House Price Booms, Current Account Deficits, and Low Interest Rates

Andrea Ferrero

University of Oxford

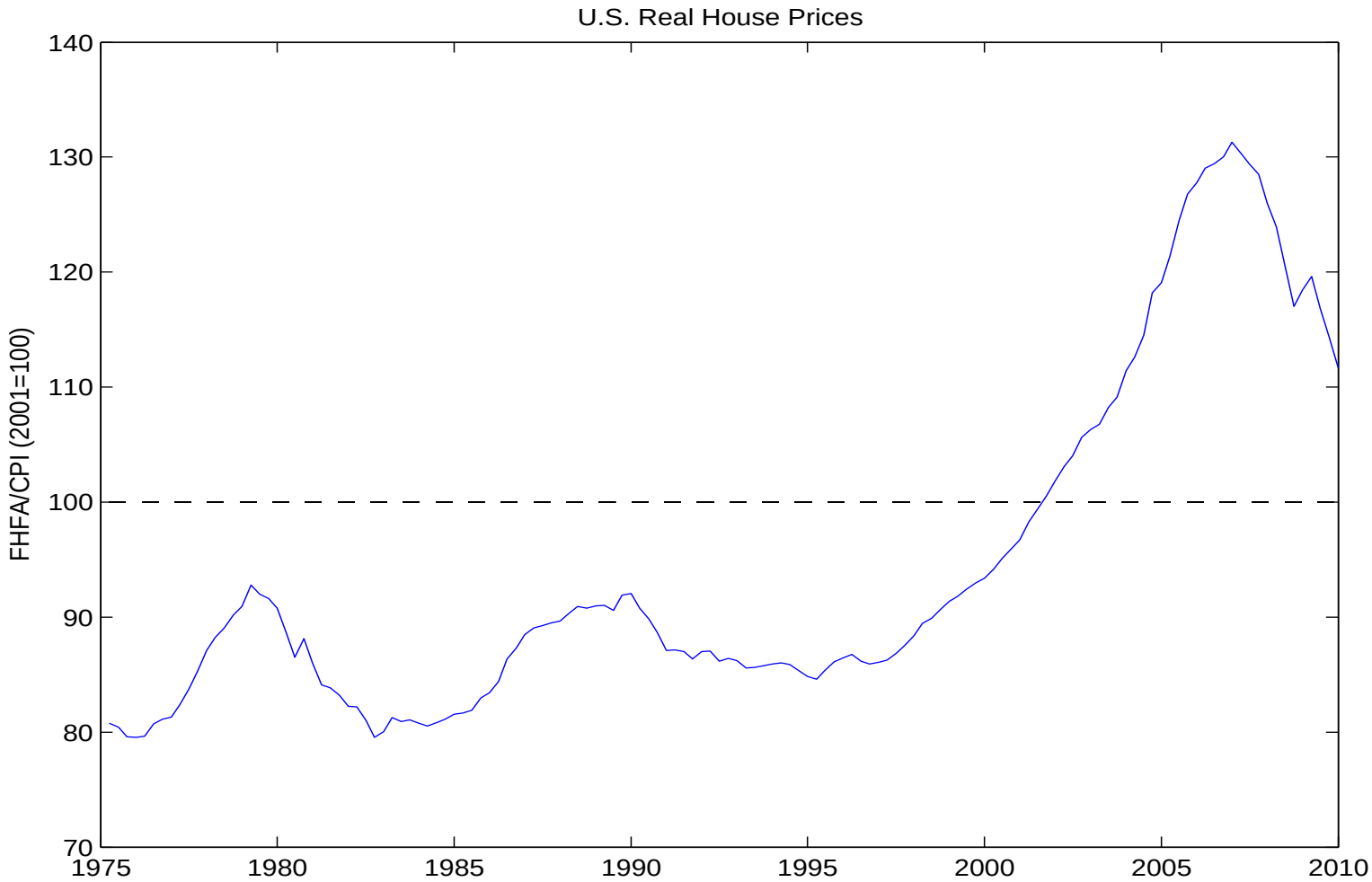
FRB Dallas/IMF/JMCB Conference on

"Housing, Stability and the Macroeconomy: International Perspectives"

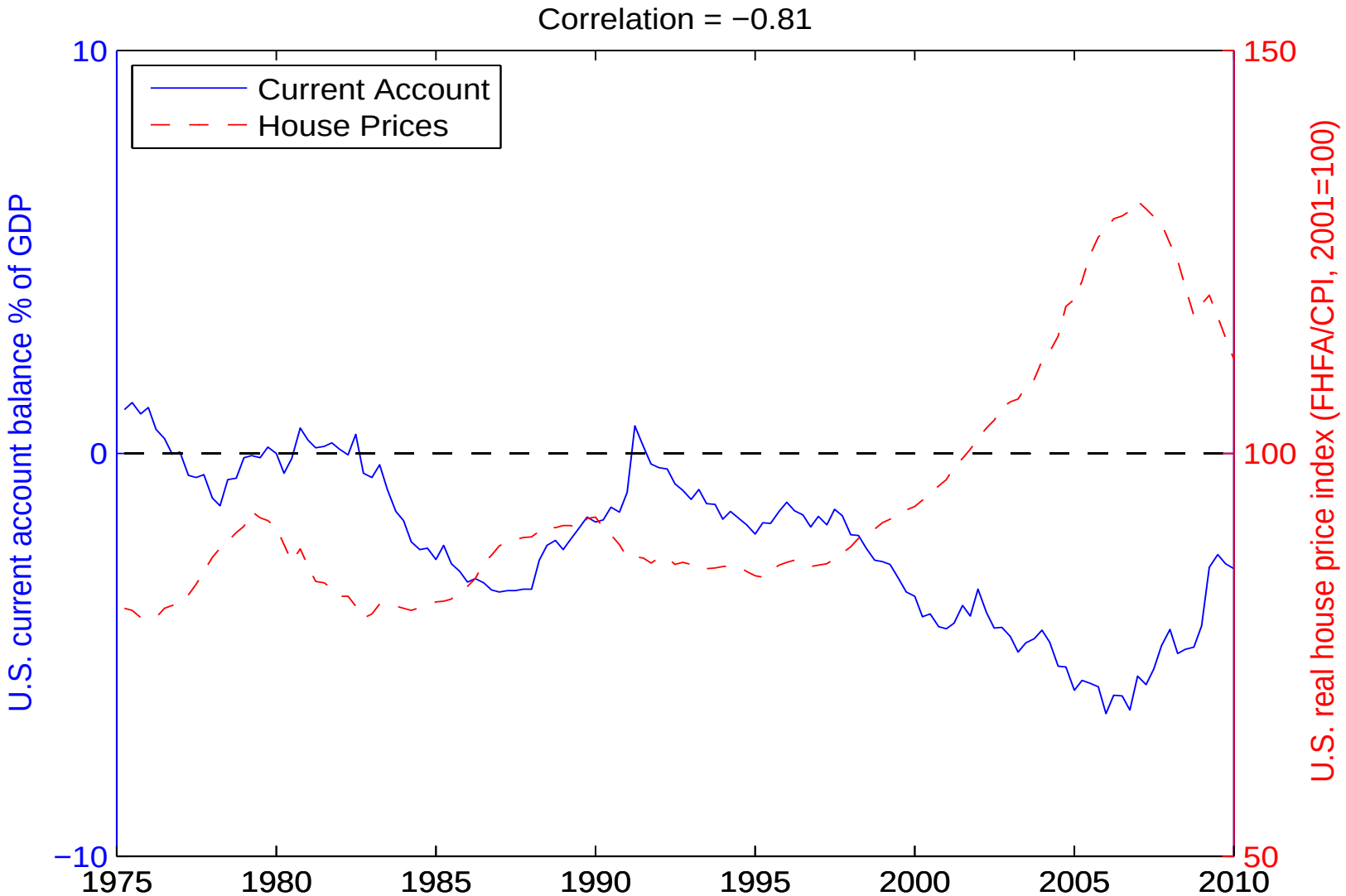
Dallas—November 14, 2013

House Prices

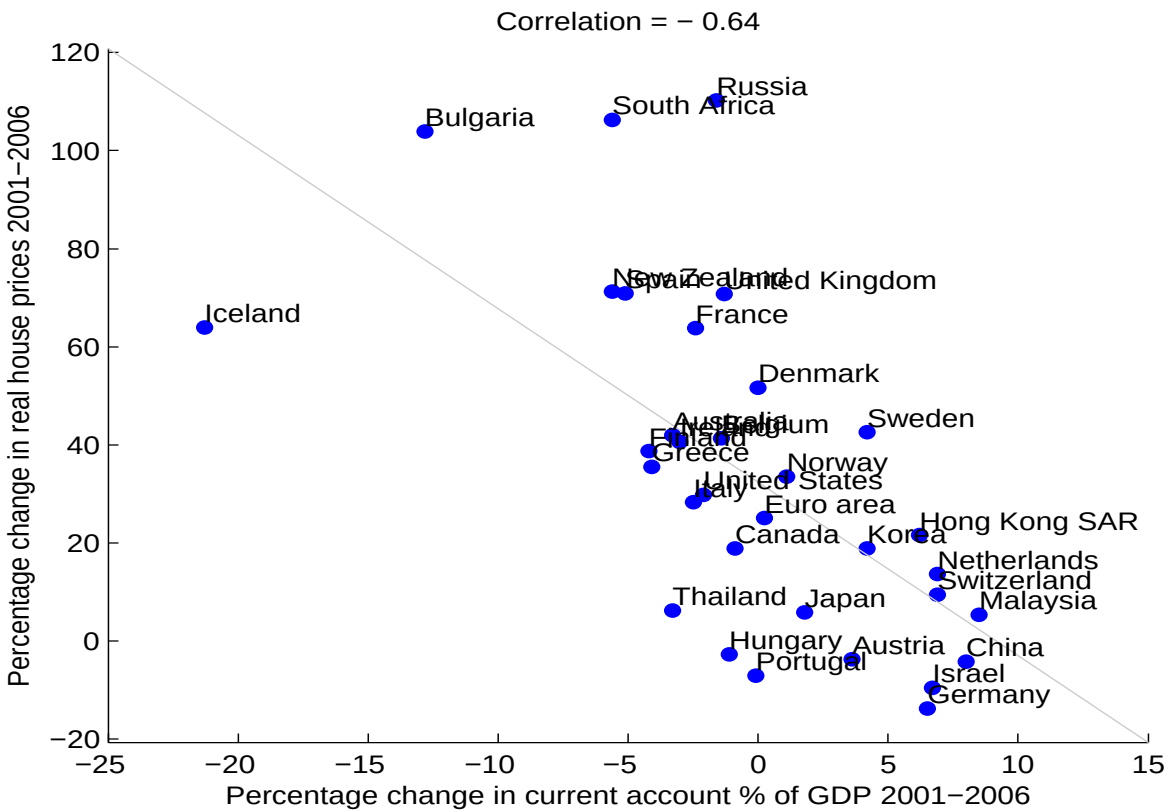
- Boom-bust cycle trigger for Great Recession: What drives house prices?



U.S. House Prices and Current Account



But Not Only a U.S. Phenomenon



"...[C]ountries in which current accounts worsened...had greater house price appreciation over this period [2001Q4-2006Q3]. ... This simple relationship requires more interpretation before any strong conclusions about causality can be drawn..."

Speech by Chairman Ben S. Bernanke
Annual Meeting of the American Economic Association
Atlanta, GA – January 3, 2010

Causality?

1. Consensus: From current account to house prices (foreign factors)
   - Global saving glut hypothesis (Bernanke, 2005)
   - Theory: Shortage of safe assets in emerging markets (Caballero et al., 2008b) or better risk-sharing opportunities in U.S. (Mendoza et al. 2009)
   - Evidence: 4% increase in lagged current account associated with 10% appreciation of real estate prices (Aizenman and Jinjarak, 2009)

Causality?

