Housing Market Spillovers: Evidence from an Estimated DSGE Model

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- Two questions:

1. What is the nature of the shocks hitting the housing market?
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  - financing frictions on the household side.

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  - Patient Households work, consume, buy homes, rent capital and land to firms and lend to impatient households
  - Impatient/Credit Constrained Households work, consume, buy homes and borrow against the value of their home
    (We set up preferences in a way that the borrowing constraint is binding)

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- Central bank runs monetary policy
- Real rigidities: habits in C, imperfect labor mobility, K adjustment costs, variabile K utilization

FIRMS

- Firms maximize profits:

$$\frac{Y_t}{X_t} + q_t IH_t - \left(\begin{array}{c} \sum w_{it} n_{it} + R_{ct} z_{ct} k_{ct-1} \\ + R_{ht} z_{ht} k_{ht-1} + p_{bt} k_{bt} + R_{lt} l_{t-1} \end{array} \right)$$

$$Y_t = \left(A_{ct} \left(n_{ct}^{\alpha} n_{ct}'^{1-\alpha} \right) \right)^{1-\mu_c} \left(z_{ct} k_{ct-1} \right)^{\mu_c}$$

$$IH_t = \left(A_{ht} \left(n_{ht}^{\alpha} n_{ht}'^{1-\alpha} \right) \right)^{1-\mu_h-\mu_b-\mu_l} \left(z_{ht} k_{ht-1} \right)^{\mu_h} k_{bt}^{\mu_b} l_{t-1}^{\mu_l}.$$

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q_t : price of new housing relative to consumption

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- Y_t :sticky price sector, IH_t flex price sector

UNCONSTRAINED HOUSEHOLDS (Lenders)

$$\max E_0 \sum_{t=0}^{\infty} (\beta G_C)^t z_t \begin{pmatrix} \log(c_t - \varepsilon g_C c_{t-1}) + j_t \log h_t \\ -\frac{\tau_t}{1+\eta}\left(n_{ct}^{1+\xi} + n_{ht}^{1+\xi}\right)^{\frac{1+\eta}{1+\xi}} \end{pmatrix}$$

- subject to budget constraint:

$$c_t + \frac{k_{ct}}{A_{kt}} + k_{ht} + q_t\left(h_t - (1-\delta_h)h_{t-1}\right) + b'_t$$

$$= \widetilde{R}_{ct} k_{ct-1} + \widetilde{R}_{ht} k_{ht-1} + R_{lt} l_{t-1} + Div_t + \frac{w_{ct}}{X_{wct}} n_{ct} + \frac{w_{ht}}{X_{wht}} n_{ht} + \frac{R_{t-1} b'_{t-1}}{\pi_t}$$

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- Discount future more heavily ($\beta' < \beta$)

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- subject to budget constraint

$$c'_t + q_t\left(h'_t - (1-\delta_h)\, h'_{t-1}\right) = \frac{w'_{ct}}{X'_{wct}} n'_{ct} + \frac{w'_{ht}}{X'_{wht}} n'_{ht} + b'_t - \frac{R_{t-1}}{\pi_t} b'_{t-1}$$

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- and to borrowing constraint

$$b'_t \leq m E_t\left(q_{t+1} h'_t \pi_{t+1} / R_t\right)$$

m : loan-to-value ratio

MONETARY POLICY

$$R_t = (R_{t-1})^{r_R} \left(\pi_t^{r_\pi} \left(\frac{GDP_t}{G_C\, GDP_{t-1}} \right)^{r_Y} \overline{rr} \right)^{1-r_R} \frac{u_{Rt}}{s_t}$$

u_{Rt} : iid monetary policy shock

s_t : highly persistent inflation objective shock

SHOCKS

- Stationary AR(1)
  z_t : preference (discount factor) shock
  j_t : housing demand shock (*or household technology shock*)
  τ_t : labor supply shock
  u_{Rt} : monetary shock (iid)
  s_t : inflation objective shock
  u_{pt} : markup/inflation shock (iid)
- Trend-stationary shocks

$$\begin{aligned}
\ln A_{ct} &= t \ln(1+\gamma_{AC}) + \ln Z_{ct}, \quad \ln Z_{ct} = \rho_{AC} \ln Z_{ct-1} + u_{Ct} \\
\ln A_{ht} &= t \ln(1+\gamma_{AH}) + \ln Z_{ht}, \quad \ln Z_{ht} = \rho_{AH} \ln Z_{ht-1} + u_{Ht} \\
\ln A_{kt} &= t \ln(1+\gamma_{AK}) + \ln Z_{kt}, \quad \ln Z_{kt} = \rho_{AK} \ln Z_{kt-1} + u_{Kt}
\end{aligned}$$

HOW DOES THE MODEL WORK?

