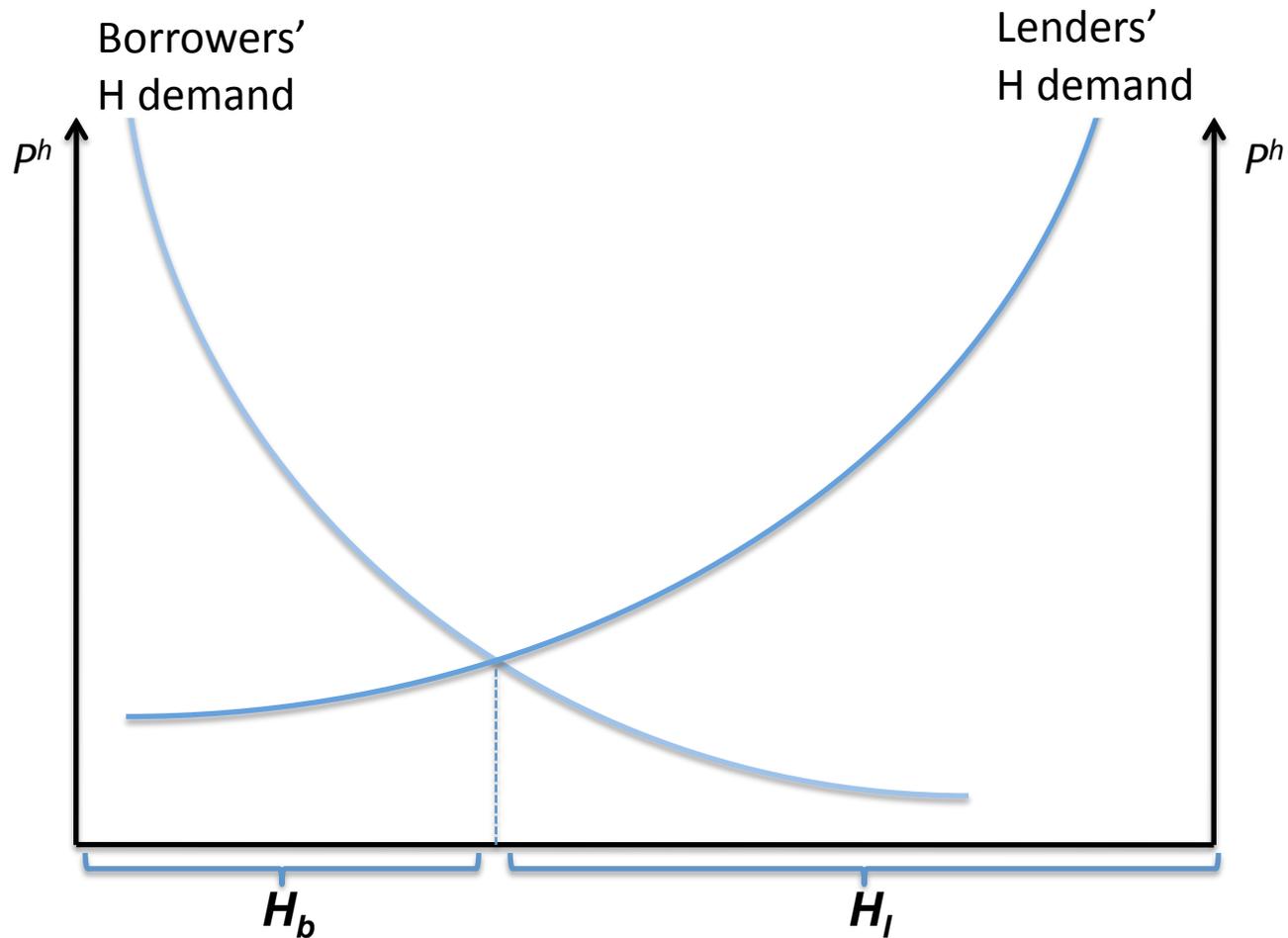
Parameter	Value
Elasticity of labor supply ( $\eta$ )	<b>1</b>
SS growth ( $\gamma$ )	<b>0.005</b>
Share of capital income ( $\alpha$ )	<b>0.3</b>
Probability of non re-optimizing prices ( $\xi$ )	<b>0.75</b>
Depreciations ( $\delta_k$ and $\delta_H$ )	<b>0.025 and 0.003</b>
Investment adjustment costs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