1. Consensus: From current account to house prices (foreign factors)
   - Global saving glut hypothesis (Bernanke, 2005)
   - Theory: Shortage of safe assets in emerging markets (Caballero et al., 2008b) or better risk-sharing opportunities in U.S. (Mendoza et al. 2009)
   - Evidence: 4% increase in lagged current account associated with 10% appreciation of real estate prices (Aizenman and Jinjarak, 2009)

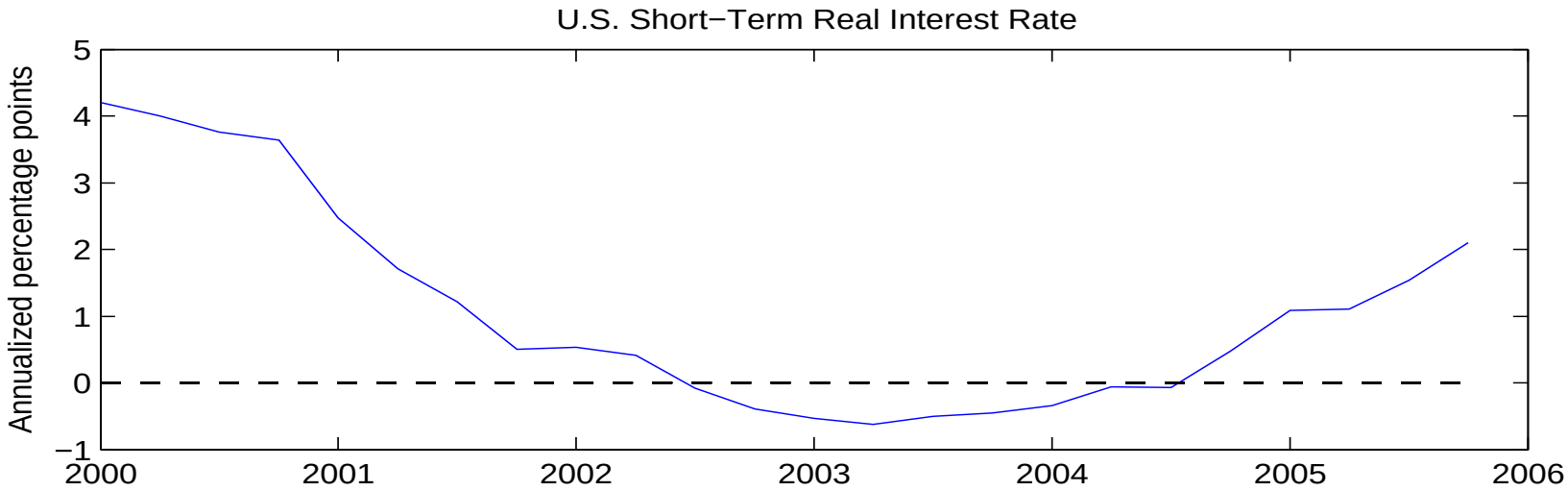
2. This paper: From house prices to current account (domestic factors)
   - Theory: Financial deregulation (Boz and Mendoza, 2011; Favilukis et al. 2011) or preference shocks (Gete, 2010; Justiniano et al. 2013)
   - Evidence: House price shocks explain $\approx 30\%$ of U.S. trade balance over a 20-quarter horizon (Fratzscher et al., 2010)

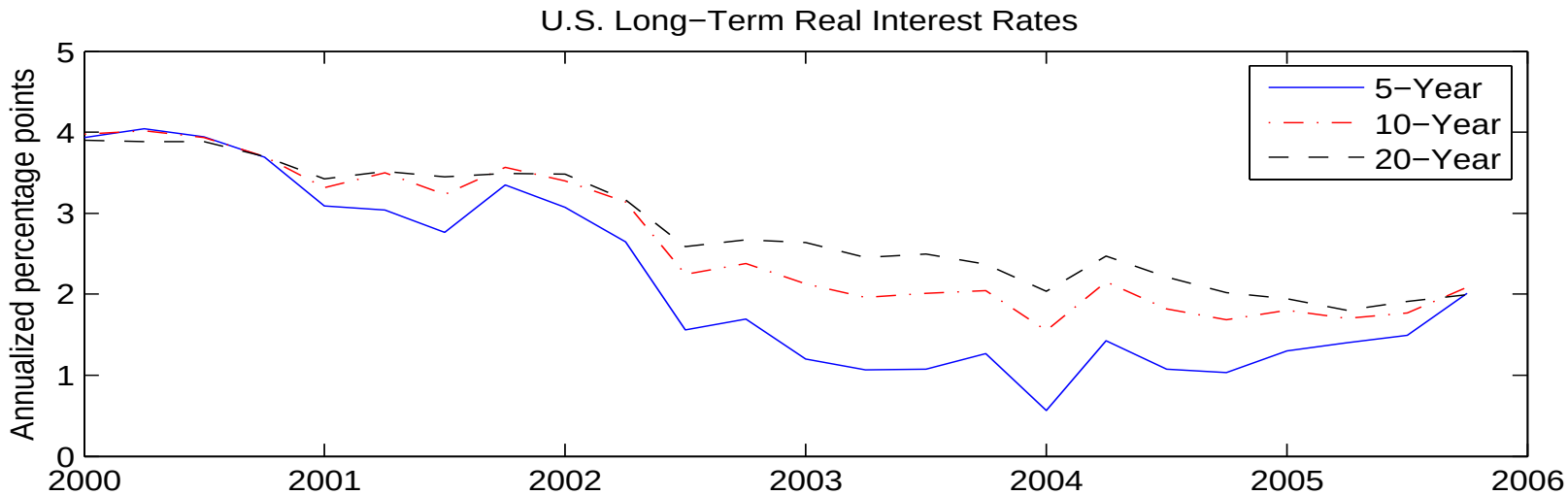
Causality?

1. Consensus: From current account to house prices (foreign factors)
   - Global saving glut hypothesis (Bernanke, 2005)
   - Theory: Shortage of safe assets in emerging markets (Caballero et al., 2008b) or better risk-sharing opportunities in U.S. (Mendoza et al. 2009)
   - Evidence: 4% increase in lagged current account associated with 10% appreciation of real estate prices (Aizenman and Jinjarak, 2009)

2. This paper: From house prices to current account (domestic factors)
   - Theory: Financial deregulation (Boz and Mendoza, 2011; Favilukis et al. 2011) or preference shocks (Gete, 2010; Justiniano et al. 2013)
   - Evidence: House price shocks explain $\approx 30\%$ of U.S. trade balance over a 20-quarter horizon (Fratzscher et al., 2010)
   - Problem: Domestic shocks $\Rightarrow$ Real interest rate tends to increase

Real Interest Rates





Results

- If financial deregulation and/or preference shocks can explain house price boom and $corr(hp, ca) \approx -1$, what explains low real interest rates?

Results

- If financial deregulation and/or preference shocks can explain house price boom and $corr(hp, ca) \approx -1$, what explains low real interest rates?

> *By now, everyone accepts some version of...a global savings glut is at the root of the problem [of low interest rates].*

Kenneth Rogoff
"The Long Mystery of Low Interest Rates"
The Korea Times, 04/19/2013

Results

- If financial deregulation and/or preference shocks can explain house price boom and $corr(hp, ca) \approx -1$, what explains low real interest rates?

- This paper: Abstract from saving glut, focus on monetary policy

Results

- If financial deregulation and/or preference shocks can explain house price boom and $corr(hp, ca) \approx -1$, what explains low real interest rates?

- This paper: Abstract from saving glut, focus on monetary policy
  - Low nominal interest rates in early 2000s
  - Foreign exchange rate pegs in emerging markets

Results

- If financial deregulation and/or preference shocks can explain house price boom and $corr(hp, ca) \approx -1$, what explains low real interest rates?

- This paper: Abstract from saving glut, focus on monetary policy
  - Low nominal interest rates in early 2000s
  - Foreign exchange rate pegs in emerging markets

- Do these factors play a role
  - For house prices (Taylor, 2008)?
  - For current account (Dooley et al., 2008)?

Results

- If financial deregulation and/or preference shocks can explain house price boom and $corr(hp, ca) \approx -1$, what explains low real interest rates?

- This paper: Abstract from saving glut, focus on monetary policy
  - Low nominal interest rates in early 2000s
  - Foreign exchange rate pegs in emerging markets

- Do these factors play a role
  - For house prices (Taylor, 2008)? No
  - For current account (Dooley et al., 2008)? No

- Dichotomy
  - Credit/Preference shocks $\Rightarrow$ House prices and $corr(hp, ca)$
  - Monetary policy $\Rightarrow$ Low real interest rates

Two-Country Model with Borrowing Constraints

- Countries: Home and Foreign
- Goods:
  - Tradable consumption goods produced in each country
  - Housing in fixed supply (land)
- Assets:
  - Risk-free bond denominated in Home currency traded internationally
  - Risk-free bond denominated in Foreign currency traded domestically
- Frictions:
  - Financial: Collateral constraint
  - Nominal: Sticky prices and wages
- Monetary authority follows standard interest rate rule

Household Problem

- Utility

$$U_t \equiv \mathbb{E}_t \left\{ \sum_{s=0}^{\infty} \beta^s \left[\frac{X_t^{1-\sigma}}{1-\sigma} - \frac{1}{1+\nu} \int_0^1 L_{t+s}(i)^{1+\nu} di \right] \right\}$$

- Consumption indexes

$$X_t \equiv \left[\omega C_t^{\frac{\epsilon-1}{\epsilon}} + (1-\omega) e^{\eta_t} H_t^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}} \quad \text{and} \quad C_t \equiv \left[\alpha^{\frac{1}{\gamma}} C_{ht}^{\frac{\gamma-1}{\gamma}} + (1-\alpha)^{\frac{1}{\gamma}} C_{ft}^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}}$$

- Budget constraint

$$P_{ht} C_{ht} + P_{ft} C_{ft} + \mathcal{Q}_t H_t - \mathcal{B}_t \leq \int_0^1 W_t(i) L_t(i) di + \mathcal{Q}_t H_{t-1} + T_t - (1+i_{t-1}) \mathcal{B}_{t-1}$$

- Borrowing constraint

$$(1+i_t) \mathcal{B}_t \leq \Theta_t \mathbb{E}_t (\mathcal{Q}_{t+1} H_t)$$

Wage and Price Setting

- Sticky wages:

$$\max_{W_t(i)} \mathbb{E}_t \left\{ \sum_{s=0}^{\infty} (\beta \zeta_w)^s \lambda_{t+s} \left[W_t(i) L_{t+s}(i) - \frac{L_{t+s}(i)^{1+\nu}}{1+\nu} \right] \right\}$$

subject to

$$L_{t+s}(i) = \left[\frac{W_t(i)}{W_{t+s}} \right]^{-\phi_w} L_{t+s}$$

- Sticky prices:

$$\max_{P_t(h)} \mathbb{E}_t \left\{ \sum_{s=0}^{\infty} (\beta \zeta_p)^s \lambda_{t+s} \left[P_t(h) Y_{t+s}(h) - W_{t+s} L_{t+s} \right] \right\}$$

subject to

$$Y_{t+s}(h) = \left[\frac{P_t(h)}{P_{ht+s}} \right]^{-\phi_p} Y_{ht+s} \qquad \text{and} \qquad Y_t(h) = A L_t$$

Monetary Policy and Equilibrium

- Interest rate rule (Taylor, 1993; plus smoothing)

$$(1+i_t) = (1+i_{t-1})^{\rho_i} \left[(1+i) \left(\frac{\Pi_{Xt}}{\widetilde{\Pi}_{Xt}} \right)^{\psi_\pi} \left(\frac{Y_{ht}}{\widetilde{Y}_{ht}} \right)^{\psi_y} \right]^{1-\rho_i} e^{\varepsilon_{it}}$$

where $\Pi_{Xt} \equiv P_{Xt}/P_{Xt-1}$, $P_{Xt} \equiv P_t^{\omega_X} OER_t^{1-\omega_X}$ and $OER_t \equiv MRS_t^{C,H}$

Monetary Policy and Equilibrium

- Interest rate rule (Taylor, 1993; plus smoothing)

$$(1+i_t) = (1+i_{t-1})^{\rho_i} \left[(1+i) \left(\frac{\Pi_{Xt}}{\widetilde{\Pi}_{Xt}} \right)^{\psi_\pi} \left(\frac{Y_{ht}}{\widetilde{Y}_{ht}} \right)^{\psi_y} \right]^{1-\rho_i} e^{\varepsilon_{it}}$$

  where $\Pi_{Xt} \equiv P_{Xt}/P_{Xt-1}$, $P_{Xt} \equiv P_t^{\omega_X} OER_t^{1-\omega_X}$ and $OER_t \equiv MRS_t^{C,H}$

- Law of one price holds for tradable goods but PPP doesn't because of home bias

$$P_{ht} = \mathcal{E}_t P_{ht}^* \qquad \text{and} \qquad S_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t} \neq 1$$

- Equilibrium in the goods market

$$Y_{ht} = C_{ht} + C_{ht}^* = \left(\frac{P_{ht}}{P_t} \right)^{-\gamma} \left[\alpha C_t + (1-\alpha) S_t^{\gamma} C_t^* \right]$$

- Equilibrium in asset markets

$$H_t = H \qquad \text{and} \qquad \mathcal{B}_t + \mathcal{B}_t^* = 0$$

Monetary Policy and Equilibrium

- Interest rate rule (Taylor, 1993; plus smoothing)

$$(1+i_t) = (1+i_{t-1})^{\rho_i} \left[(1+i) \left(\frac{\Pi_{Xt}}{\widetilde{\Pi}_{Xt}} \right)^{\psi_\pi} \left(\frac{Y_{ht}}{\widetilde{Y}_{ht}} \right)^{\psi_y} \right]^{1-\rho_i} e^{\varepsilon_{it}}$$

  where $\Pi_{Xt} \equiv P_{Xt}/P_{Xt-1}$, $P_{Xt} \equiv P_t^{\omega_X} OER_t^{1-\omega_X}$ and $OER_t \equiv MRS_t^{C,H}$

- Law of one price holds for tradable goods but PPP doesn't because of home bias

$$P_{ht} = \mathcal{E}_t P_{ht}^* \qquad \text{and} \qquad S_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t} \neq 1$$

- Equilibrium in the goods market

$$Y_{ht} = C_{ht} + C_{ht}^* = \left(\frac{P_{ht}}{P_t} \right)^{-\gamma} [\alpha C_t + (1-\alpha) S_t^{\gamma} C_t^*]$$

- Equilibrium in asset markets

$$H_t = H \qquad \text{and} \qquad \mathcal{B}_t + \mathcal{B}_t^* = 0$$

  - Price of land explains 2/3 of U.S. house prices (Davis and Heathcote, 2007)

