Monetary Policy, Heterogeneity and the Housing Channel

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Introduction

Transmission Channels of Monetary Policy

Recent strand in the monetary policy literature focusing on mechanisms that complement the **intertemporal substitution channel:**

- Beraja et al (2017), Cloyne et al (2015), Gornemann et al (2012), Greenwald (2016), Kaplan et al (2016), Luetticke (2015), Sterk and Tenreyro (2015), and many others.
- **Key insight:** Household portfolios and MPC heterogeneity are important for the conduct of monetary policy.

We focus on the role of **housing** and **mortgage debt** in the transmission of monetary policy.

Why Housing and Mortgages?

For many households, **houses** are the single most important asset in their portfolio, tied to long-term nominal debt-**mortgages**.

Various indirect effects on aggregate demand could be at play:

- wealth effects due to endogenous movements in house prices
- liquidity effects on mortgage lending standards
- cash-flow effects (e.g., Flodén et al. 2016)
- redistribution channel (e.g., Auclert 2015)

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- Any asymmetry between contractionary and expansionary policy?
- Does effectiveness of monetary policy depend on the **distribution of LTV ratios**?
  - e.g. low-LTV (pre-2000) vs high-LTV(pre-Great Recession).

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- How to manage a liquidity trap induced by a housing bust?

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- Any asymmetry between contractionary and expansionary policy?
- Does effectiveness of monetary policy depend on the **distribution of LTV ratios**?
- How to manage a liquidity trap induced by a housing bust?

How to answer?

- Develop an **H**eterogenous **A**gents **N**ew **K**eynesian model with frictional housing market and long-term mortgages.

Today

- An AiyaGali-HANK model with housing and long-term nominal debt
- Calibration and model's fit
  - Compare MPCs w.r.t LTVs between the data and the model.
- Monetary policy experiments
- Conclusion

Model

Households

- Infinitely lived households with time separable preferences
- Preferences over consumption c, housing services s and leisure l
- Stochastic (uninsured) labor productivity, z_t
- Can save in one-period uncontingent bonds, ($b_t > 0$)

Housing

Owner-occupied housing

- Houses come in a set of discrete sizes $h \in \mathcal{H}$
- Housing supply is fixed.

Rental housing

- A linear, reversible technology converts the final good into apartment space.
- Apartment size a generates $s = a$ services, whereas owner-occupied house of size h generates $s = \omega h$, $\omega > 1$.
- Partial segmentation in housing market: $a_{max} < h_{min}$.

Directed Search in the Housing Market

- Housing market is subject to search frictions.
  - it takes time to sell a house.
- Owners of house size h who wish to sell choose:
  - List at price x_s, meet a broker with probability $p_s(\theta_s(x_s, h))$
- Sellers face a tradeoff between price and liquidity.
  - Room for the LTV distribution to affect prices and liquidity.

Real Estate Brokers

- Risk-neutral real estate brokers.
- Free entry with cost $\kappa_s h$ to enter (x_s, h)
- Probability finding a seller, $\alpha_s(\theta_s(x_s, h))$
- Sells houses at price p_h per unit in centralized market
- Free entry $\Rightarrow \theta_s(x_s, h)$ in a submarket depends only on p_h and x_s.

$$\kappa_s h \geq \underbrace{\alpha_s\left(\theta_s\left(x_s, h\right)\right)}_{\text{prob of match}} \underbrace{\left(p_h h - x_s\right)}_{\text{broker revenue}}$$

Mortgages

- Collateralized, long-term, adjustable rate nominal debt contract.
- Option to **default**: Forfeit house to the bank and incur utility cost ξ_f
- Option to **refinance** at an origination cost of ζ
- Mortgages amortized at rate $r_{mt} = \overbrace{(1+\phi)}^{\text{spread}} \overbrace{(1+r_t)(1+\pi_t)}^{\text{nominal risk-free rate}}$
- Price at origination $q_0(r_{mt}, m, b', h, z)$ reflect all idiosyncratic default and refi risk.
- Required to pay fraction χ of balance each period $\Rightarrow$ effective duration is $1/\chi$

Financial Sector

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  - *Ex-ante* zero profits from each type of loan.

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  - *Ex-ante* zero profits from each type of loan.
- *Ex-post* losses or profits (because of unanticipated shocks) absorbed by government via GSEs (e.g. Fannie/Freddie).
  - Aggregate state and monetary policy *still* affects contemporaneous pricing of mortgages, q_0.