1. At a basic level, it works like an RBC model with sticky prices/wages in the $Y-$sector, like an RBC with flex prices/sticky wages in the $IH-$sector (added twist: IH sector produces durables)
2. Sector specific shocks or preference shocks can shift resources from one sector to the other
3. Housing collateral generates wealth effects on consumption from fluctuations in housing values

ROLE OF TRENDS

1. Log preferences and Cobb-Douglas yield balanced growth
2. C and qIH grow at the same rate over time.
3. IK can grow faster than C, thanks to A_K progress
4. IH can grow slower than C, if land is a limiting factor and A_H is slow
5. Long-run growth rates

$$
\begin{aligned}
\frac{\Delta C}{C} &= \gamma_{AC} + \frac{\mu_c}{1-\mu_c}\gamma_{AK} \\
\frac{\Delta IK}{IK} &= \gamma_{AC} + \frac{1}{1-\mu_c}\gamma_{AK} \\
\frac{\Delta IH}{IH} &= (\mu_h + \mu_b)\gamma_{AC} + \frac{\mu_c(\mu_h + \mu_b)}{1-\mu_c}\gamma_{AK} + (1-\mu_h-\mu_I-\mu_b)\gamma_{AH} \\
\frac{\Delta q}{q} &= (1-\mu_h-\mu_b)\gamma_{AC} + \frac{\mu_c(1-\mu_h-\mu_b)}{1-\mu_c}\gamma_{AK} \\
&\quad -(1-\mu_h-\mu_I-\mu_b)\gamma_{AH}
\end{aligned}
$$

2. ESTIMATION

1. Use 10 time-series (1965Q1-2006Q4) for US
   logged raw series for C, IH, IK, q
   R, π, sectoral hours N_c and N_h, sectoral wages Δw_c and Δw_h

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   R, π, sectoral hours N_c and N_h, sectoral wages Δw_c and Δw_h
2. Some parameters calibrated to match steady state ratios
   $\beta = 0.9925$, $\beta' = 0.97$, $m = 0.85$
   $Y = N_c^{0.65} k_c^{0.35}$, $IH = N_h^{0.70} k_h^{0.10} k_b^{0.10} I^{0.10}$
   Targets: $(K + qH) / GDP = 3.2$, $(qH) / GDP = 1.35$,
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   $(\delta_h qH) / GDP = 0.06$
3. Other parameters (including degree of financing frictions) estimated by Bayesian techniques

3. RESULTS

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2. Wage share of credit constrained households $1 - \alpha$ =21 percent
3. High price rigidity ($\theta_{\pi} = 0.83$) and indexation ($\iota_{\pi} = 0.71$)
   High wage rigidity ($\theta_{wc} = 0.81, \theta_{wh} = 0.91$), low wage indexation ($\iota_{wc} = 0.07, \iota_{wh} = 0.42$)

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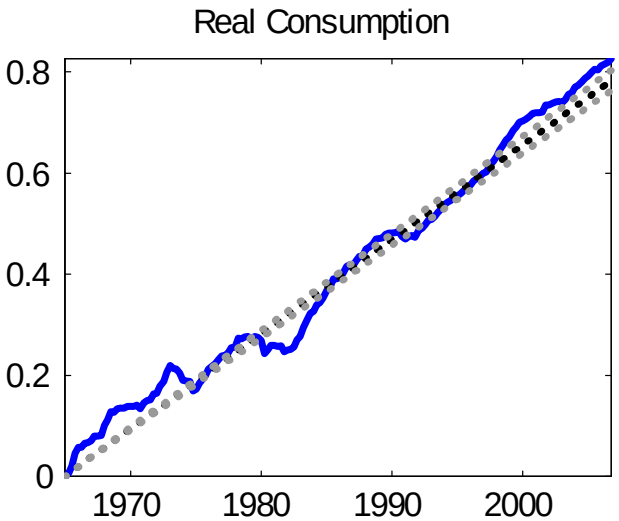
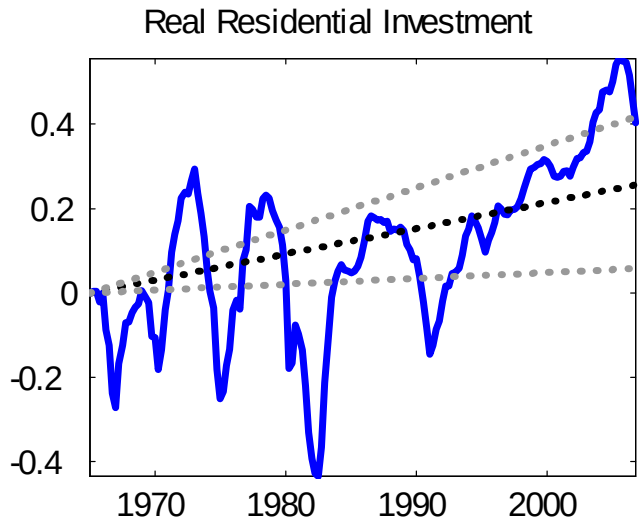
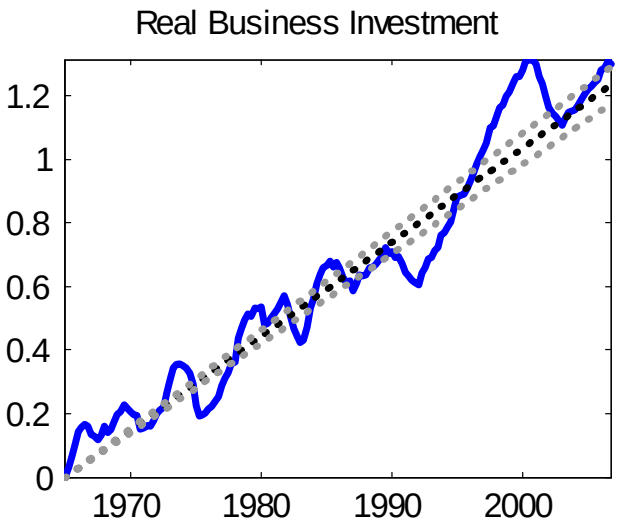
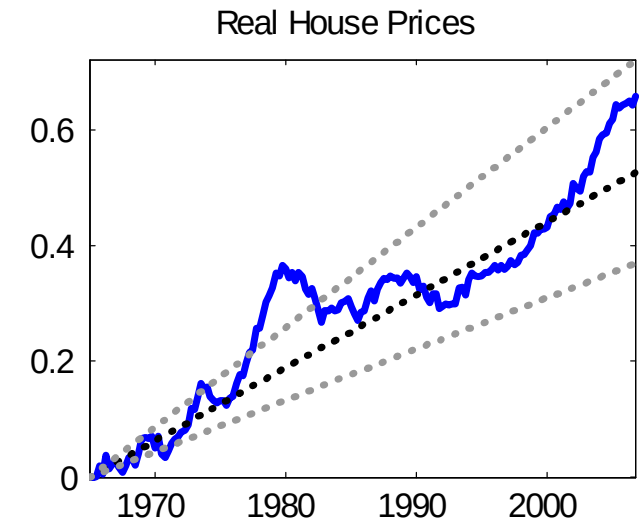
4. Taylor rule: $R_t = 0.61 R_{t-1} + 0.39 \left[1.38 \pi_t + 0.51 \left(gdp_t - gdp_{t-1}\right)\right]$