Asymmetric Steady State

- Two-country model admits
  - One symmetric steady state with $\mathcal{B} = 0$
  - A continuum of asymmetric steady states indexed by $\mathcal{B} \neq 0$

Asymmetric Steady State

- Two-country model admits
  - One symmetric steady state with $\mathcal{B} = 0$
  - A continuum of asymmetric steady states indexed by $\mathcal{B} \neq 0$

- Solve the model with linear methods
  - Symmetric steady state not interesting for looking at effects of θ_t ($\Xi = 0$)

$$q_t = \tilde{q}_t + \Xi\Theta\left[\xi_t + \theta_t - (\eta_t + c_t) + \mathbb{E}_t q_{t+1} + \mathbb{E}_t \pi_{t+1}\right]$$

  where $\tilde{q}_t$ is formula for real house prices absent borrowing constraint

Asymmetric Steady State

- Two-country model admits
  - One symmetric steady state with $\mathcal{B} = 0$
  - A continuum of asymmetric steady states indexed by $\mathcal{B} \neq 0$

- Solve the model with linear methods
  - Symmetric steady state not interesting for looking at effects of θ_t ($\Xi = 0$)

$$q_t = \tilde{q}_t + \Xi\Theta\left[\xi_t + \theta_t - (\eta_t + c_t) + \mathbb{E}_t q_{t+1} + \mathbb{E}_t \pi_{t+1}\right]$$

    where $\tilde{q}_t$ is formula for real house prices absent borrowing constraint

$\Rightarrow$ Focus on asymmetric steady state ($\beta < \beta^* \Rightarrow \mathcal{B} > 0 \Rightarrow \Xi > 0$)

Asymmetric Steady State

- Two-country model admits
  - One symmetric steady state with $\mathcal{B} = 0$
  - A continuum of asymmetric steady states indexed by $\mathcal{B} \neq 0$

- Solve the model with linear methods
  - Symmetric steady state not interesting for looking at effects of θ_t ($\Xi = 0$)

$$q_t = \tilde{q}_t + \Xi\Theta\left[\xi_t + \theta_t - (\eta_t + c_t) + \mathbb{E}_t q_{t+1} + \mathbb{E}_t \pi_{t+1}\right]$$

    where $\tilde{q}_t$ is formula for real house prices absent borrowing constraint

  $\Rightarrow$ Focus on asymmetric steady state ($\beta < \beta^* \Rightarrow \mathcal{B} > 0 \Rightarrow \Xi > 0$)

- Aside: Open economy model with incomplete markets but binding borrowing constraint pins down steady state net foreign debt position

Standard (International) Macro Parameters

β^*	$=$	0.99	Foreign discount factor
σ	$=$	2	Risk aversion
ν	$=$	2	Frisch elasticity
α	$=$	0.7	Home bias
γ	$=$	2	Elasticity of substitution H vs F
ϵ	$=$	1	Elasticity of substitution C vs H
$\phi_p = \phi_w$	$=$	7.67	Elasticity of substitution among varieties
$\zeta_p = \zeta_w$	$=$	0.75	Price and wage stickiness
ψ_π	$=$	1.5	Taylor rule coefficient on inflation
ψ_y	$=$	0.5	Taylor rule coefficient on output
ρ_i	$=$	0.7	Interest rate smoothing
ω_X	$=$	0.7	Weight on goods consumption price index

House Price Booms

- Two potential drivers (domestic factors):
  1. Financial deregulation
  2. Preference shocks

House Price Booms

- Two potential drivers (domestic factors):
  1. Financial deregulation
  2. Preference shocks

1. Financial deregulation:
   - Debate on actual importance for house price boom/bust (Favilukis et al., 2011; vs. Justiniano et al., 2013)
   - Take as given ongoing debate on causes
     - ⋆ Political response to inequality (Rajan, 2010)
     - ⋆ Political economy of financial system (Mian et al., 2013)
     - ⋆ Technological improvements in banking (Favara and Imbs, 2011)

House Price Booms

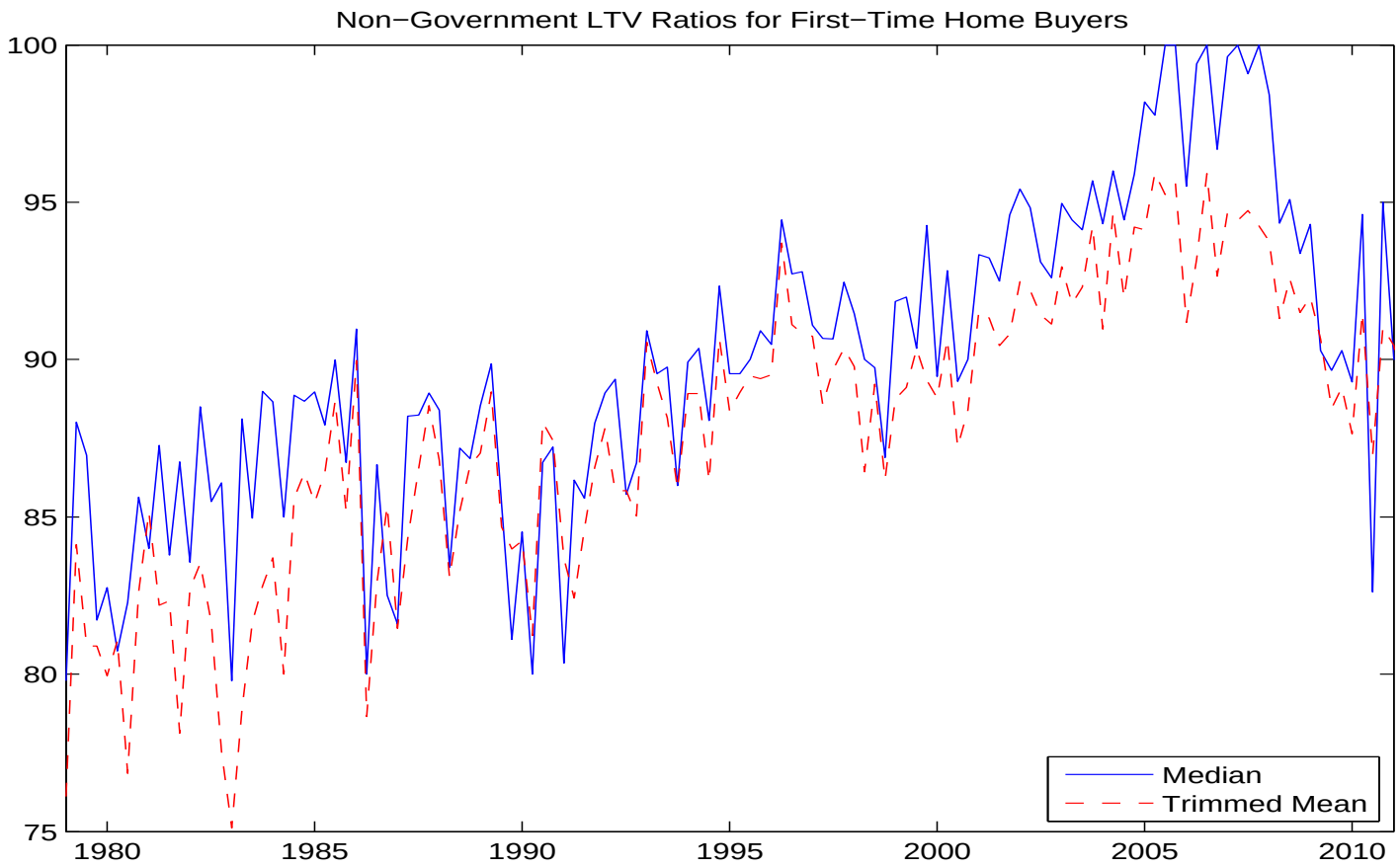
- Two potential drivers (domestic factors):
  1. Financial deregulation
  2. Preference shocks

1. Financial deregulation:
   - Debate on actual importance for house price boom/bust (Favilukis et al., 2011; vs. Justiniano et al., 2013)
   - Take as given ongoing debate on causes
     - ⋆ Political response to inequality (Rajan, 2010)
     - ⋆ Political economy of financial system (Mian et al., 2013)
     - ⋆ Technological improvements in banking (Favara and Imbs, 2011)

2. Preference shocks:
   - Possibly a stand-in for house price bubbles (Case and Shiller, 2003)
   - Crucial role in estimated DSGE models (Iacoviello and Neri, 2010)
   - Can generate negative correlation with current account (Gete, 2010)

Financial Deregulation: Two Experiments

1. Θ literally represents Loan-to-Value ratio:
   - Θ_t from 85% to 95% between 2001 and 2006 (Justiniano et al. 2013)



Source: Duca, Muellbauer and Murphy (2011, updated 2013)

Financial Deregulation: Two Experiments

1. Θ literally represents Loan-to-Value ratio:
   - Θ_t from 85% to 95% between 2001 and 2006 (Justiniano et al. 2013)
2. $\mathcal{B}$ represents all forms of collateralized borrowing:
   - Θ_t from 75% to 99% between 2001 and 2006 (Favilukis et al. 2011)

Financial Deregulation: Two Experiments

1. Θ literally represents Loan-to-Value ratio:
   - Θ_t from 85% to 95% between 2001 and 2006 (Justiniano et al. 2013)
2. $\mathcal{B}$ represents all forms of collateralized borrowing:
   - Θ_t from 75% to 99% between 2001 and 2006 (Favilukis et al. 2011)

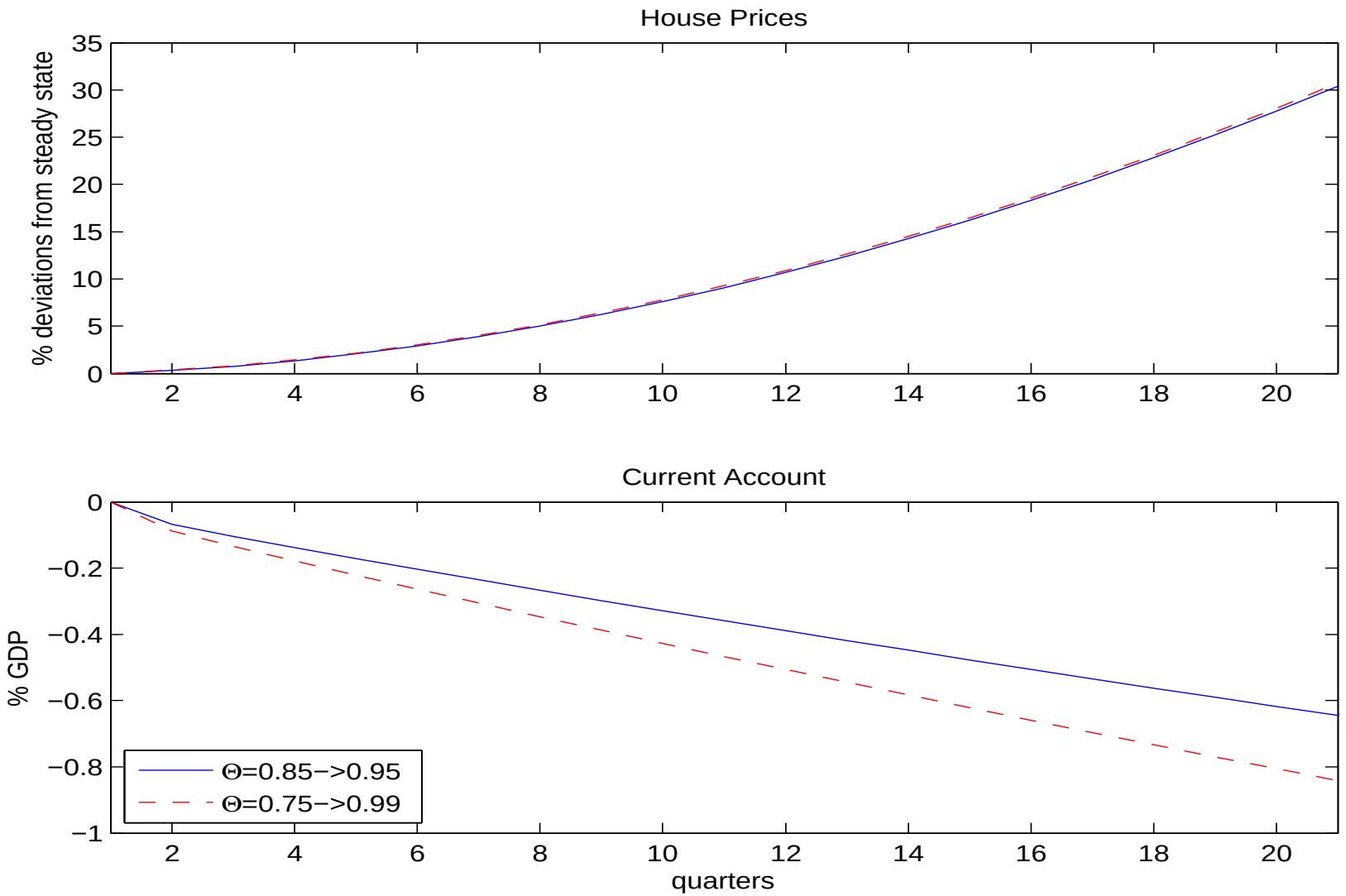
   - HELs allow for additional credit (Mian and Sufi, 2011)
   - Also capture reduction of transaction costs (Favilukis et al. 2011)
   - Entry of households previously unable to buy (Geanakoplos, 2010a,b)
   - At peak of boom marginal household borrows with zero downpayment (Haughwout et al., 2011)

