HOUSING MARKET CYCLES, PRODUCTIVITY GROWTH, AND HOUSEHOLD DEBT

Dmitry Brizhatyuk

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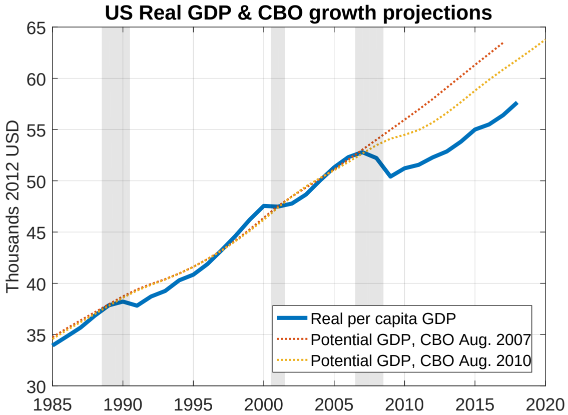
Slow recoveries from financial crises



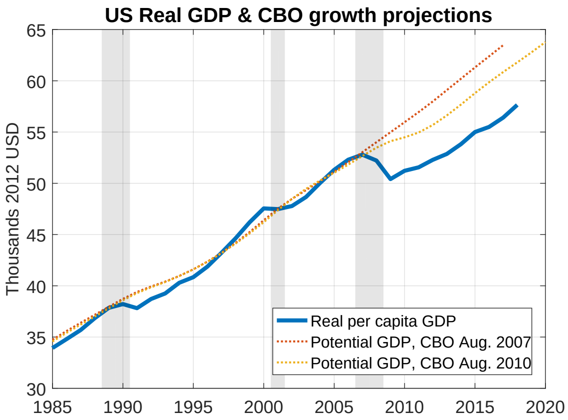
Recoveries from financial crises tend to be slow and incomplete

(e.g. Cerra and Saxena 2008; Reinhart and Rogoff 2009; Romer and Romer 2017)

A growing literature on **hysteresis**

(e.g. Benigno and Fornaro 2018; Comin and Gertler 2006; Queralto 2019)

Slow recoveries from financial crises



Big question: under what conditions hysteresis effects are most prominent?

Focus of this paper: the role of housing market and household debt cycles

Empirical evidence and a dynamic general equilibrium model

Intuition

Negative house price shock → household deleveraging

- AD-driven contraction in the short-run
- Endogenous fall in growth and a persistently lower TFP level in the long run

- Amplification through a feedback loop b/w deleveraging, house price, and growth
- Sensitivity to the initial level of household debt
- Asymmetry (positive vs negative house price shocks)

Empirical evidence

Housing market boom-and-bust cycles predict lower future productivity growth

(A) Unbalanced panel of 50 countries, 1950 - 2018:

- House price indexes
- Household debt
- Real economy indicators
- Utilization-adjusted TFP (constructed using the Imbs (1999) correction)

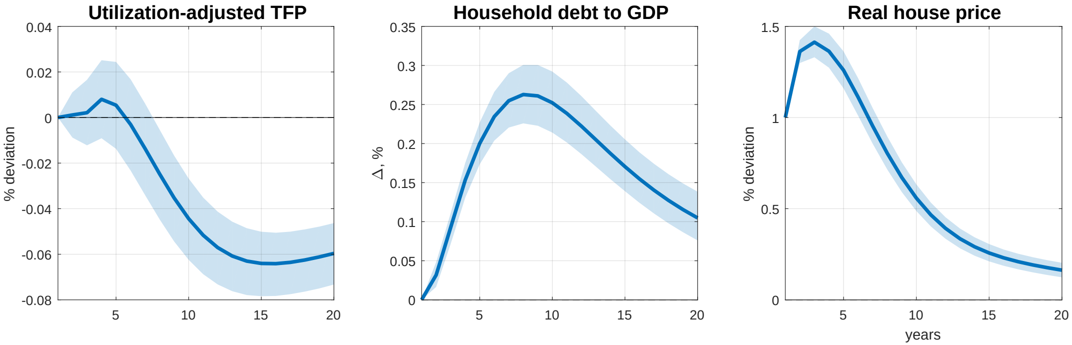
Two experiments:

- House price shock in a panel VAR
- Event study of housing market crashes by local projections

(B) Cross-section of US MSAs since the Great Recession

House price shock in a panel VAR

Panel VAR in levels, Cholesky identification, house price ordered last:



A rise in house prices and household debt predicts lower TFP growth in the medium run

Event study of housing market crashes

63 housing market boom-and-bust events List

Elasticities of macroeconomic variables to the house price decline during the crash:

$$\Delta_h y_{i,t+h} = \alpha_i^h + \alpha_t^h + \boldsymbol{\beta}^h \Delta p_{i,t}^{\text{crash}} + X_{i,t}' \Gamma^h + \varepsilon_{it}^h$$

$\Delta_h y_{i,t+h} = \log(Y_{i,t+h}) - \log(Y_{i,t})$, country i

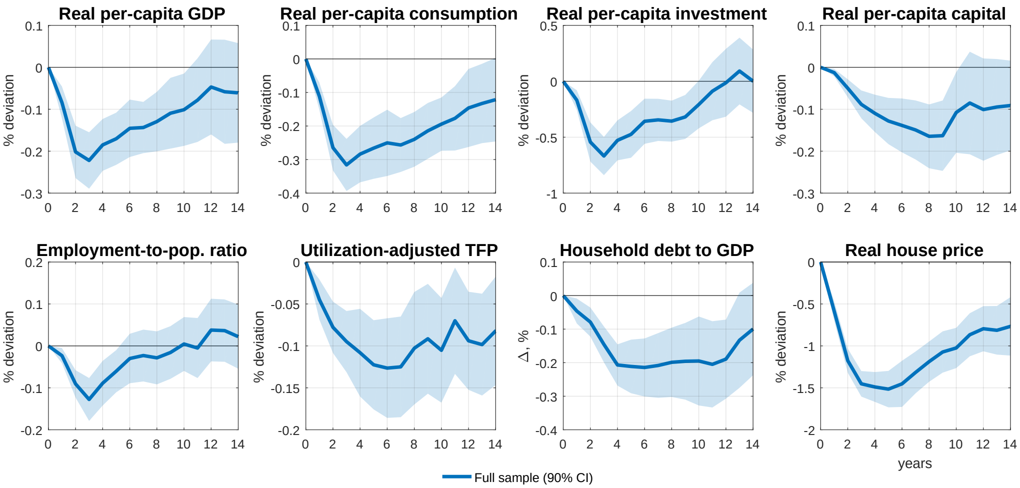
$\Delta p_{i,t}^{\text{crash}}$ – housing crash measure (3-year price decline from the peak)

α_i^h, α_t^h – country and year fixed effects

$X_{i,t}$ – vector of controls List

H-period response: $\{\boldsymbol{\beta}^h\}_{h=1:H}$

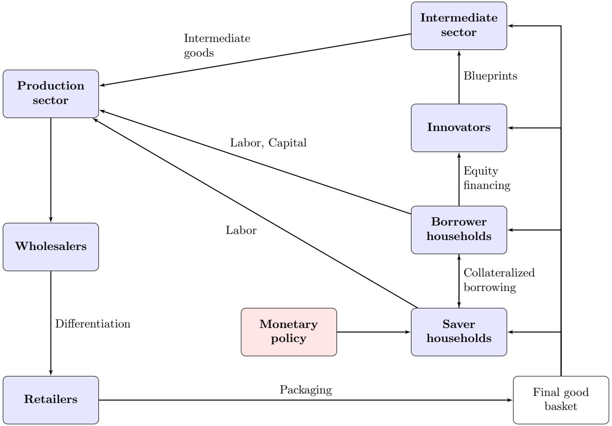
Event study of housing market crashes



Deleveraging → persistent decrease in TFP and capital driving persistence

Pre-2007 sample

General equilibrium model



- Borrower-saver NK model
- Housing as collateral (Iacoviello 2005)
- Borrowing subject to an occasionally binding constraint
- Endogenous growth through product creation (Romer 1990)
- **Experiment:** a housing market crash triggered by negative housing demand shocks (Liu et al. 2013)