Variables and estimated trends





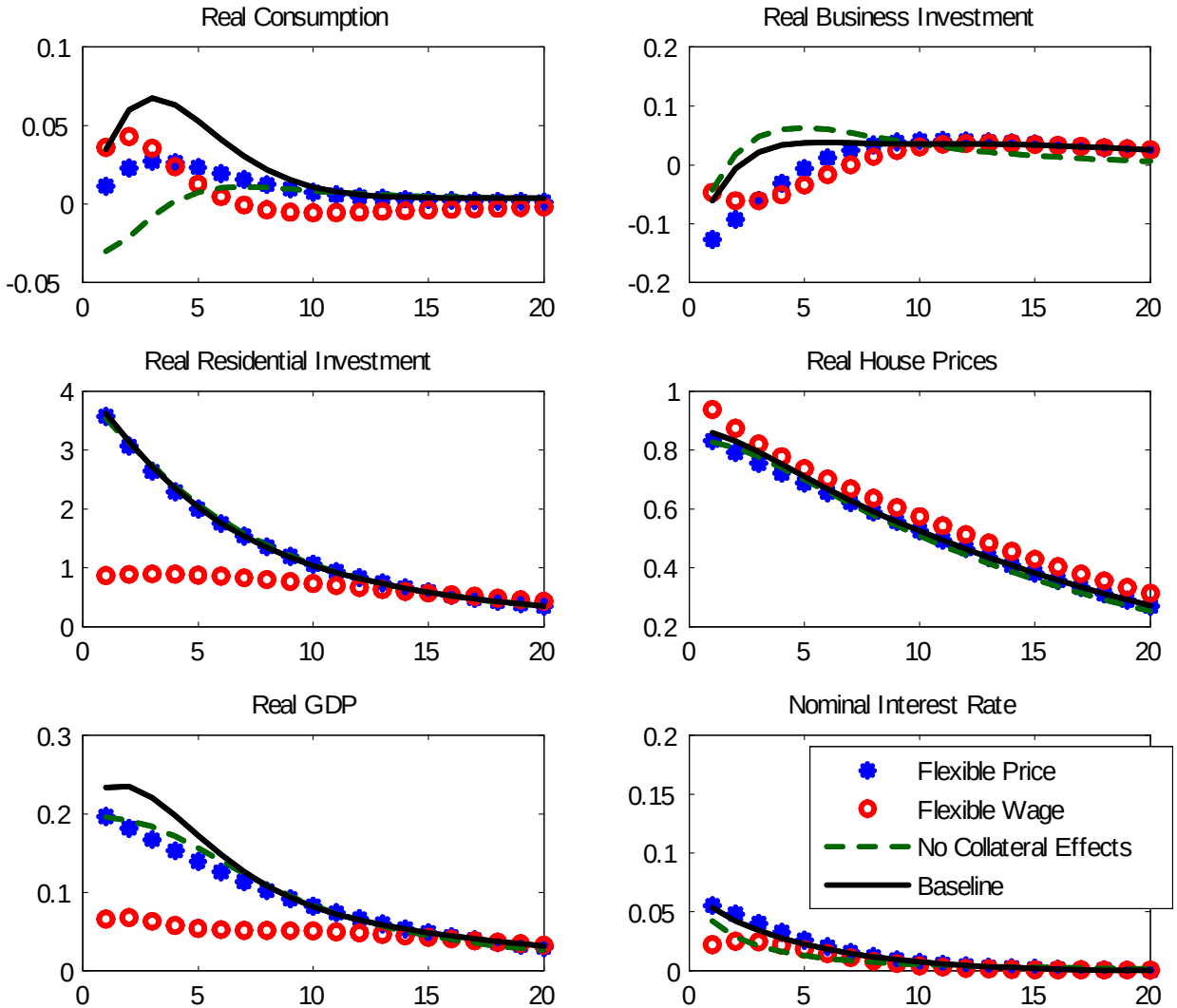




Variance Decomposition

Housing demand shocks and housing technology shocks account for one quarter each of the cyclical volatility of residential investment and house prices.
Monetary shocks account for between 15 and 20 percent