Borrowers:

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

Lenders:

$$P_t^h = \frac{1}{R_t} \left[ MRS_{l,t+1}^{h,c} + (1 - \delta_h) P_{t+1}^h \right]$$

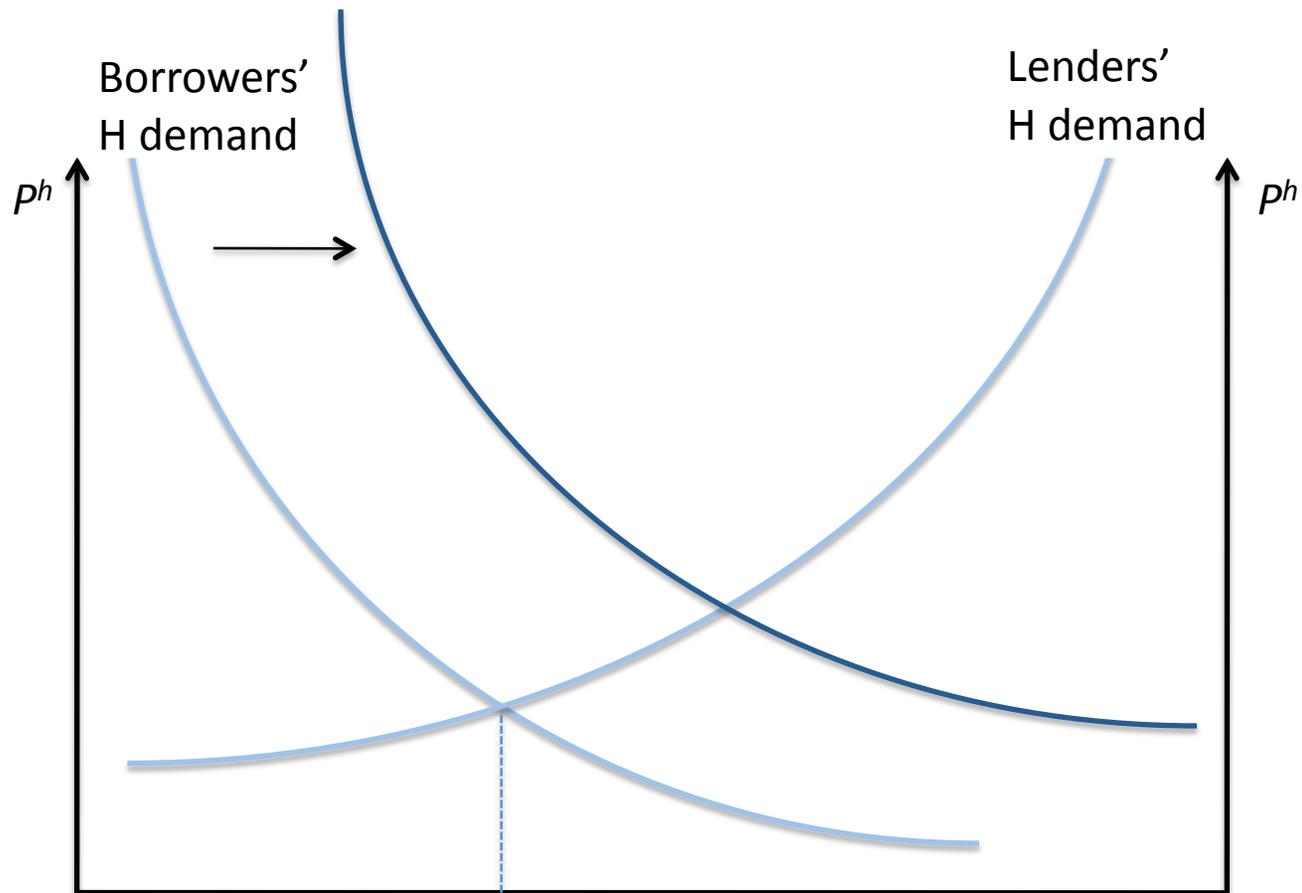


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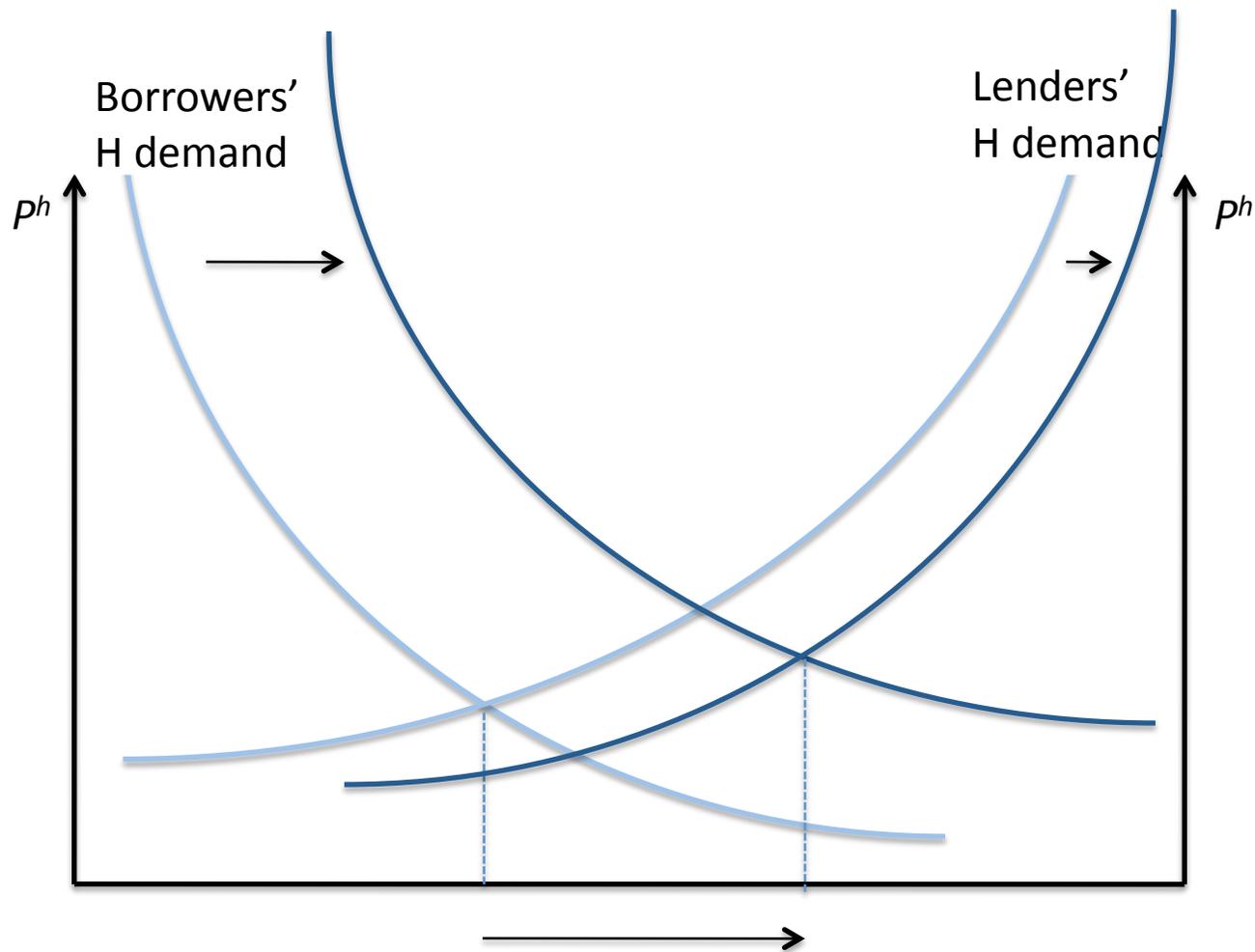