Final Good Producers

- Aggregate intermediate goods: $Y_t = \left(\int_0^1 y_{jt}^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}$
- Intermediate goods face downward sloping demand function.

Production and Prices

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- Intermediate goods face downward sloping demand function.

Intermediate Firms

- Intermediate good production is linear in labor services: $mc = w$
- **Quadratic price adjustment costs** for deviations from target inflation à la Rotemberg (1982).

Fiscal Policy

- Taxes labor income and provides nominal transfers, $\tilde{T}_t$.
- Taxes intermediate firms profits, $P_t d_t$.
- Issues nominal bonds, B_t^g.
- Faces nominal expenditures G_t growing at $\overline{\Pi}$
- Absorbs aggregate risk in mortgage market, T_t^{GSE}.
- Government budget constraint is given by:

$$B_{t+1}^g = (1 + i_t) B_t^g + P_t G_t + T_t^{GSE} - P_t d_t - \int \tilde{T}_t (w_t s_t l_t) \, d\Omega$$

Monetary Policy

- Follows a simple Taylor rule that responds to only inflation.
  - Monetary shocks follow an AR(1) process.
- Monetary-fiscal coordination: transfers are adjusted to keep real government debt constant.
- Real rate follows the fisher equation.

Calibration and Model Fit

Calibration

- Calibrate the steady state of the model to US economy prior to the Great Recession (2003-2005).
- Some parameters set externally. Others chosen to hit some key moments.
- Emphasis on matching
  - housing moments related to sales, time on the market, etc.
  - joint distribution of housing wealth and mortgage debt.

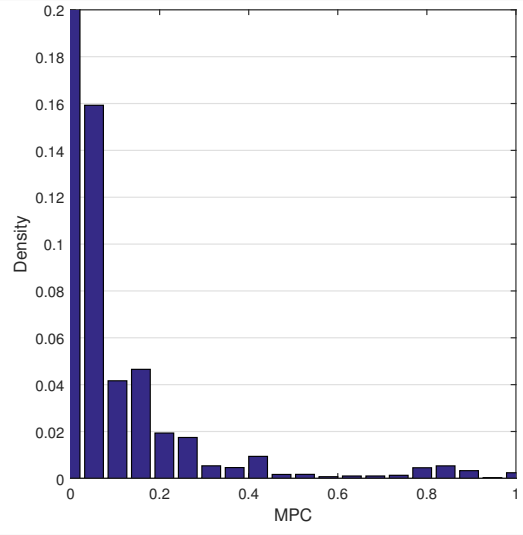
Fit to targeted moments

Moment	Model	Data
Home ownership rate	66%	63%
Median net worth (rel. to mean income)	0.79	1.06
Mean mortgage debt (rel. to median income)	2.10	1.87
Foreclosure rate (%)	0.4	0.4
Mean seller time on the market (weeks)	17.1	17.3
Mean REO time on the market (weeks)	29	52

LTV Distribution

Moment	Model	Data
Median mortgage debt	1.54	1.55
Fraction of homeowners with a mortgage	99%	82%
Median LTV	0.68	0.49
Percent with LTV$>$70%	44.7	28.5
Percent with LTV$>$80%	14.6	18.1
Percent with LTV$>$90%	9.6	9.4
Percent with LTV$>$95%	5.4	5.8

Distribution of MPCs



Relationship Between MPC and LTV

- We follow Blundell, Pistaferri, Preston (AER, 2008) to estimate MPC out of transitory income changes.
  - Regress Δc_t on Δy_t, instrument with future inc. growth Δy_{t+1}.
- MPC of homeowners by LTV:

	All	Model
High LTV(≥ 0.85)	0.27	
	(0.01)	
Low LTV(< 0.85)	0.19	
	(0.00)	

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High LTV(≥ 0.85)	0.27	0.17
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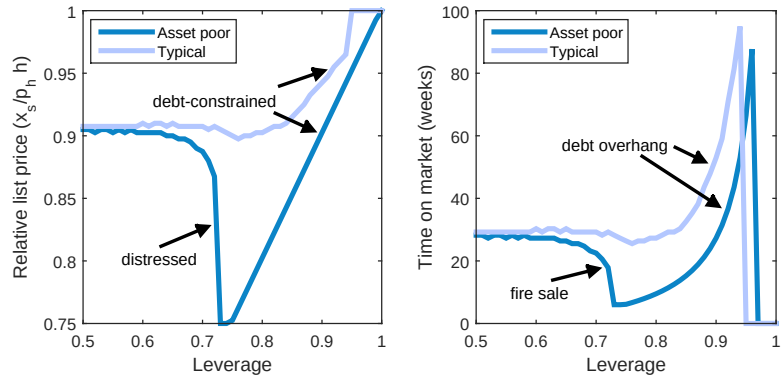
	(0.00)	

- The model can generate significant differences in the MPCs between the high- and low-LTV groups.