Impulse Responses, Housing Preference Shocks



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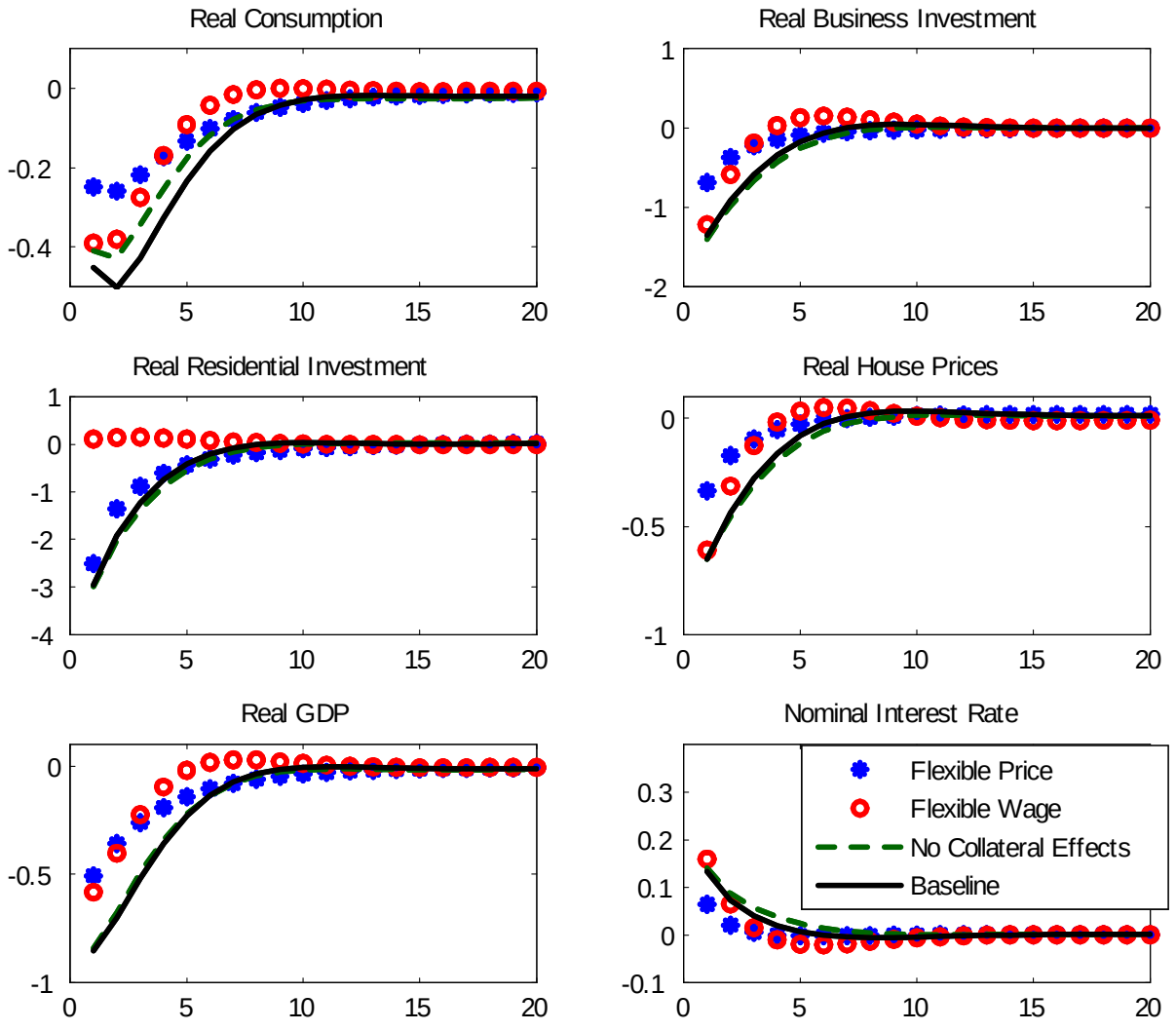

Role of Monetary Shocks

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   If IH sector were flex wage, flex price, it would not contract after contractionary policy (BHK 2007)
3. Model elasticity of house prices to a monetary shocks of similar magnitude to what is found in VAR studies

Our two original questions, revisited.

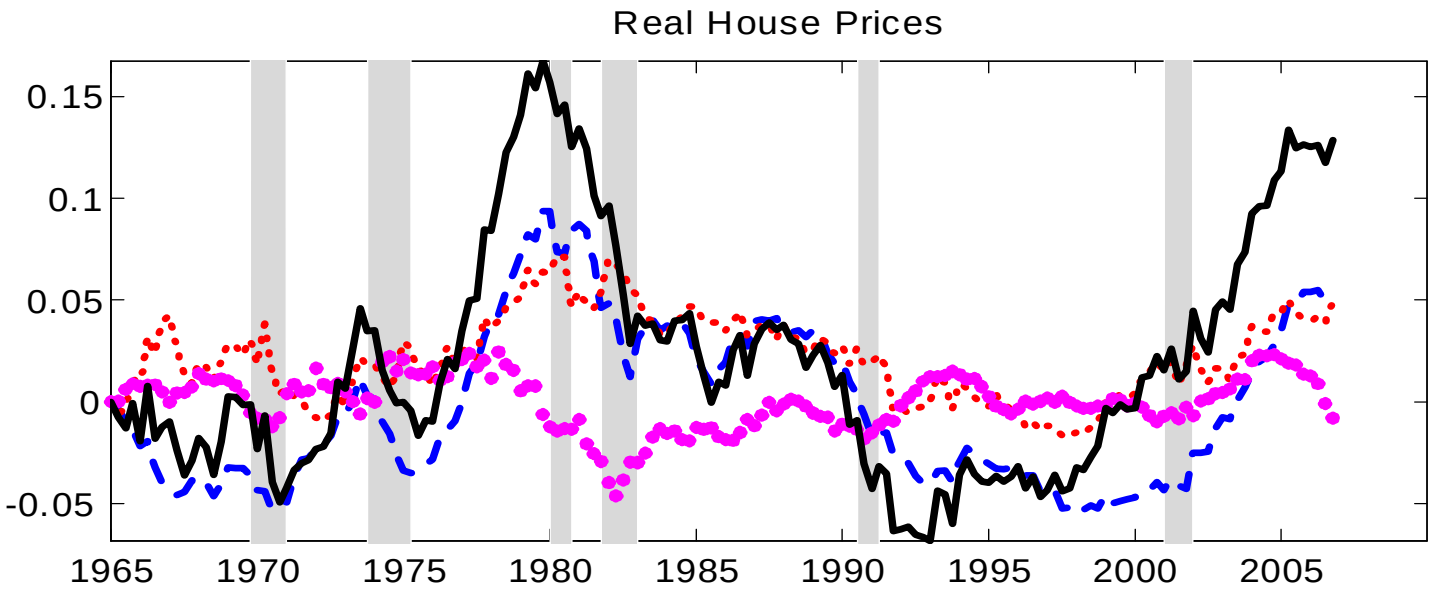
1. What drives the housing market? Focus on recent period.
2. How big are the spillovers? Focus on pre and post 1980's