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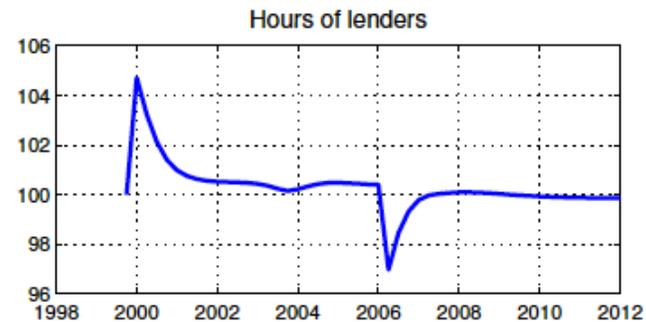
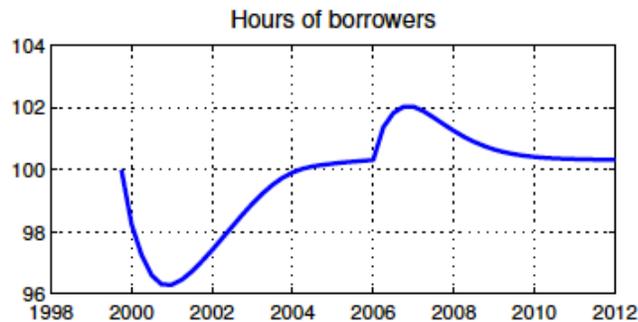
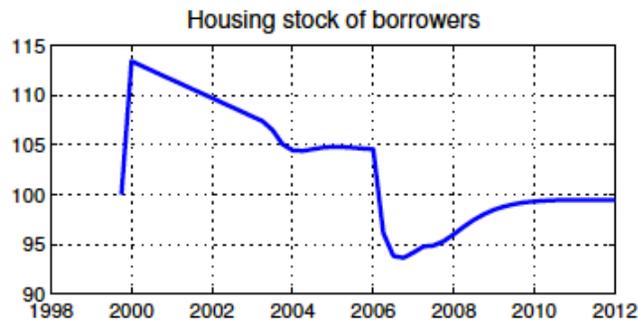
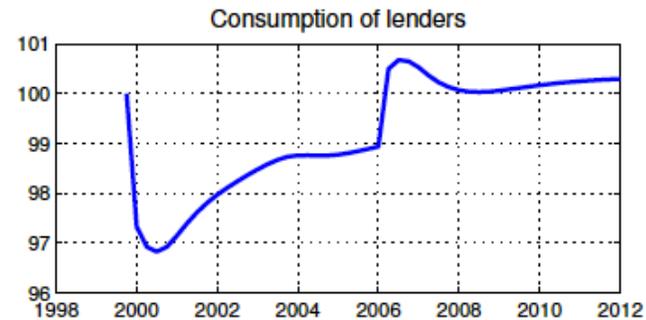
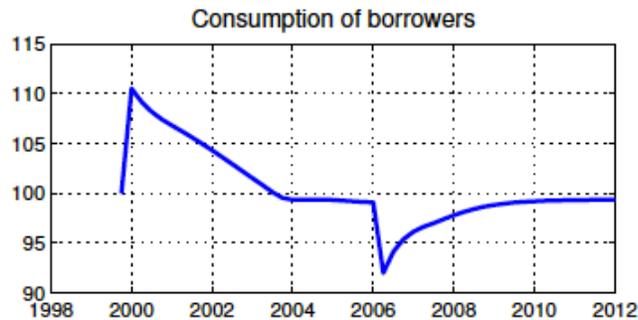
Lenders:

$$P_t^h = \frac{1}{R_t} \left[ MRS_{l,t+1}^{h,c} + (1 - \delta_h) P_{t+1}^h \right]$$