Financial Deregulation: Two Experiments

1. Θ literally represents Loan-to-Value ratio:
   - Θ_t from 85% to 95% between 2001 and 2006 (Justiniano et al. 2013)
2. $\mathcal{B}$ represents all forms of collateralized borrowing:
   - Θ_t from 75% to 99% between 2001 and 2006 (Favilukis et al. 2011)

- Persistence: $\rho_\theta = 0.99$
  - "Regime-switching effect" (Boz and Mendoza, 2012)
- Find β s.t. financial deregulation fully generates boom
  - If Θ_t from 85 to 95% $\Rightarrow \beta = 0.89$
  - If Θ_t from 75 to 99% $\Rightarrow \beta = 0.96$
- Generate full boom-bust cycle but focus on boom only

Financial Deregulation



Preference Shocks: Equivalence Result

- In spite of evidence of higher LTVs, not obvious lower collateral constraints cause house price booms (Glaeser et al., 2008)

Preference Shocks: Equivalence Result

- In spite of evidence of higher LTVs, not obvious lower collateral constraints cause house price booms (Glaeser et al., 2008)

- Alternative: House price (preference) shocks

$$q_t = (1 - \beta - \Xi\Theta)\,\eta_t + \Xi\Theta\,\theta_t + ...,$$

  - Direct impact of preference shocks $\propto$ Direct impact of financial deregulation

Preference Shocks: Equivalence Result

- In spite of evidence of higher LTVs, not obvious lower collateral constraints cause house price booms (Glaeser et al., 2008)

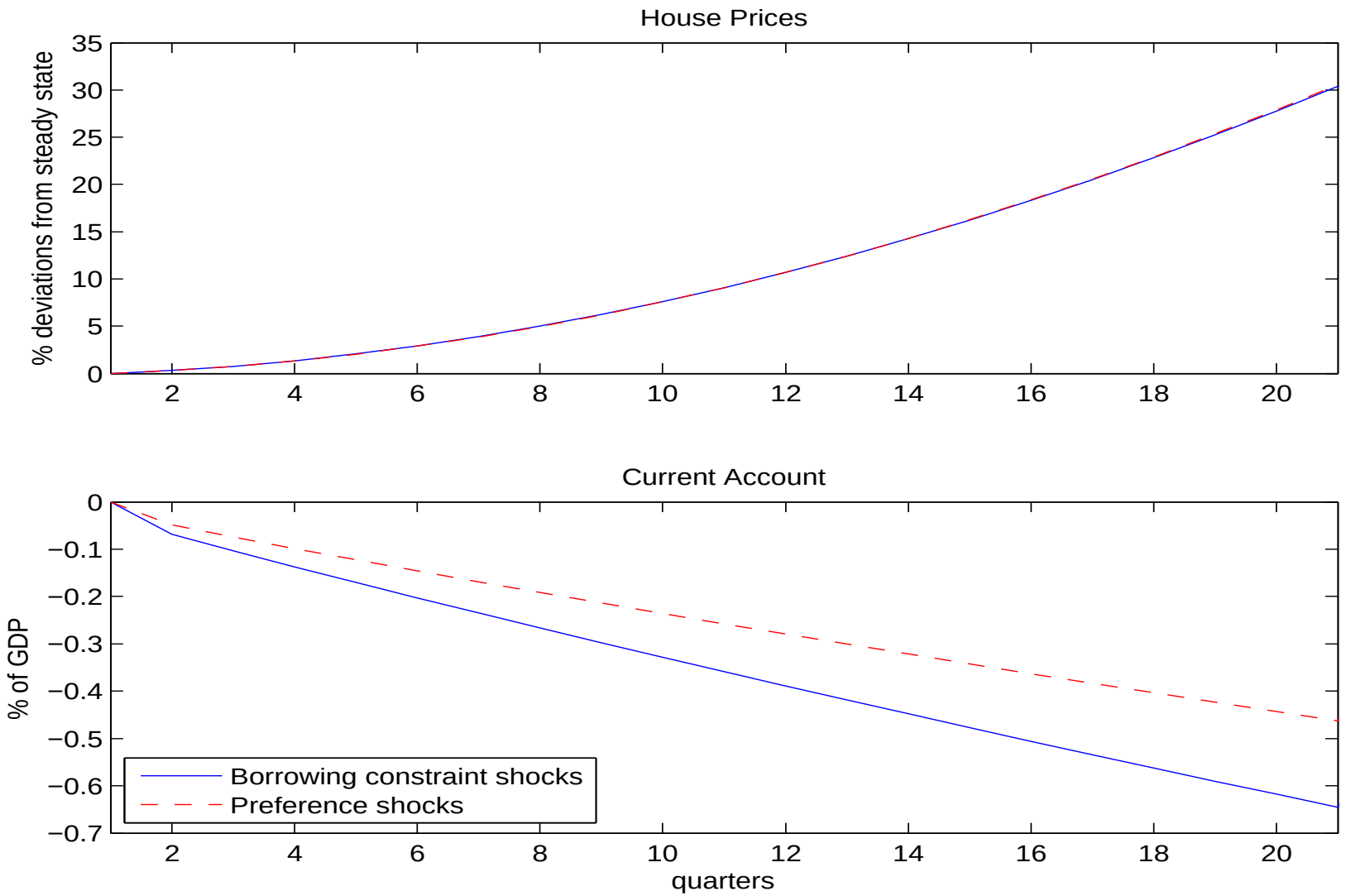
- Alternative: House price (preference) shocks

$$q_t = (1 - \beta - \Xi\Theta)\, \eta_t + \Xi\Theta\, \theta_t + ...,$$

  - Direct impact of preference shocks $\propto$ Direct impact of financial deregulation

- Main difference: Preference shocks do not directly impact debt
  - Deterioration of current account less pronounced

Preference Shocks: Equivalence Result



Financial Deregulation and Preference Shocks

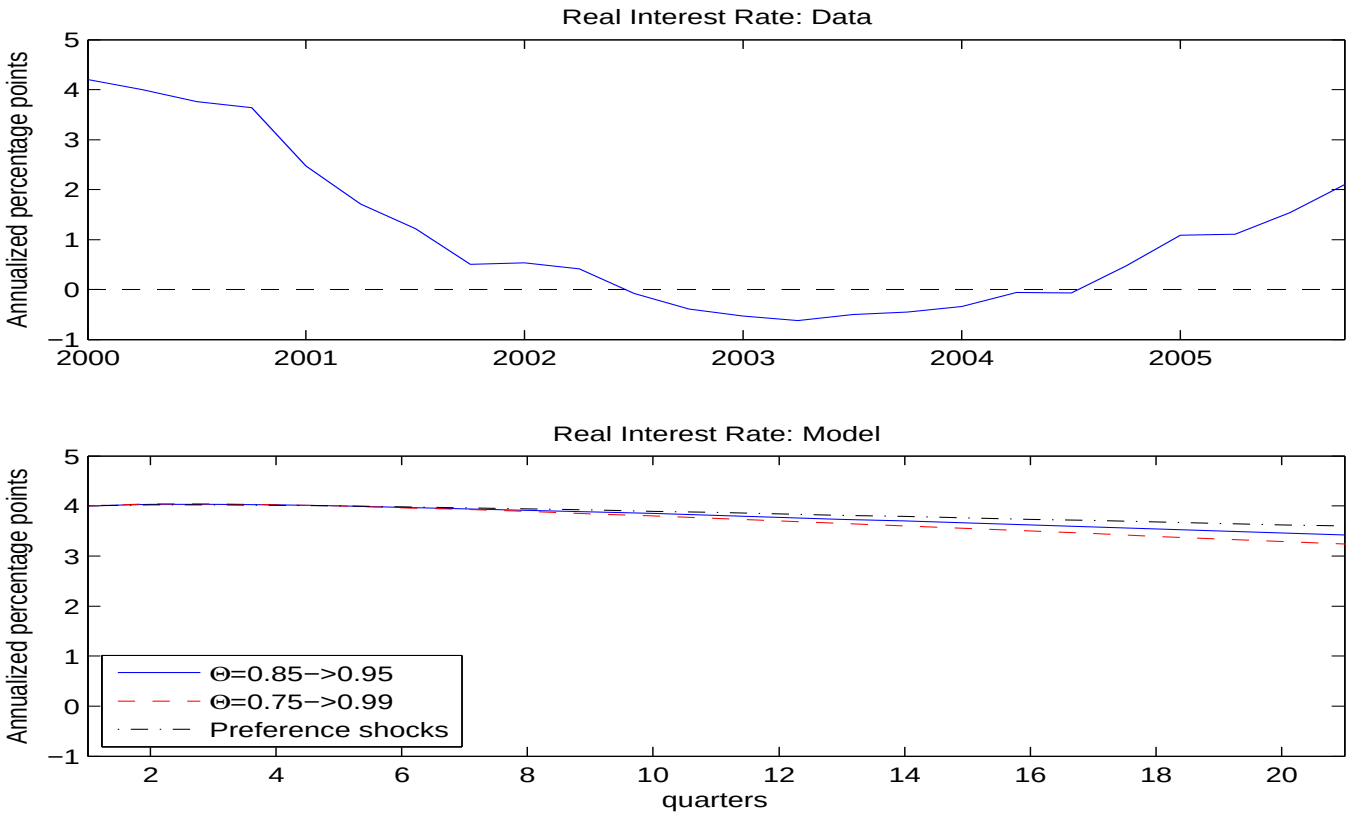
- Full house price boom
- Between 1/4 and almost 1/2 of current account deterioration (% of GDP)
  - Corollary: $corr(hp, ca) \approx -1$

Financial Deregulation and Preference Shocks

- Full house price boom
- Between 1/4 and almost 1/2 of current account deterioration (% of GDP)
  - Corollary: $corr(hp, ca) \approx -1$
- Also consistent with:
  - Increase in net foreign debt (Lane and Milesi-Ferretti, 2007)
  - Increase in consumption: Non-durable consumption $\approx 2\%$ above trend

Financial Deregulation and Preference Shocks

- Full house price boom
- Between 1/4 and almost 1/2 of current account deterioration (% of GDP)
  - Corollary: $corr(hp, ca) \approx -1$
- Problem: Counterfactual evolution of real interest rate



Financial Deregulation and Preference Shocks

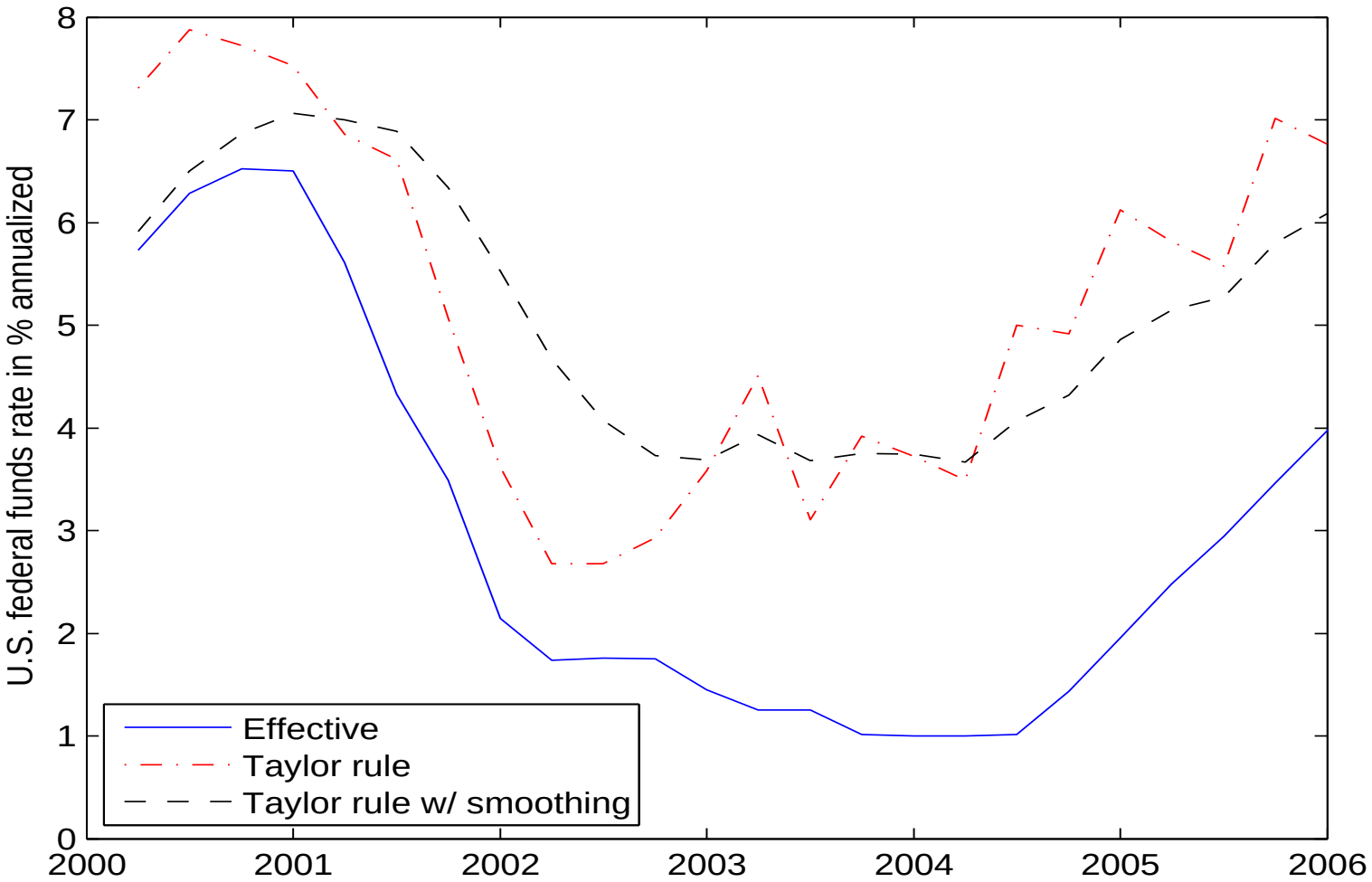
- Full house price boom
- Between 1/4 and almost 1/2 of current account deterioration (% of GDP)
  - Corollary: $corr(hp, ca) \approx -1$
- Problem: Counterfactual evolution of real interest rate
  - Popular explanation: Global saving glut (Bernanke, 2005)