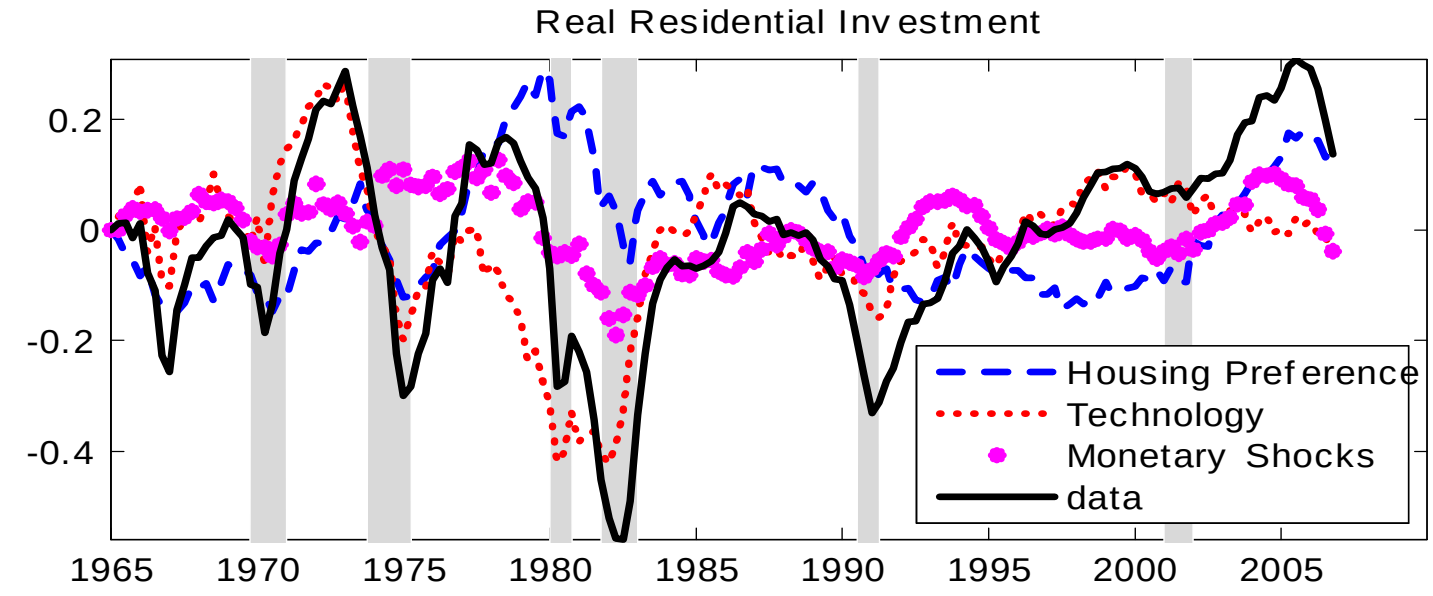
WHAT DRIVES THE HOUSING MARKET?

Focus on 2000-2006:

Period		% q	Technology	Monetary Pol.
1998:I	2005:I	14.1	5.9	2.1
2005:II	2006:IV	-0.3	-0.2	-2.7
		% IH		
1998:I	2005:I	22.2	-4.1	9.8
2005:II	2006:IV	-15.5	-4.3	-11.4

Comparison with 1976-1985 period: monetary policy has played a larger role here.


Real House Prices
0.15
0.1
0.05
0
-0.05
1965
1970
1975
1980
1985
1990
1995
2000
2005


Real Residential Investment
0.2
0
-0.2
-0.4
1965
1970
1975
1980
1985
1990
1995
2000
2005
Housing Preference
Technology
Monetary Shocks
data

HOW BIG ARE THE SPILLOVERS?