# Credit liberalization and its reversal

## ■ Borrowers and lenders



# Credit liberalization and its reversal

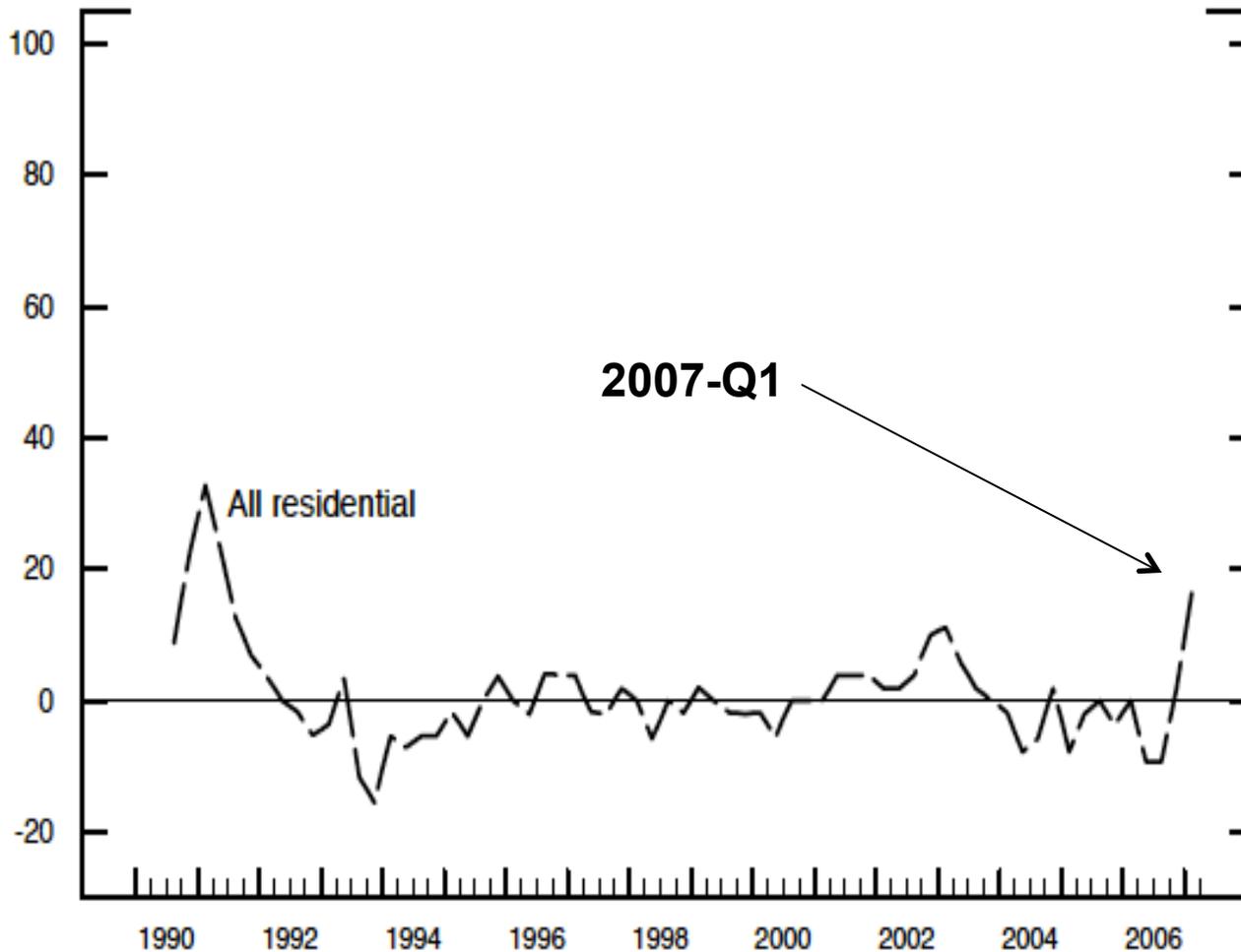
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- Exogenous change in the collateral constraint
- Does not match the data
  - Interest rate: wrong direction!
  - House prices: barely move
  - Debt-to-GDP: fairly modest response
  - Debt-to-collateral: increases and falls, not stable and spikes
  - GDP: moderate effects
  - **In the data house prices down before tightening of credit standards**