Financial Deregulation and Preference Shocks

- Full house price boom
- Between 1/4 and almost 1/2 of current account deterioration (% of GDP)
  - Corollary: $corr(hp, ca) \approx -1$
- Problem: Counterfactual evolution of real interest rate
  - Popular explanation: Global saving glut (Bernanke, 2005)
  - This paper: A role for monetary policy?
    - ⋆ Loose monetary policy in the U.S. (Taylor, 2008)
    - ⋆ Foreign exchange rate pegs (Dooley et al., 2008)

Taylor's Hypothesis

- Loose U.S. monetary policy caused housing bubble (Taylor, 2008)



Taylor's Hypothesis

- Loose U.S. monetary policy caused housing bubble (Taylor, 2008)
  - Fed kept FFR below "prescribed" interest rate between 2001 and 2005
  - If inflation expectations anchored $\Rightarrow$ Real interest rate too low
  - Interest-rate sensitive sectors (e.g. housing) took off

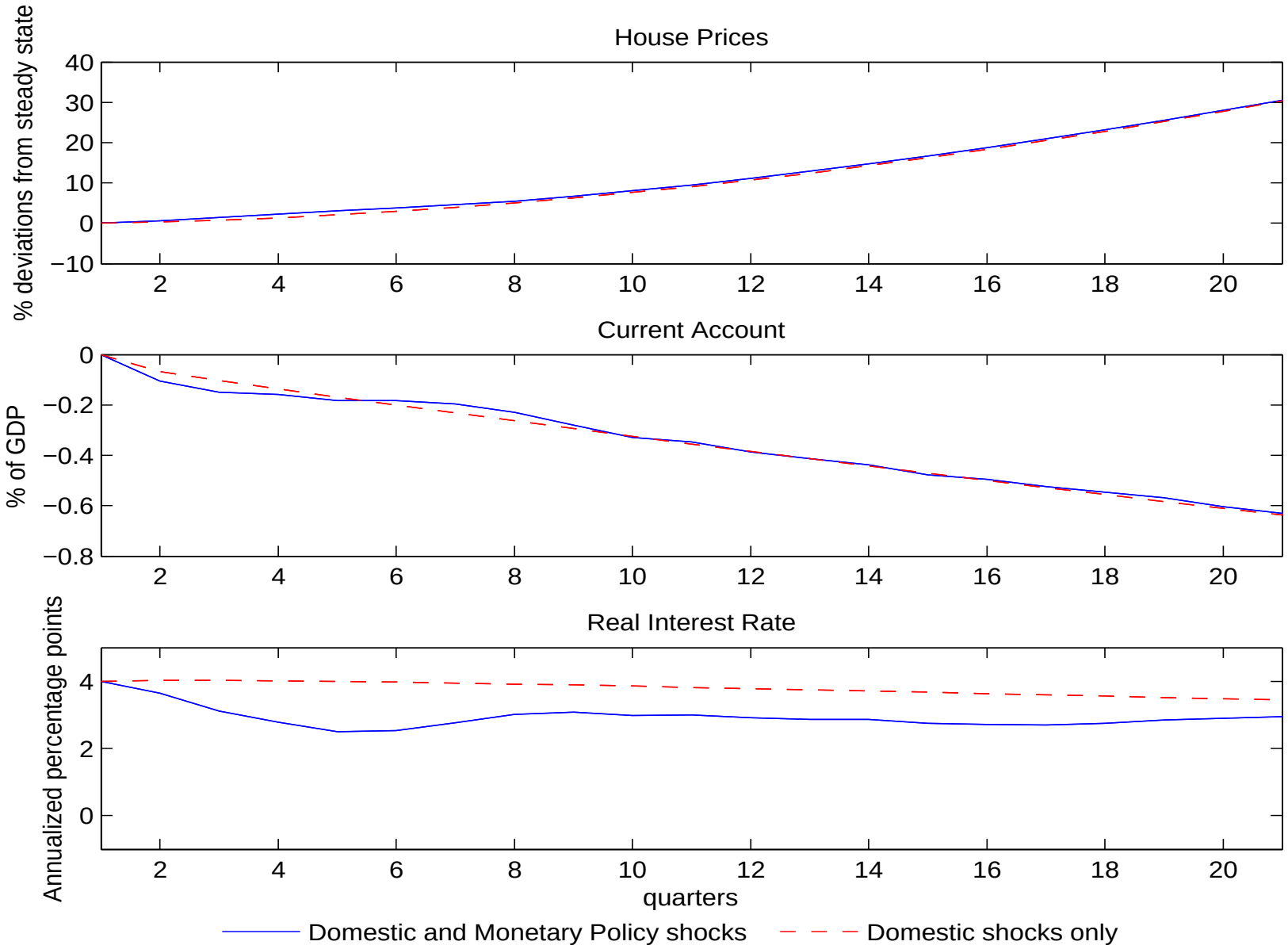
Taylor's Hypothesis

- Loose U.S. monetary policy caused housing bubble (Taylor, 2008)
  - Fed kept FFR below "prescribed" interest rate between 2001 and 2005
  - If inflation expectations anchored $\Rightarrow$ Real interest rate too low
  - Interest-rate sensitive sectors (e.g. housing) took off
- Quantitative evaluation of Taylor's hypothesis:
  - Domestic factors continue to generate house price boom
    - ★ Θ from 85 to 95% ($\beta = 0.95$) $\Rightarrow$ 50% of boom
    - ★ Other 50% due to preference shocks
  - Departures of FFR from interest rate prescribed by

$$i_t = 0.7^* i_{t-1} + 0.3^* [1.5^* (\pi_t - 2) + 0.5^* (y_t - \tilde{y}_t)]$$

    - ★ $\pi_t \equiv$ YOY CPI inflation
    - ★ $y_t - \tilde{y}_t \equiv$ Deviation of real GDP from CBO potential

Evaluating Taylor's Hypothesis



Summary

1. Domestic shocks account for house price boom and $corr(hp, ca) \approx -1$
2. Monetary policy shocks unimportant for house prices and current account
3. Monetary policy shocks explain low real interest rate

Summary

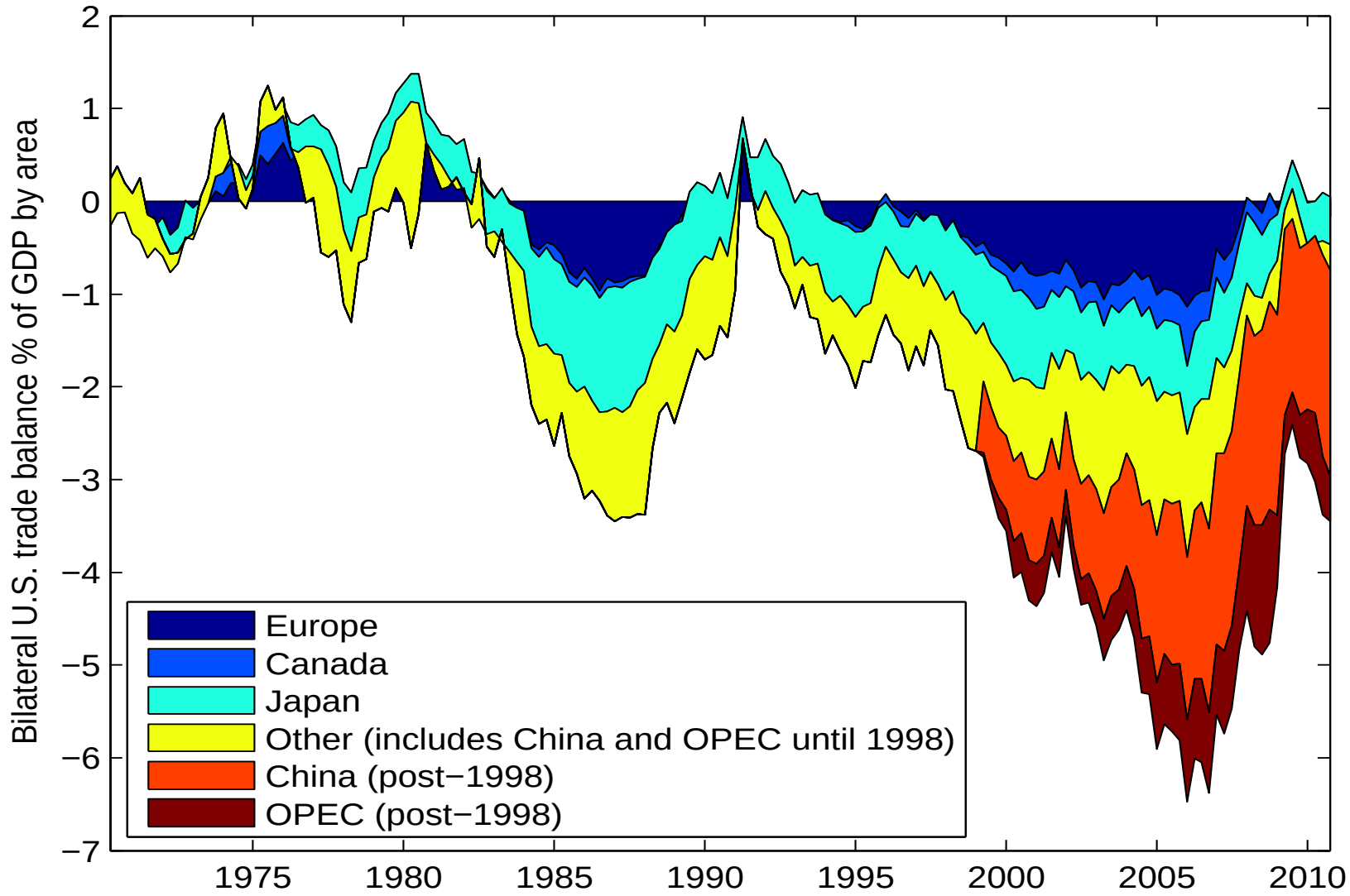
1. Domestic shocks account for house price boom and $corr(hp, ca) \approx -1$
2. Monetary policy shocks unimportant for house prices and current account
3. Monetary policy shocks explain low real interest rate
   - Effect still small (model: $\approx -1\%$, data: $\approx -4\%$)

Summary

1. Domestic shocks account for house price boom and $corr(hp, ca) \approx -1$
2. Monetary policy shocks unimportant for house prices and current account
3. Monetary policy shocks explain low real interest rate
   - Effect still small (model: $\approx -1\%$, data: $\approx -4\%$)

- Role for foreign monetary policy?
  - Assume ROW pegs to \$ $\Rightarrow$ Evaluation of "Bretton Woods II" hypothesis

Who Finances U.S. External Deficits?