- Most of the spillovers are through the effect on consumption.
  For given LTV m, they are a function of α.
  Regression based on artificial data generated by the model

$$\begin{aligned}\Delta \log C_t &= 0.0041 + 0.123 \Delta \log HW_{t-1} \text{ if } \alpha = 0.79 \\ \Delta \log C_t &= 0.0041 + 0.099 \Delta \log HW_{t-1} \text{ if } \alpha = 1\end{aligned}$$

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- To better measure spillovers in sample, we re-estimate the model across subsamples (1965-1982, 1989-2006).
  First period: fix $m = 0.775$, $1 - \widehat{\alpha} = 0.33$
  Second period: fix $m = 0.925$, $1 - \widehat{\alpha} = 0.21$

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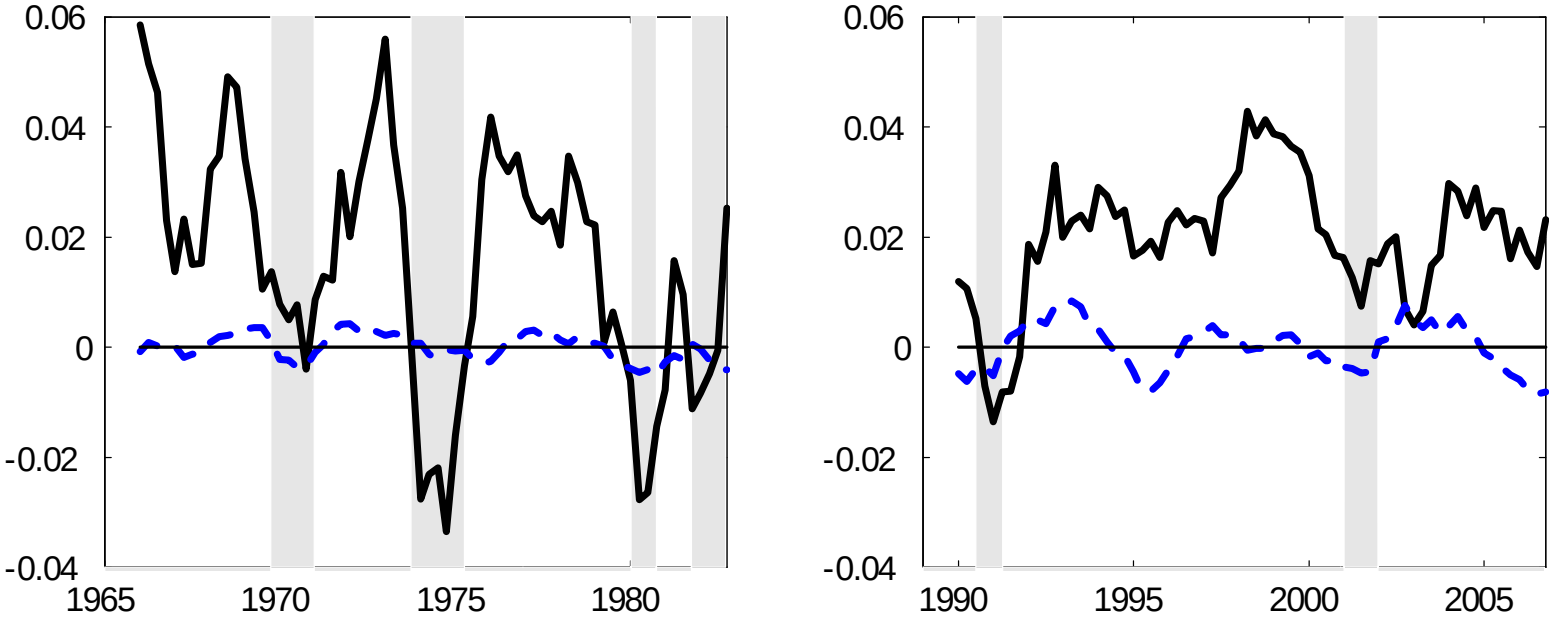
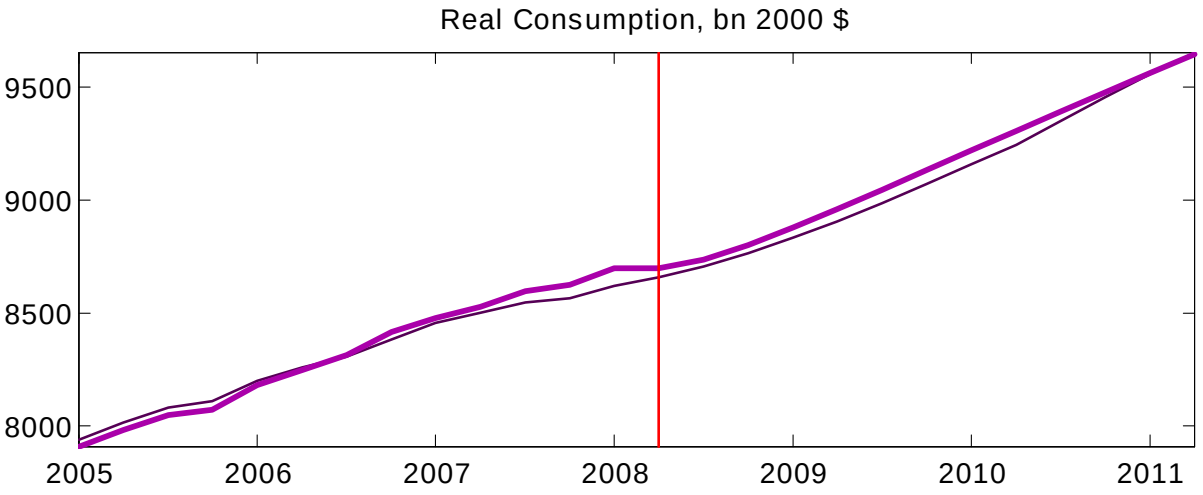
- Two implications
  Monetary policy is more "powerful" in the second period
  Housing shocks have larger spillover effects on consumption in the second period