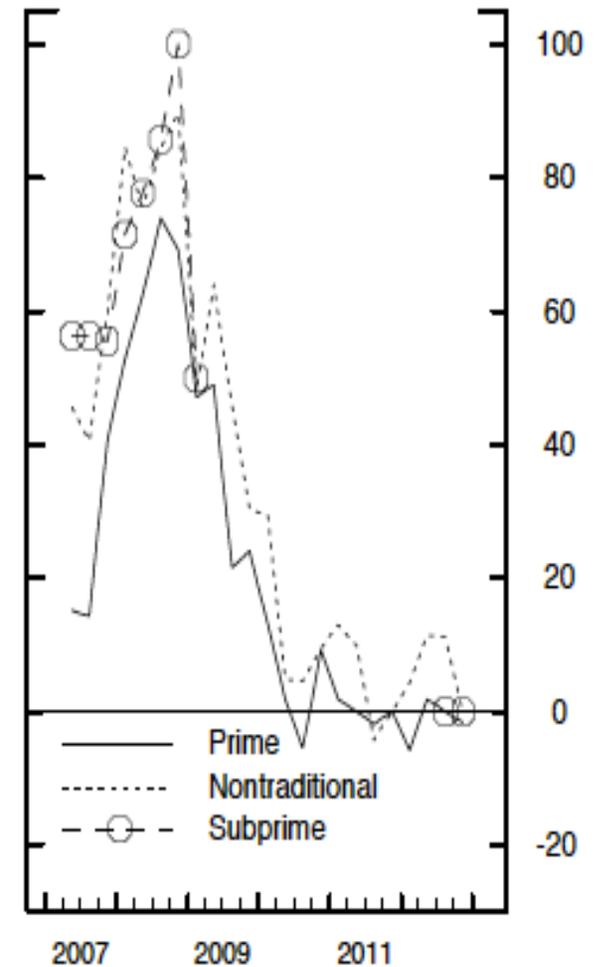
# Senior Loan Officer Opinion Survey

Net Percentage of Domestic Respondents Tightening Standards for Residential Mortgage Loans

Percent



Percent



# Credit liberalization and its reversal: extreme calibration

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- 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