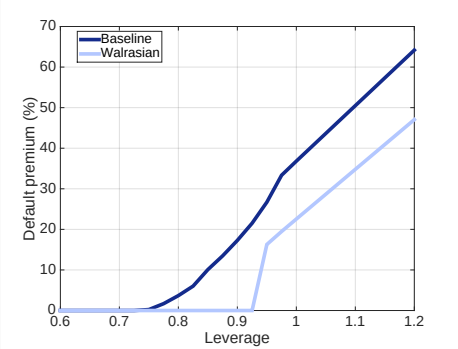
Steady State Behavior

Price Posting Behavior



- Distressed homeowners list their house at low prices (fire sale).
- Typical homeowners increase their selling price as LTV increases.

Frictions and Default Premia



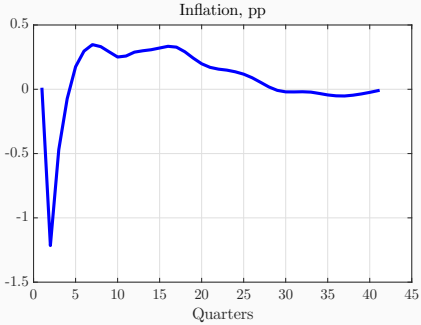
- In Walrasian model, having negative equity is a necessary condition for default.
  - With frictions homeowners with positive equity may default.

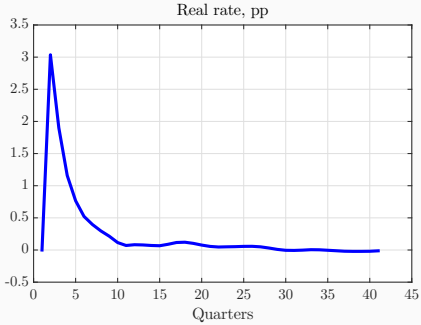
Policy Experiments

Monetary Policy Shocks

- We assume that the economy is initially in steady state in period $t = 0$.
- **The experiment:** In period $t = 1$ monetary authority hits the economy with a persistent contractionary shock, η_1 =100bp.
  - $\epsilon_t = \rho_\epsilon \epsilon_{t-1} + \eta_t$, $\rho_\epsilon = 0.60$, $\epsilon_0 = 0$.
- Simulate perfect foresight transition of the economy response to a one-time unexpected monetary shock at time $t = 1$.

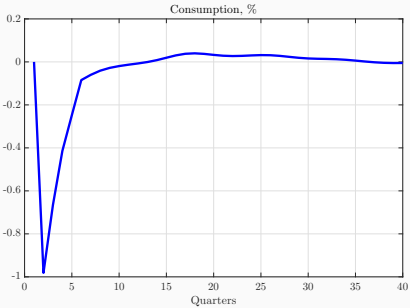
Inflation and Real Rate

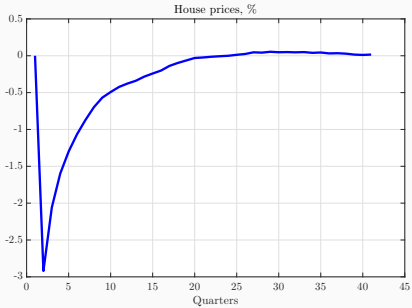




- Model cannot generate hump-shaped impulse responses.
  - No capital, no capital adjustment costs, no external habits.