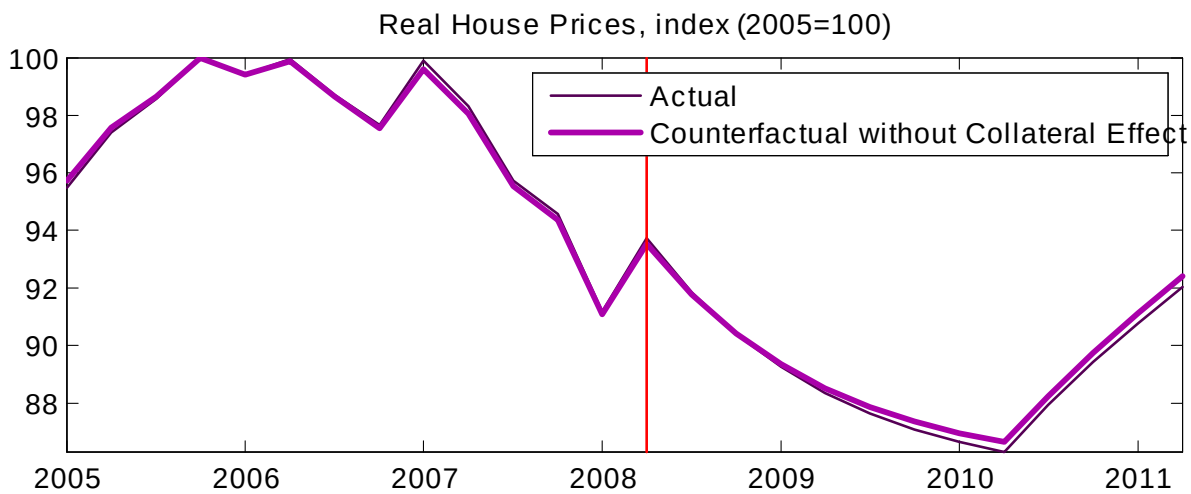


Variance of yoy ΔC explained by collateral effects in

1965-1982: 4 percent 1989-2006: 12 percent

Doomsday scenario: what if the drop in house prices continues?
Based on estimates up to 2008Q2
(Assuming a further decline in house prices over the next two years)