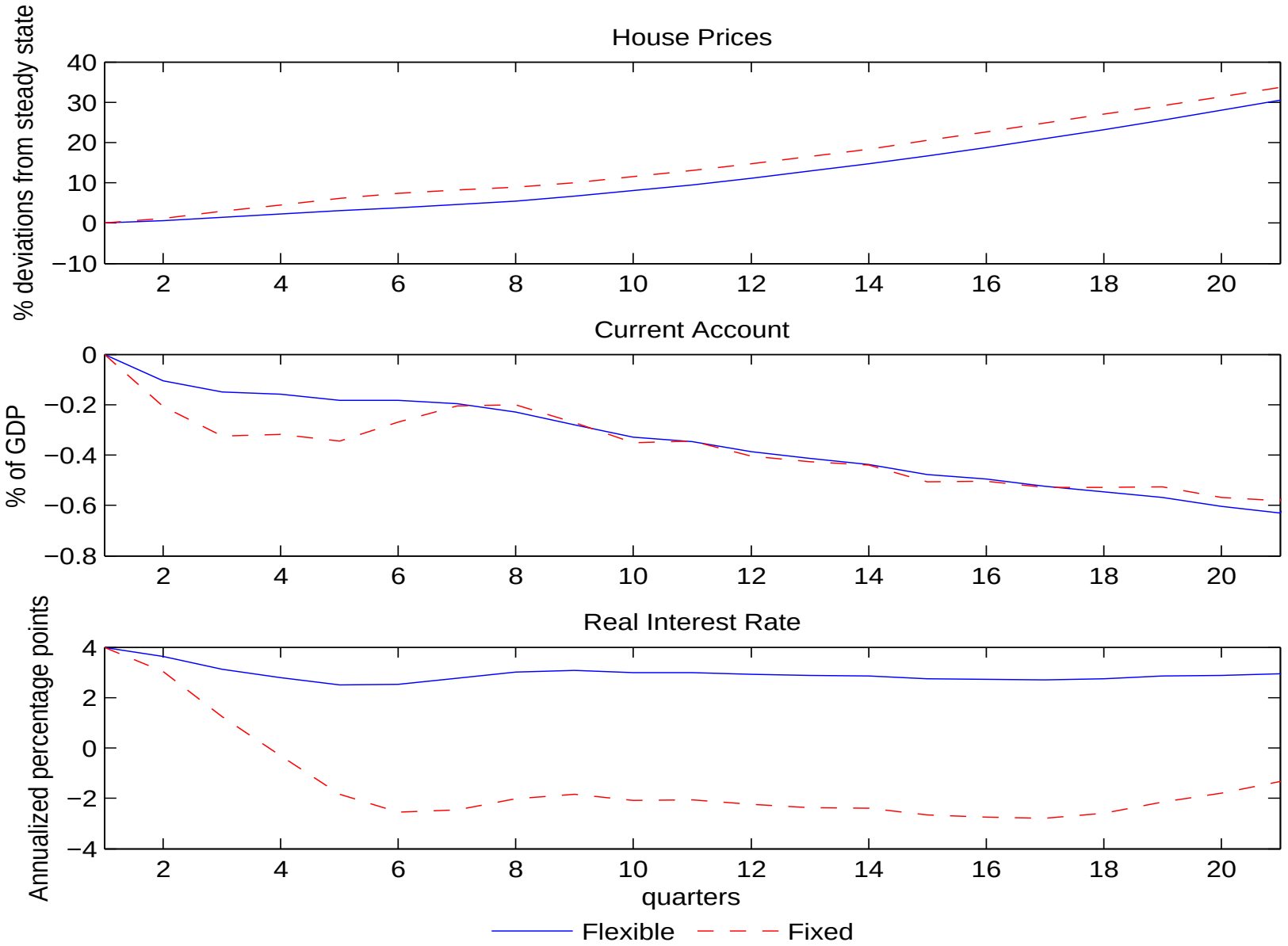
The "Bretton Woods II" Hypothesis

- Emerging markets and oil producers pegged exchange rate to $
  - IMF exchange rate regime classification
- These countries "finance" widening U.S. current account deficit
  - Emerging Asia: High productivity growth
  - Oil Producers: High oil prices
- Flexible exchange rates $\Rightarrow$ Appreciation of domestic currency

The "Bretton Woods II" Hypothesis

- Emerging markets and oil producers pegged exchange rate to $
  - IMF exchange rate regime classification
- These countries "finance" widening U.S. current account deficit
  - Emerging Asia: High productivity growth
  - Oil Producers: High oil prices
- Flexible exchange rates $\Rightarrow$ Appreciation of domestic currency
- Peg $\Rightarrow$ Emerging economies "import" U.S. monetary policy
- Loose U.S. monetary policy $\Rightarrow$ Loose global monetary policy
  - Downward pressure on world real interest rates
  - Prevents U.S. real exchange rate from depreciating
  - Policy stimulus for emerging markets exports

Evaluating "Bretton Woods II" Hypothesis



Conclusions

- Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
- Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate

Conclusions

- Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
- Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate
- Results complement role of global saving glut

Conclusions

- Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
- Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate
- Results complement role of global saving glut
- Extensions:
  1. Risk-taking channel of monetary policy? Little evidence from LTVs and FFR

Conclusions

- Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
- Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate
- Results complement role of global saving glut
- Extensions:
  1. Risk-taking channel of monetary policy? Little evidence from LTVs and FFR
  2. Monetary policy response to house prices? Recession and deflation

Interest Rates and Financial Deregulation

- Financial deregulation process exogenous to monetary policy
  - Objection: Low(er) interest rates encourage excessive risk-taking
    1. Lower than predicted by benchmark rule? (Taylor, 2008)
    2. Low levels? (Rajan, 2013)

Interest Rates and Financial Deregulation

- Financial deregulation process exogenous to monetary policy
  - Objection: Low(er) interest rates encourage excessive risk-taking
    1. Lower than predicted by benchmark rule? (Taylor, 2008)
    2. Low levels? (Rajan, 2013)
- Dependent variable: Non-government median LTV series for first-time home buyers from American Housing Survey (Duca et al., 2013)

Interest Rates and Financial Deregulation

- Financial deregulation process exogenous to monetary policy
  - Objection: Low(er) interest rates encourage excessive risk-taking
    1. Lower than predicted by benchmark rule? (Taylor, 2008)
    2. Low levels? (Rajan, 2013)
- Dependent variable: Non-government median LTV series for first-time home buyers from American Housing Survey (Duca et al., 2013)

$$LTV_t = \alpha + \beta x_t + u_t$$

	α	β	R^2
$x_t = \varepsilon_{FFR,t}$	-0.010^{**}	-0.013^{***}	0.145
	(0.005)	(0.003)	
$x_t = FFR_t$	-0.001	-0.008^{***}	0.146
	(0.005)	(0.002)	

Interest Rates and Financial Deregulation

- Financial deregulation process exogenous to monetary policy
  - Objection: Low(er) interest rates encourage excessive risk-taking
    1. Lower than predicted by benchmark rule? (Taylor, 2008)
    2. Low levels? (Rajan, 2013)
- Dependent variable: Non-government median LTV series for first-time home buyers from American Housing Survey (Duca et al., 2013)

$$LTV_t = \alpha + \rho LTV_{t-1} + \beta x_t + u_t$$

	α	ρ	β	R^2
$x_t = 0$	0.000	0.696^{***}	0	0.480
	(0.004)	(0.074)		
$x_t = \varepsilon_{FFR,t}$	-0.004	0.641^{***}	-0.005^{*}	0.500
	(0.004)	(0.079)	(0.003)	
$x_t = FFR_t$	0.000	0.640^{***}	-0.003^{**}	0.502
	(0.004)	(0.078)	(0.002)	

Monetary Policy and Asset Prices

- Dicothomy:
  - Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
  - Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate

Monetary Policy and Asset Prices

- Dicothomy:
  - Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
  - Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate
- What would have happened if Fed had responded to house prices?

Monetary Policy and Asset Prices

- Dicothomy:
  - Financial deregulation + Preference Shocks $\Rightarrow corr(hp, ca) \approx -1$
  - Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate
- What would have happened if Fed had responded to house prices?
  - Modify Taylor rule to introduce response to house price inflation

$$i_t = \rho_i i_{t-1} + (1-\rho_i)(\psi_\pi \pi_{Xt} + \psi_y y_{ht}) + \psi_q \Delta q_t + \varepsilon_{it}$$

Monetary Policy and Asset Prices

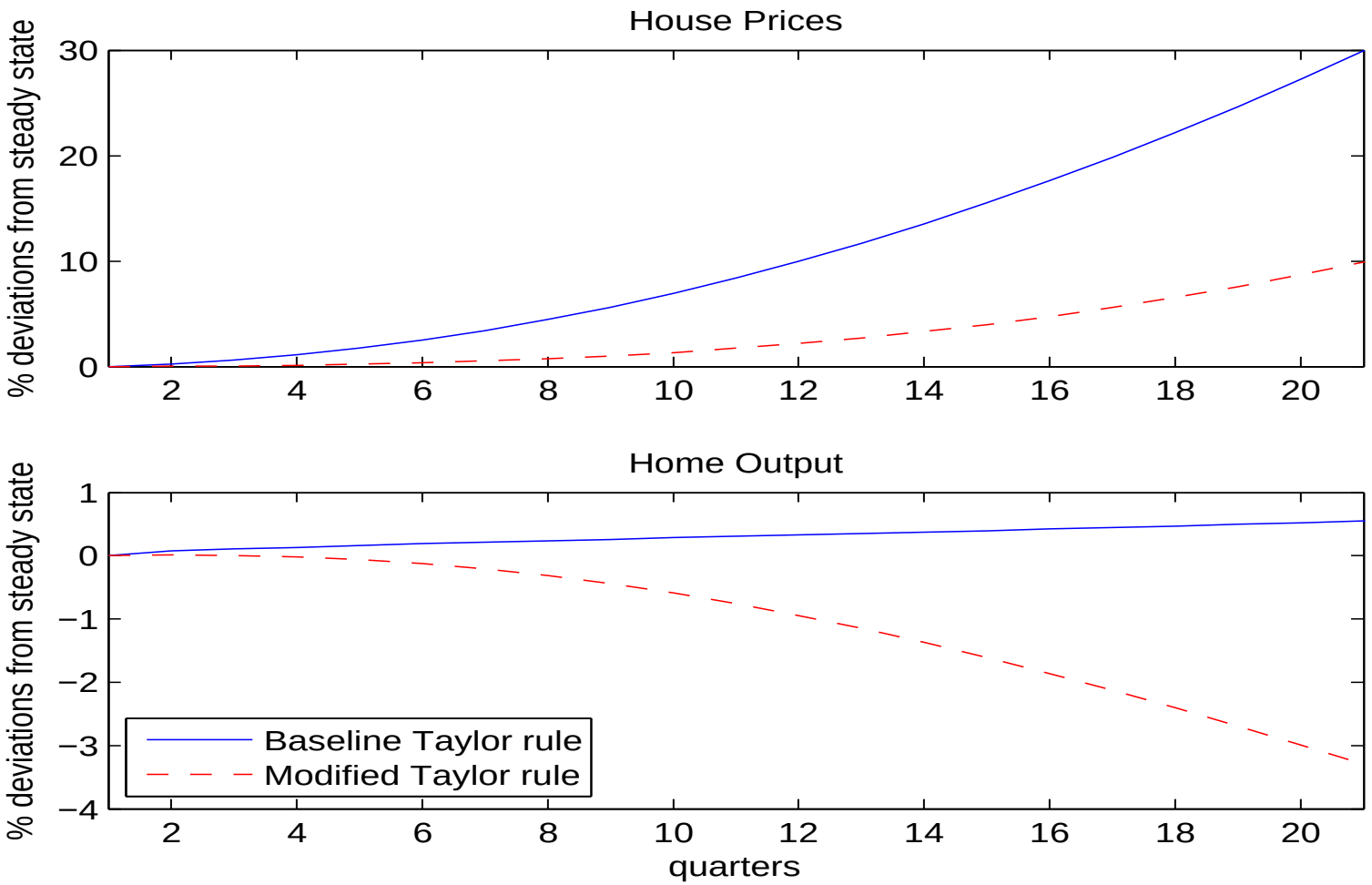
- Dicothomy:
  - Financial deregulation + Preference Shocks $\Rightarrow$ $corr(hp, ca) \approx -1$
  - Monetary policy shocks + Foreign peg $\Rightarrow$ Decline in real interest rate
- What would have happened if Fed had responded to house prices?
  - Modify Taylor rule to introduce response to house price inflation

$$i_t = \rho_i i_{t-1} + (1-\rho_i)(\psi_\pi \pi_{Xt} + \psi_y y_{ht}) + \psi_q \Delta q_t + \varepsilon_{it}$$

  - Experiment:
    - ★ Same combination of financial deregulation and preference shocks as before
    - ★ No monetary policy shocks
    - ★ Pick ψ_q so that house prices increase by 10% max

Monetary Policy and Asset Prices

- Response to house prices $\Rightarrow$ Recession + Deflation



Financial Deregulation: Intuition (Partial Equilibrium)

- Steady state of small open economy version with single consumption good, fixed labor supply, no nominal rigidities

Net foreign debt

$$RB = \Theta QH$$

Real value of housing stock

$$QH = (\omega^{-1} - 1)\, C / (1 - \beta - \Xi\Theta)$$

Financial Deregulation: Intuition (Partial Equilibrium)

- Steady state of small open economy version with single consumption good, fixed labor supply, no nominal rigidities

Net foreign debt	Real value of housing stock
$RB = \Theta QH$	$QH = (\omega^{-1} - 1)C/(1 - \beta - \Xi\Theta)$

- Experiment: Permanent increase in Θ (borrowing constraint)
  - For given consumption, foreign debt and real house prices increase

Financial Deregulation: Intuition (Partial Equilibrium)

- Steady state of small open economy version with single consumption good, fixed labor supply, no nominal rigidities

Net foreign debt	Real value of housing stock
$RB = \Theta QH$	$QH = (\omega^{-1} - 1)C/(1 - \beta - \Xi\Theta)$

- Experiment: Permanent increase in Θ (borrowing constraint)
  - For given consumption, foreign debt and real house prices increase
  - Endogenous amplification on B via QH

Financial Deregulation: Intuition (Partial Equilibrium)

- Steady state of small open economy version with single consumption good, fixed labor supply, no nominal rigidities