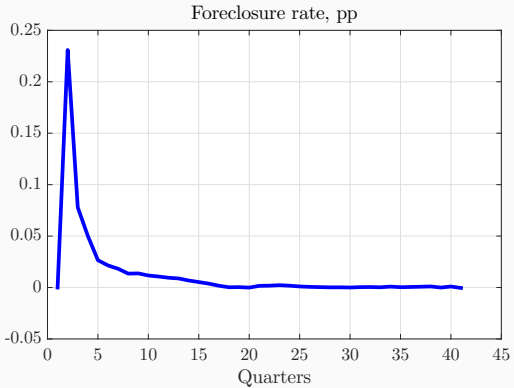
Consumption and House Prices





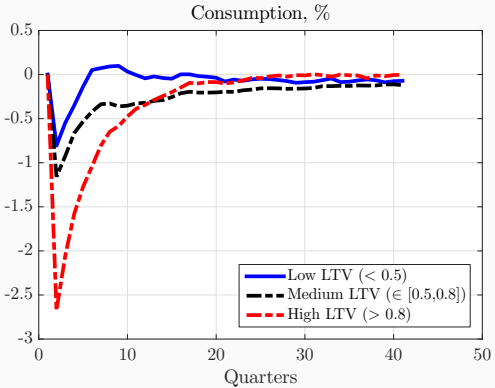
- Consumption responds significantly to monetary shock.
- Rise in the financing cost decreases house prices.
  - House prices are very elastic against monetary shocks.

Foreclosures



- Increase in real rates increases mortgage payments
- Decline in house prices (along with an increase in the TOM) accompanied by jump in foreclosures.

Consumption response by LTV



- Effect of monetary shocks are heterogeneous.
  - High-LTV households respond most.

Policy Experiments

Decomposing the Transmission of Monetary Policy

Decomposing the Channels

- Consumption as a function of price paths and government policies.

$$\left\{ C_t\left(\{ T_t, \tau_t, w_t, P_t, p_t^h, i_t, q_t^m \}_{t \geq 0} \right) \right\}_{t \geq 0}$$

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- Total impact of monetary shock on consumption:

$$(\Delta C)_t = \overbrace{C_t\left(\{T_t, \tau_t, w_t, P_t, p_t^h, i_t, q_t^m\}_{t\geq 0}\right)}^{\text{Equilibrium Consumption}} - \overbrace{C_t\left(\{\bar{T}, \bar{\tau}, \bar{w}, \bar{P}, \bar{p^h}, \bar{i}, \bar{q^m}\}_{t\geq 0}\right)}^{\text{Steady State Consumption}}$$

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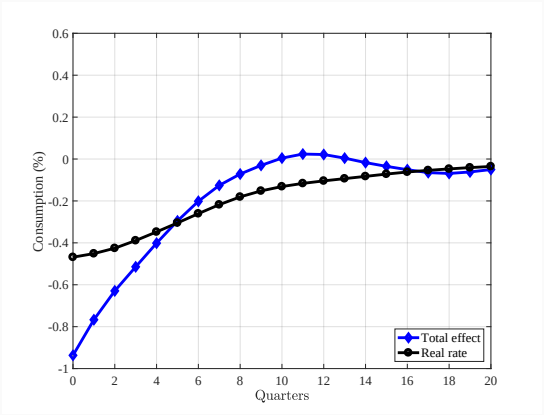
- Start from SS path and add one equilibrium path each time. For example, to identify the role of real rates (direct effect):

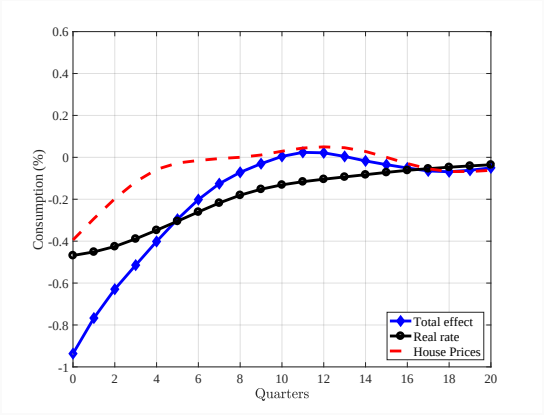
$$(\Delta C)_t^i = C_t\left(\{\bar{T}, \bar{\tau}, \bar{w}, P_t, \bar{p^h}, i_t, \bar{q^m}\}_{t\geq 0}\right) - C_t\left(\{\bar{T}, \bar{\tau}, \bar{w}, \bar{P}, \bar{p^h}, \bar{i}, \bar{q^m}\}_{t\geq 0}\right)$$

Decomposing the Effects: Real Rate



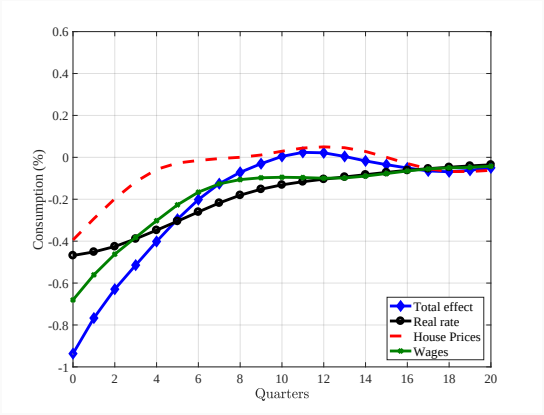
- Higher interest rates lead to fall in consumption.