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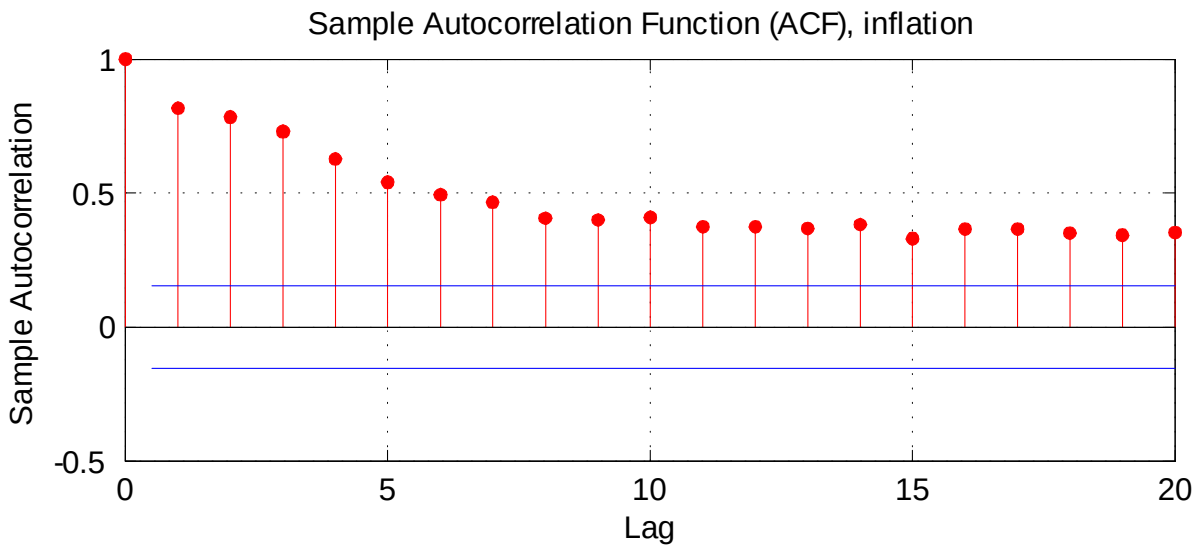
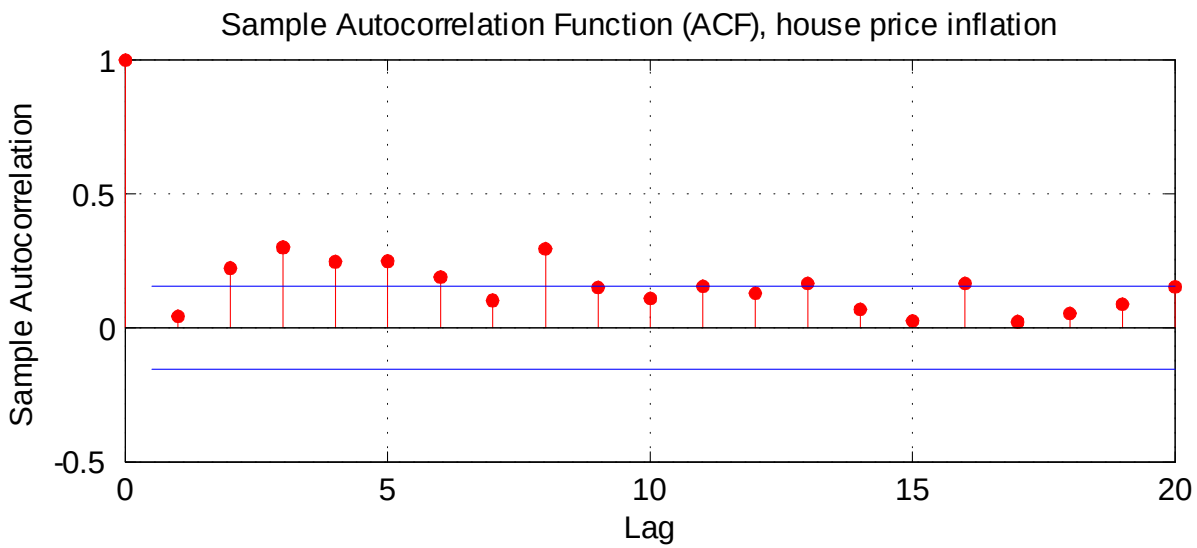
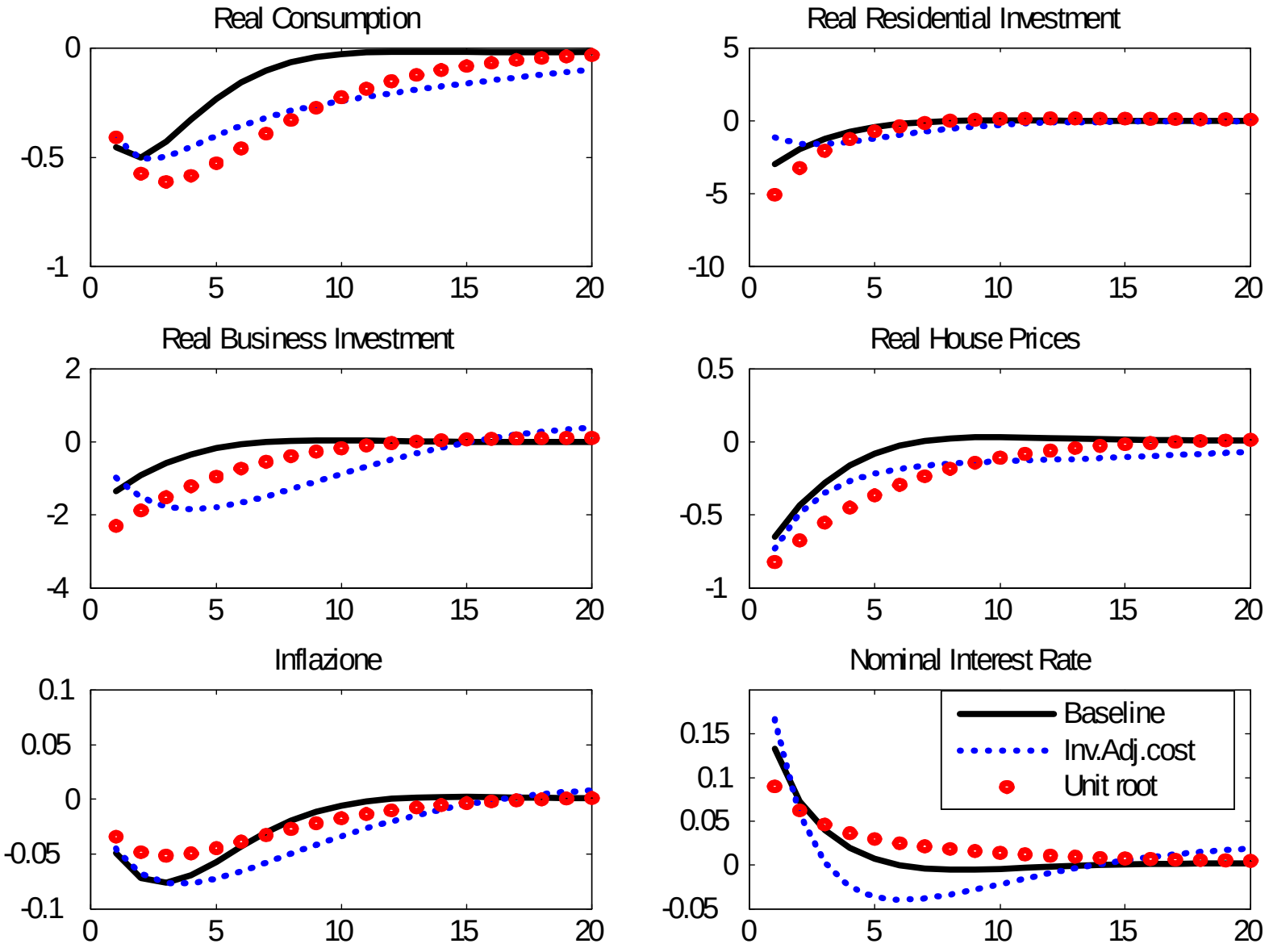
- Spillovers from the housing market to the broader economy are non-negligible and concentrated on consumption rather than business investment
- These spillovers might have become more important over time, to the extent that financial innovation has increased the marginal availability of funds for credit-constrained agents

Autocorrelations





Alternative model versions



Inflation and housing