Net foreign debt

$$RB = \Theta QH$$

Real value of housing stock

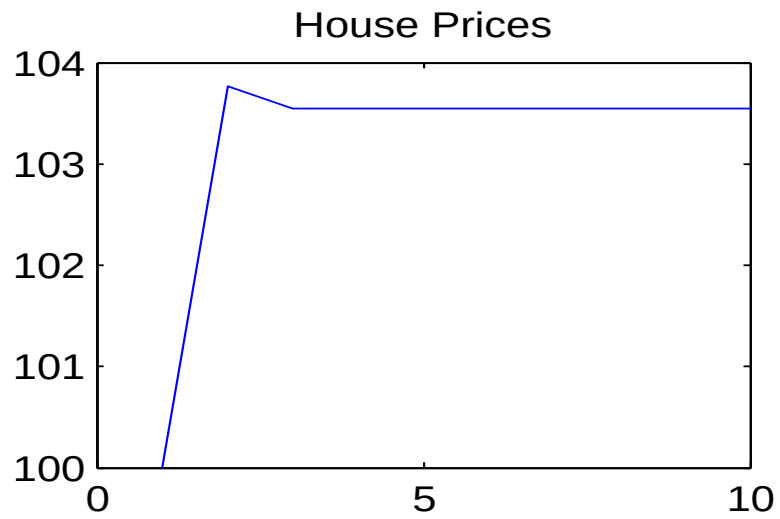
$$QH = (\omega^{-1} - 1)C/(1 - \beta - \Xi\Theta)$$

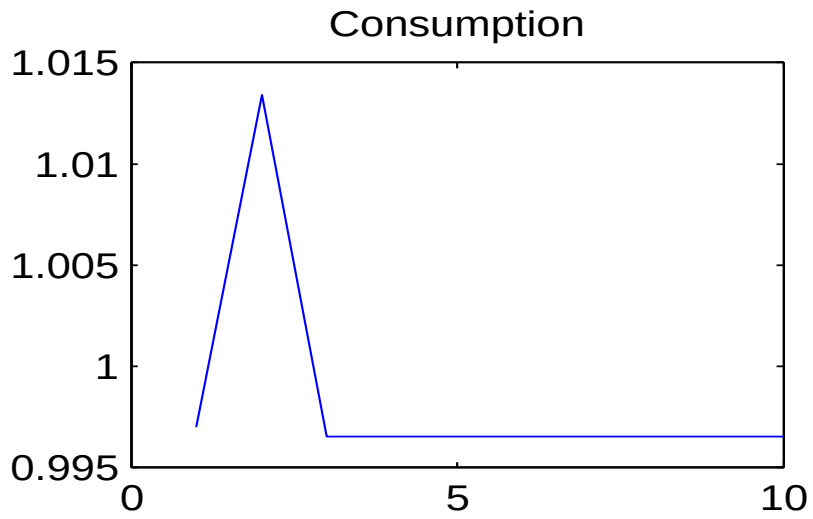
- Experiment: Permanent increase in Θ (borrowing constraint)
  - For given consumption, foreign debt and real house prices increase
  - Endogenous amplification on B via QH
  - Eventually, consumption decreases to repay debt

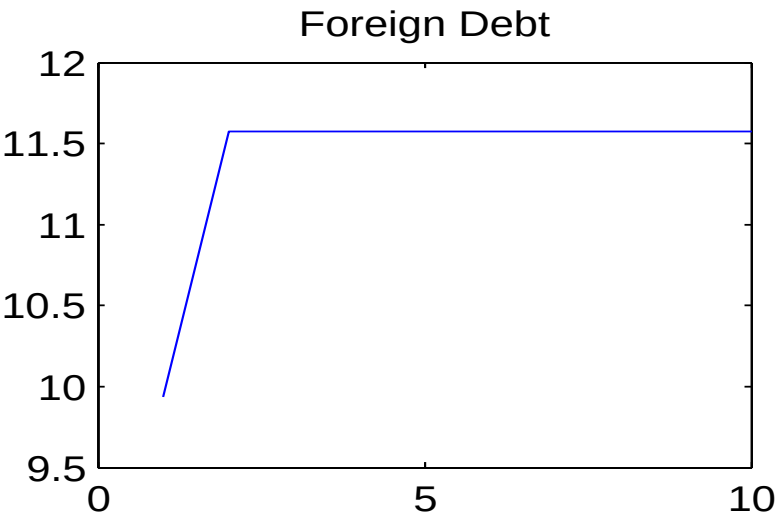
$$C = Y - (R-1)B$$

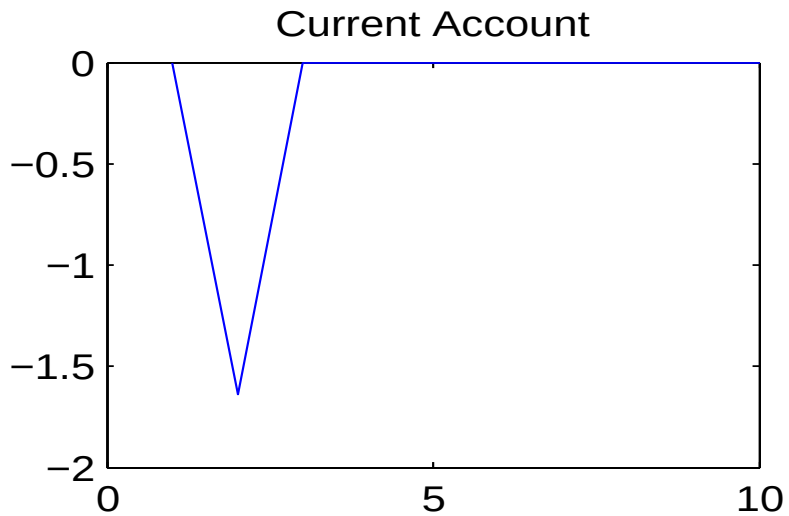
But along transition consumption booms (credit availability increases)

Permanent Increase in LTV from 80% to 90%









Intuition (Partial Equilibrium)

- Steady state of small open economy version with single consumption good, fixed labor supply, no nominal rigidities

Net foreign debt

$$RB = \Theta QH$$

Real value of housing stock

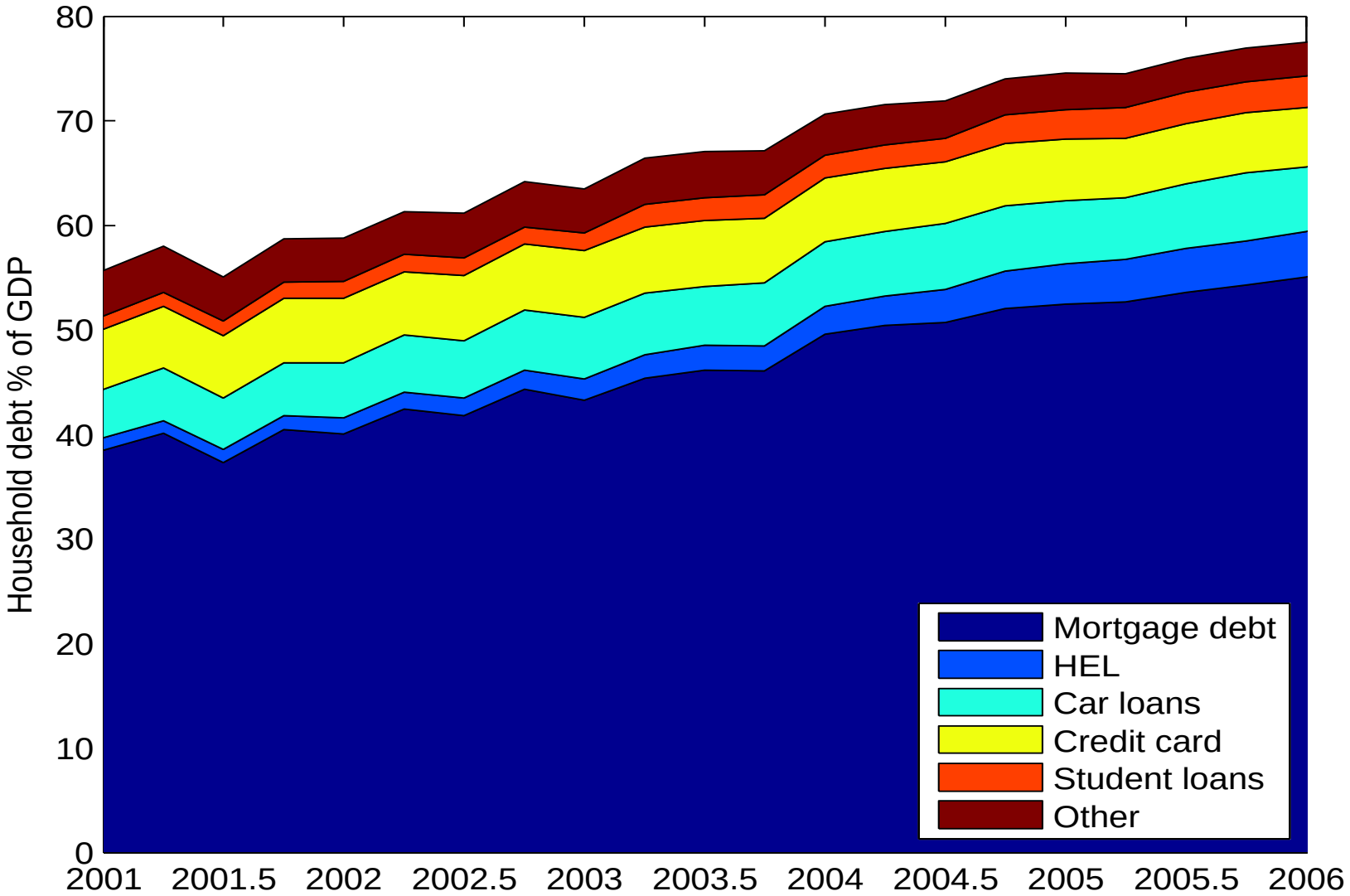
$$QH = (\eta^{-1} - 1)C/(1 - \beta - \Xi\Theta)$$

- Note: Borrowing constraint binding

$$\Xi = (1 - \beta R)/R > 0$$

- True only if $1 - \beta R > 0 \Rightarrow$ "Low" real interest rate ($R < 1/\beta$)
  - True in the data
  - Problem for a two-country model conditional on shocks to Θ only

United States: A Nation in Debt[1]



[1] Data source: FRBNY Quarterly Report on Household Debt and Credit

Growth of Subprime

Mortgage Origination by Product (in %)

Year	FHA/VA	Conv/Conf	Jumbo	Subprime	Alt A	HEL
2001	8	57	20	7	2	5
2002	7	63	21	1	2	6
2003	6	62	16	8	2	6
2004	4	41	17	18	6	12
2005	3	35	18	20	12	12
2006	3	33	16	20	13	14
2007	4	48	14	8	11	15

* Source: Abraham, Pavlov and Wachter (2008)
- FHA/VA = Federal Housing / Veteran Administration
- Conv/Conf = Convertible/Conformable loans
- Jumbo = Above comformable ($417K)
- Alt A = "Alternative to Agency"
- HEL = Home Equity Loans

Growth of Subprime

Mortgage Origination by Product (in %)

Year	FHA/VA	Conv/Conf	Jumbo	Subprime	Alt A	HEL
2001	8	57	20	7	2	5
2002	7	63	21	1	2	6
2003	6	62	16	8	2	6
2004	4	41	17	18	6	12
2005	3	35	18	20	12	12
2006	3	33	16	20	13	14
2007	4	48	14	8	11	15

* Source: Abraham, Pavlov and Wachter (2008)
- FHA/VA = Federal Housing / Veteran Administration
- Conv/Conf = Convertible/Conformable loans
- Jumbo = Above comformable ($417K)
- Alt A = "Alternative to Agency"
- HEL = Home Equity Loans

- Definition of "subprime" (Board of Governors, 2001)
  - $\geq$ 2 30-day ($\geq$ 1 60-day) delinquencies in last 12 (24) months
  - Judgment, foreclosure, repossession, or charge-off in prior 24 months
  - Bankruptcy in last 5 years
  - Relatively high default probability (FICO $\leq$ 660)
  - Debt-income ratio $\geq$ 50%

- Pinto (2008): Subprime is larger than "subprime" (Alt-A and HELs also have subprime characteristics)

Loan-to-Value Ratios

LTVs for prime, Alt-A and subprime mortgages (in %)

Year	Fixed-Rate		Adjustable-Rate	
CLTV	Mean	$> 80\%$	Mean	$> 80\%$
		Prime		
2002	65.4	3.0	66.5	4.1
2003	63.8	4.4	68.2	10.1
2004	67.4	7.0	73.5	20.7
2005	70.9	13.4	74.1	21.7
2006	74.5	23.1	75.3	26.2
		Alt-A		
2002	74.7	22.0	74.3	20.8
2003	71.5	21.4	78.0	33.3
2004	75.3	29.5	82.6	46.9
2005	76.2	31.3	83.5	49.6
2006	79.4	39.6	85.0	55.4
		Subprime		
2002	77.3	38.0	81.2	46.8
2003	78.0	41.7	83.5	55.6
2004	77.7	41.2	85.3	61.1
2005	78.7	44.5	86.6	64.4
2006	78.7	44.6	86.7	64.0

* Source: Abraham, Pavlov and Wachter (2008)

\- CLTV = Combined (i.e. first and second mortgage) loan-to-value ratio

Loan-to-Value Ratios

LTV ratios (in %)