Decomposing the Effects: Housing & Mortages



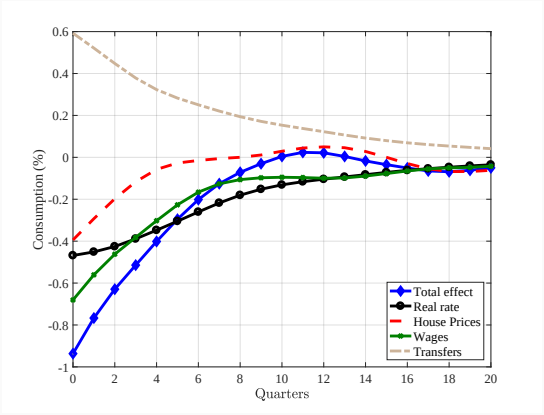
- Houses and mortgages are important for the transmission of monetary policy.

Decomposing the Effects: Wages



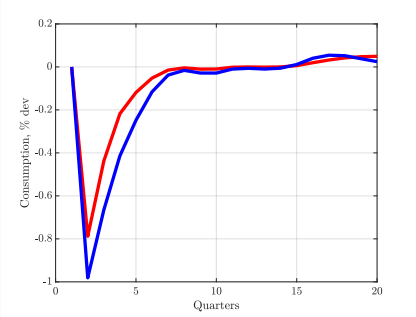
- GE (labor supply+wage) effects leads to large decline in consumption.

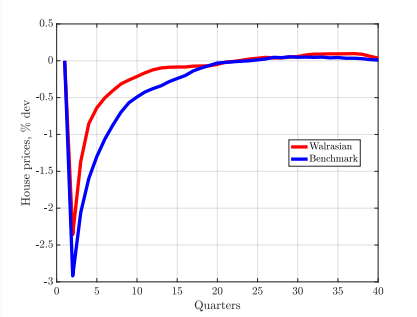
Decomposing the Effects: Transfers



- Transfers becomes significantly positive because of countercyclical markups.

The Role of Search Frictions



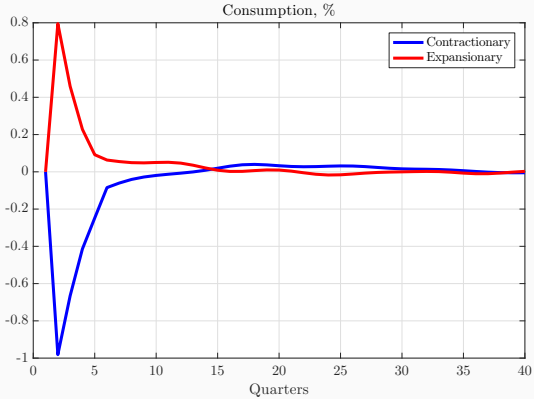


- Solve version of model with Walrasian housing markets.
  - Frictions amplify and propagate shocks

Policy Experiments

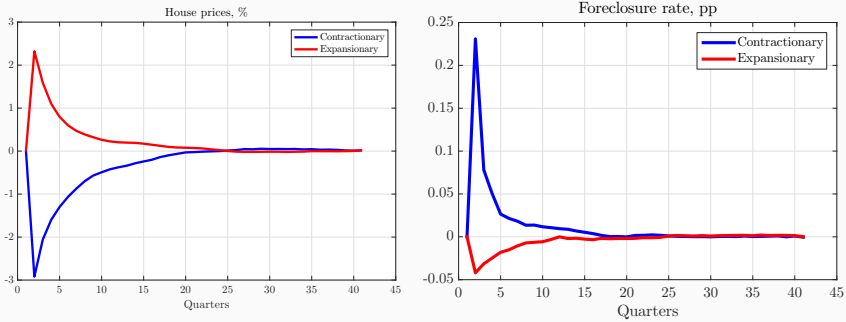
Asymmetric Effects

Consumption



- Consumption responds to a contraction more than it does to an expansion.

House prices and foreclosures



- House prices and foreclosures respond more to contractionary shocks.