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- Results

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

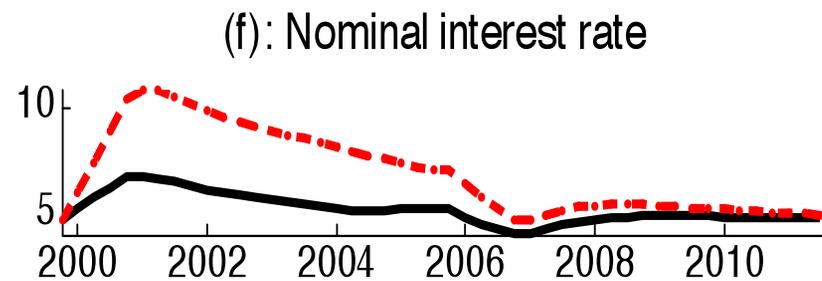
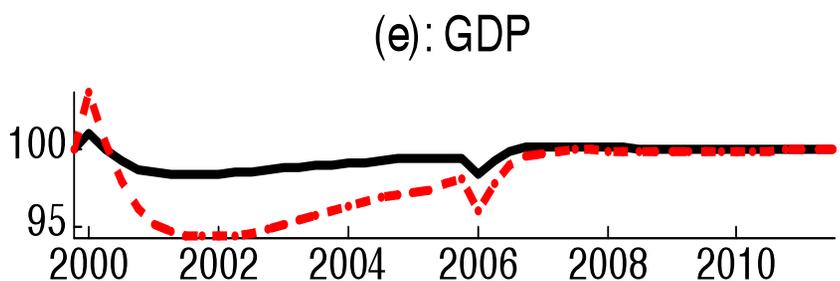
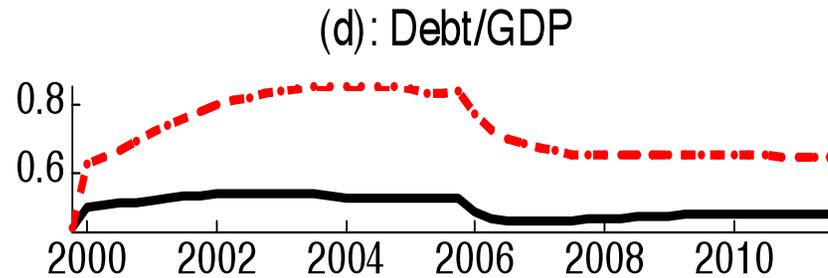
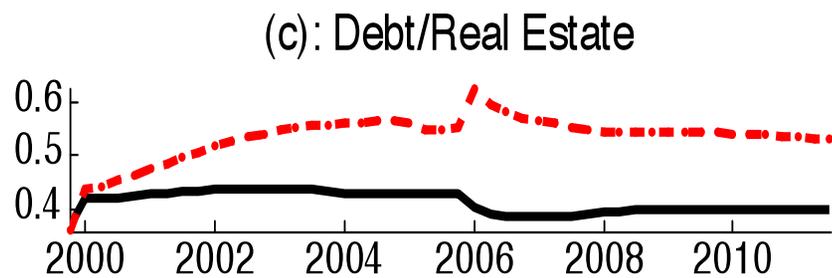
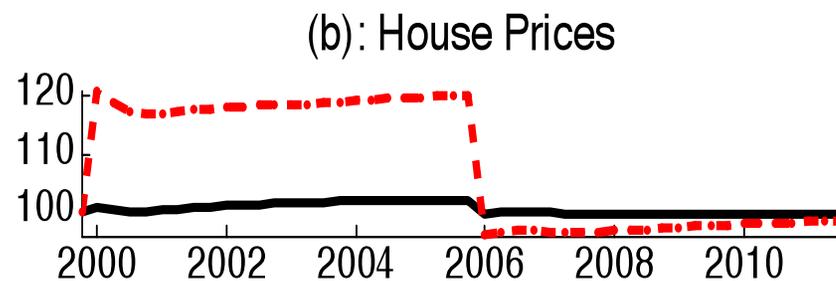
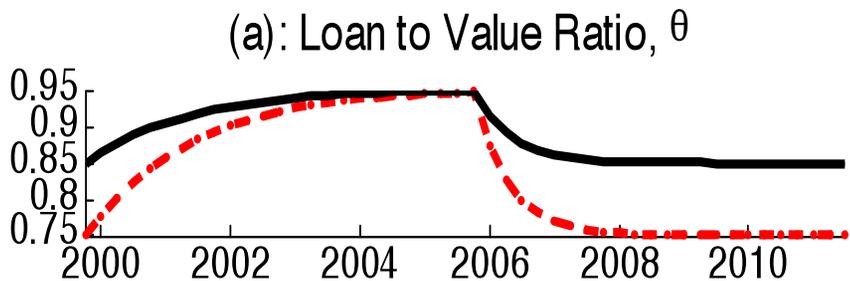
# Credit liberalization and its reversal: extreme calibration

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## ■ 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



— Baseline  
 - - - All changes jointly