All Housing Purchases[2]				
Year	25^{th}	50^{th}	75^{th}	90^{th}
2004	56	80	95	100
2005	64	86	99	100
2006	70	90	100	100
Non-Prime Purchases[3]				
Year	25^{th}	50^{th}	75^{th}	90^{th}
2004	80	95	100	100
2005	80	95	100	100
2006	90	99	100	100

[2] Source: Glaeser, Gottlieb and Gyourko (2010)

[3] Source: Haughwout, Lee, Tracy and Van der Klaauw (2011)

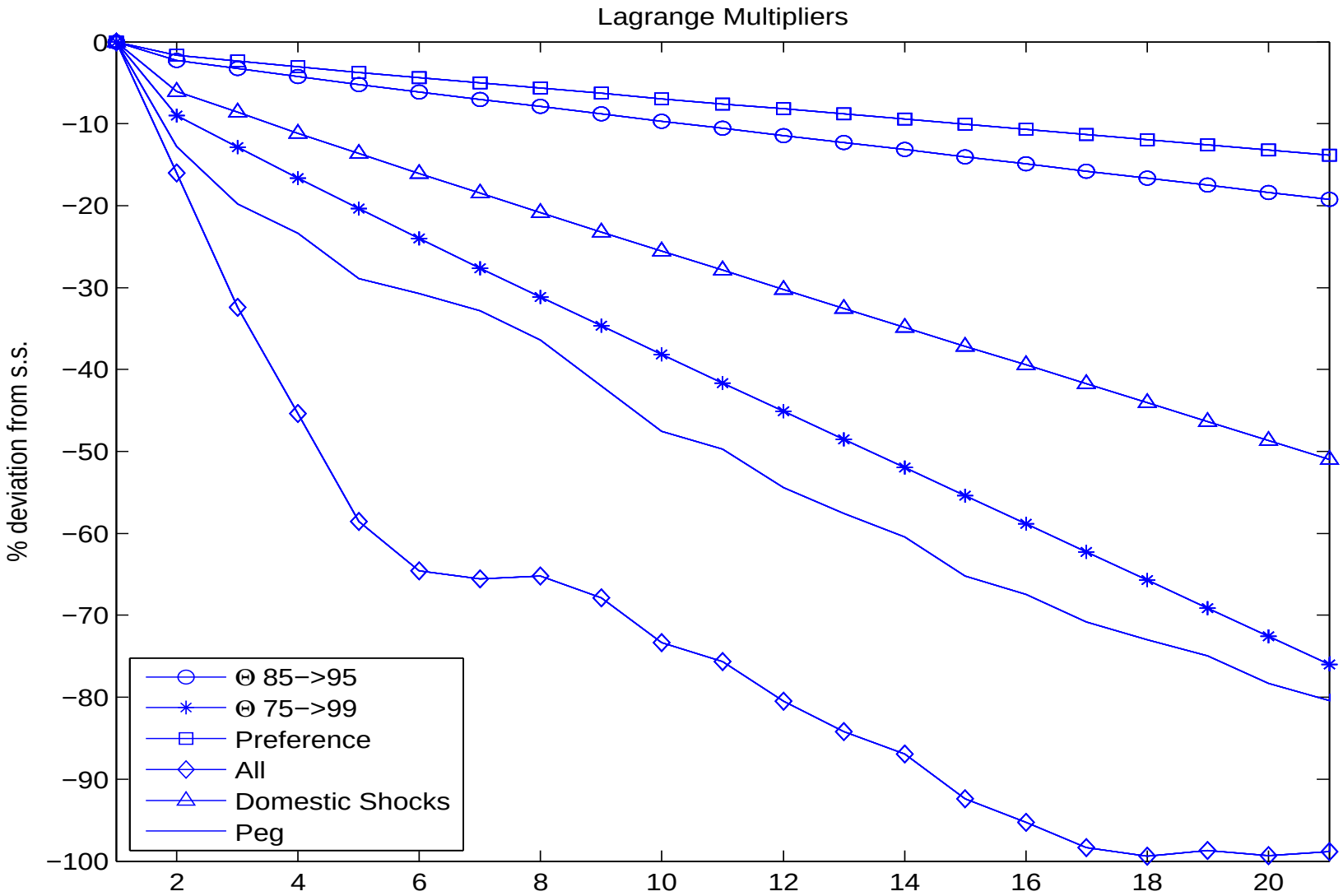
Beyond LTV Ratios: Home Equity Loans (HEL)

- From 5 to 15% of **new** mortgage origination between 2001 and 2007
- Mian and Sufi (2011): Increase in HEL by **existing** homeowners responsible for substantial fraction of:
  - Increase in household leverage between 2002 and 2006
  - Increase in default rates between 2006 and 2008
- Average household extracts 25c per $1 of house price appreciation
- Borrowed funds not used to buy new real estate or repay (high interest) credit card debt
  - Must be used for real outlays
    - ⋆ Consumption
    - ⋆ Home improvement

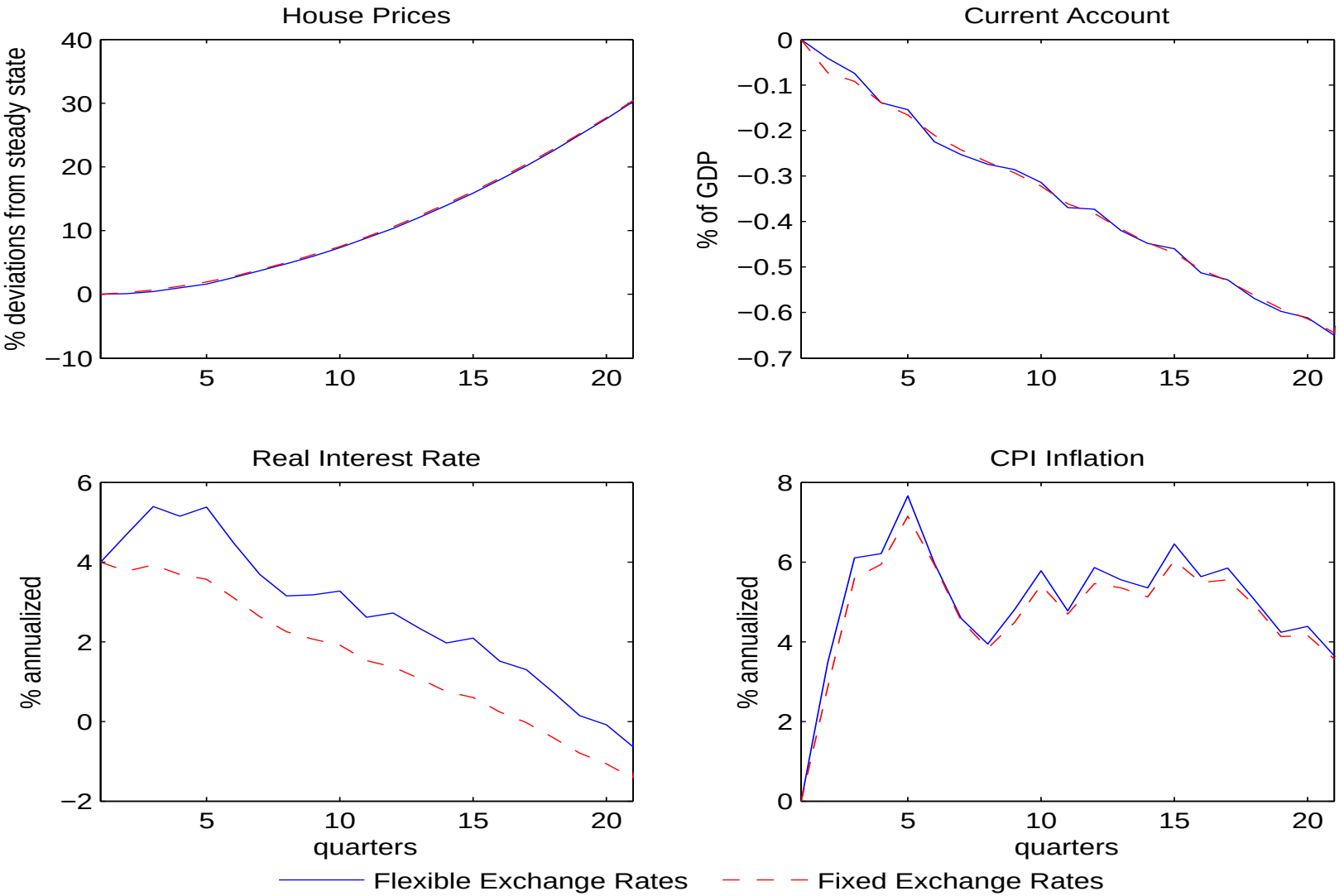
Notable International Episodes

- Iceland: LTVs from 65% to 90% in 2003 (EMF Hypostat, 2008)
  - 60% increase in real house prices between 2001 and 2006
  - 20% deterioration of current account over same period
- UK (80s): LTVs from 75% to 85% (Ortalo-Magné and Rady, 2004)
  - House prices up 88% between 1982 and 1989
  - Current account balance from $\approx +2\%$ to $\approx -5\%$ over a decade
- Spain: Tight regulation on LTV ratios (Bank of Spain)
  - Recent events revealed different reality
  - Plus other ways to get around restrictions (e.g. inflated appraisals)

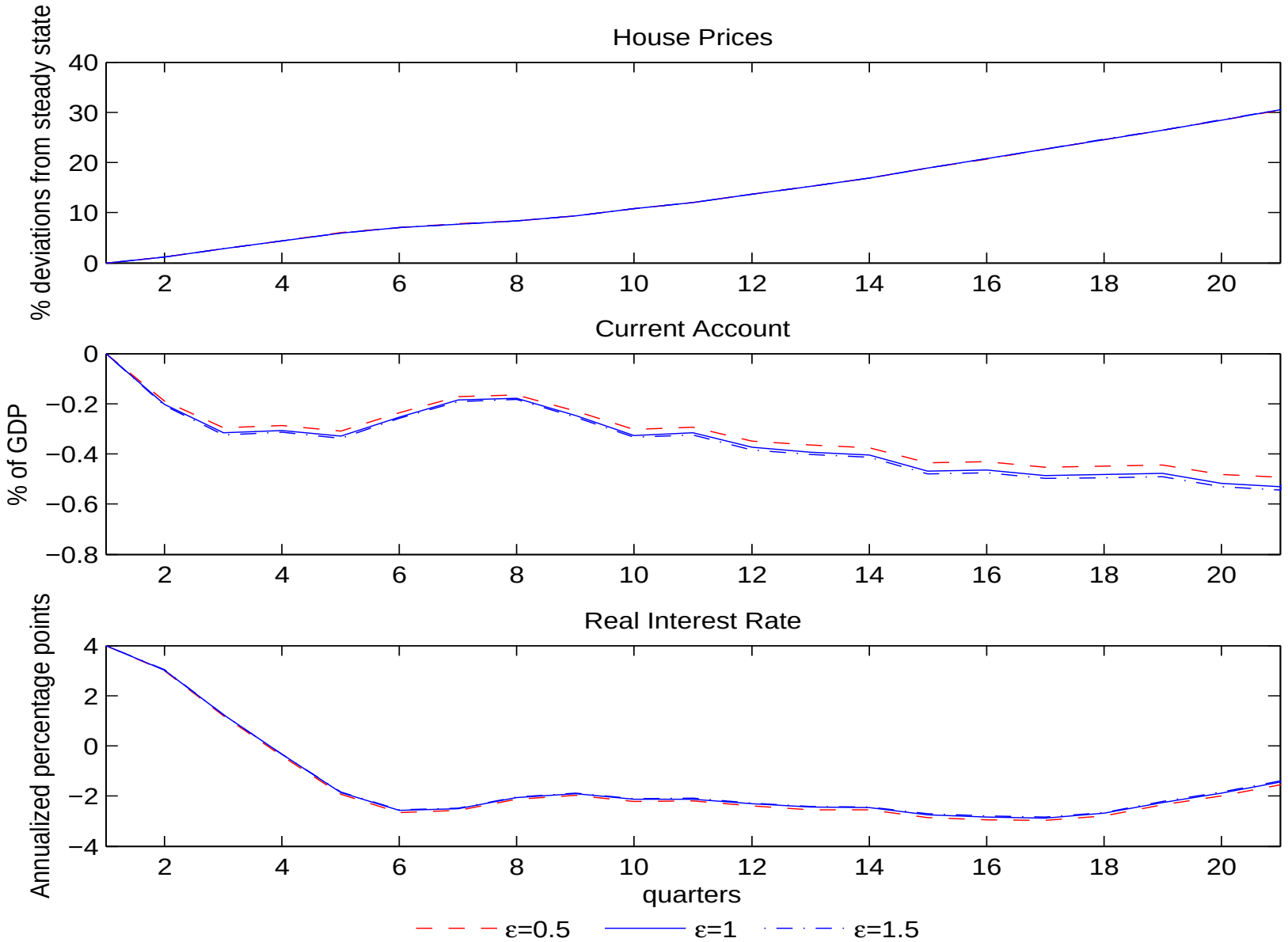
Lagrange Multipliers



The Role of Nominal Rigidities



Robustness


House Prices
% deviations from steady state
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
Current Account
% of GDP
0
−0.2
−0.4
−0.6
−0.8
Real Interest Rate
Annualized percentage points
4
2
0
−2
−4
quarters
ε=0.5
ε=1
ε=1.5