The Role of LTV Distribution

- The nonlinearities in the joint distribution of the LTV and the MPC lead to asymmetries between expansionary and contractionary shocks.
- Different LTV distributions may results in different responses of consumption against the same monetary shock.
- Preliminary results support this intuition that the efficacy of monetary policy may depend on the LTV distribution.
  - In low LTV environment monetary policy is less effective.

Conclusion

Conclusion

- Develop a HANK model of housing and mortgages to study monetary policy.
  - Houses and mortgages and their joint distribution are important for monetary policy.
- Tightening has larger effects on consumption than expansion.
- Preliminary results suggest that monetary policy is more effective in environments with high mortgage debt.

Future Research

- Exciting avenues for future research
- How do **the different types of mortgage** affect the efficacy of monetary policy?
  - e.g. US vs Sweden vs Denmark or ARM vs FRM.
- Unconventional monetary policy in a housing-bust induced liquidity trap study.

Additional Slides

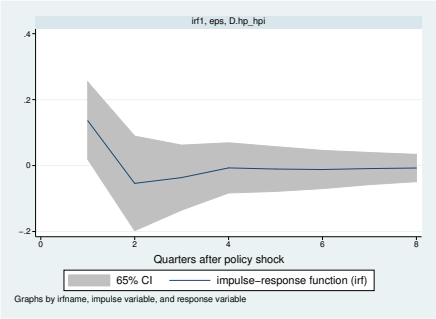
Externally calibrated parameters

Parameter(s)	Interpretation	Value(s)
Γ	Income process	GKOS 2016
σ	Risk aversion	2
φ	Frisch elasticity	0.33
ϕ	Mortgage servicing cost	0.025
ς	Mortgage initiation cost	0.4%
ν	Maximum LTV	125%
ϕ_T	Taylor rule coefficient	1.25
τ	Tax rate	0.2
	Government spending (quarterly)	0.0425

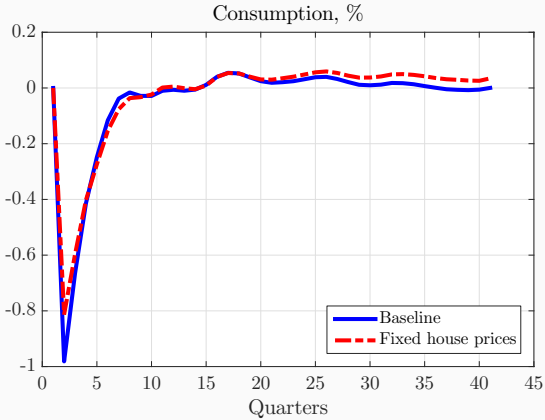
Internally calibrated parameters

Parameter	Interpretation	Value(s)
β	Discount factor	0.95
ϕ_h	Taste for housing	0.4244
γ_h	Elasticity of substitution c, h	0.5
λ_s	Elasticity of match. fnc.	0.8922
κ_s	Min house price that sells w. prob 1	0.7538
$\underline{h}$	Size of smallest house	2.9486
$\underline{h_r}$	Size of largest rental apartment	2.4287
ξ_F	Utility cost of foreclosure	0.0153
η	Efficiency loss due to foreclosure	1.53%

VAR evidence: Monetary policy shocks, house prices and delinquencies



Role of house prices



- Drop in house prices explains 20% of the consumption response.

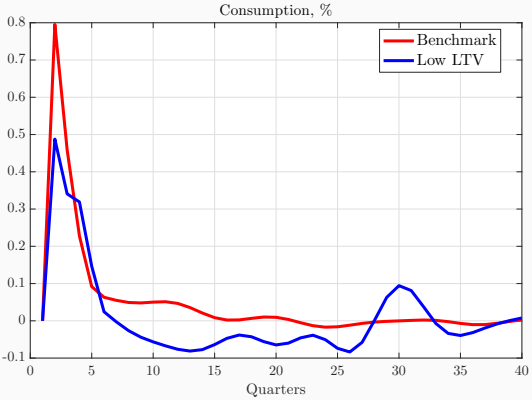
Additional Slides

Monetary policy in a low-LTV economy

How does the LTV distribution affect the effectiveness of monetary policy?

- LTV distribution moves for various reasons (housing cycles).
- Is monetary policy more or less effective in times, where there is less mortgage debt?
- Simple experiment to answer this question
  - decrease the LTV limit exogenously to 80%
  - expansionary policy

Consumption



- Monetary policy less effective in a low LTV economy.

House prices and foreclosures