Endogenous growth through innovation

Aggregate production function: $Y_t = F\Big(\underbrace{K_t,\ L_t}_{\text{Rival factors}},\ \underbrace{\int_0^{N_t} x_t(\omega) d\omega}_{\text{Non-rival "ideas"}} \Big)$

New "ideas" through innovation (S): $\dot{N}_t = \phi_t S_t^{\rho}$

Positive externality in innovation: $\phi_t = \phi N_t$ (generates growth)

Monopolistic competition: $x_t(\omega)$ are imperfectly substitutable $\rightarrow$ positive profit $\rightarrow$ entry subject to a sunk cost

Connection to business cycles: Entry incentives depend on cyclical conditions

Housing as collateral

$$\max \quad \mathbb{E}_t \sum_{j=t}^{\infty} \beta^{j-t} [u(C_j, L_j) + \underbrace{\eta_j g(h_j^B)}_{\text{Utility from housing}}]$$

Budget constraint: $\quad C_t + P_t^h(h_t - h_{t-1}) + (1 + r_{t-1})\frac{B_{t-1}}{P_t} = \frac{B_t}{P_t} + \text{other terms}$

Occasionally binding collateral constraint: $\quad B_t \leq \underbrace{mP_t^h h_t}_{\text{Fraction of housing value}}$

$$\mathbb{E}_t \left(\beta \frac{u'_{c_{t+1}}}{u'_{c_t}} \frac{1+r_t}{\Pi_{t+1}}\right) = \underbrace{1 - \chi_t}_{\text{Intertemporal distortion}}$$

$\chi_t \geq 0 \equiv$ Lagrange multiplier w.r.t. the collateral constraint

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The rest of the model includes standard quantitative NK features: nominal rigidities, capital accumulation subject to adjustment costs, varying capital utilization, etc.

IRF matching

Crisis experiment: a sequence of negative housing preference shocks to mimic the empirical housing price decline

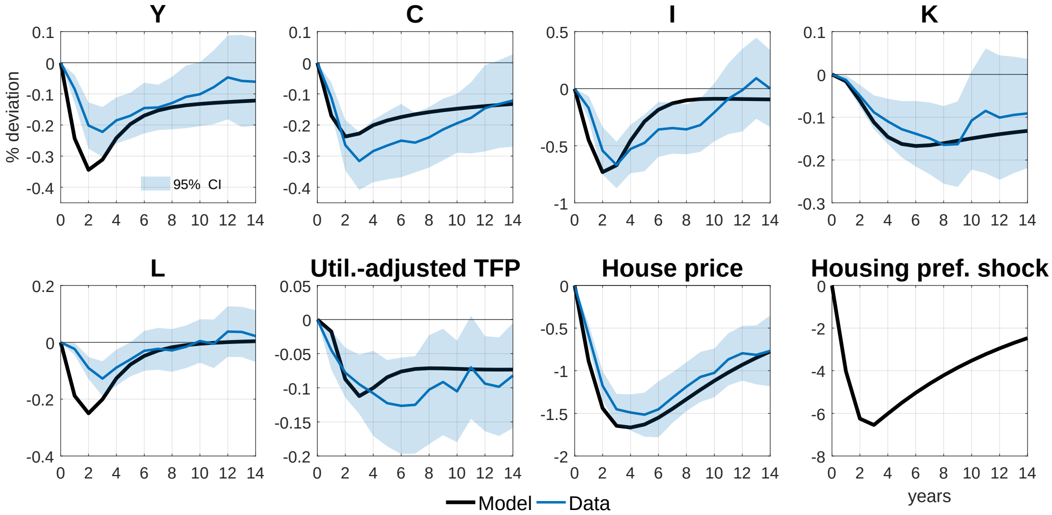
The resulting theoretical IRFs are used to estimate a set of quantitative parameters P

IRF matching estimator: choose P to minimize the weighted distance between empirical (Σ^{LP}) and theoretical (Σ^{DSGE}) impulse responses:

$$\min_{P} \;(\Sigma^{DSGE}(P) - \Sigma^{LP})\; \Omega^{-1}\; (\Sigma^{DSGE}(P) - \Sigma^{LP})'$$

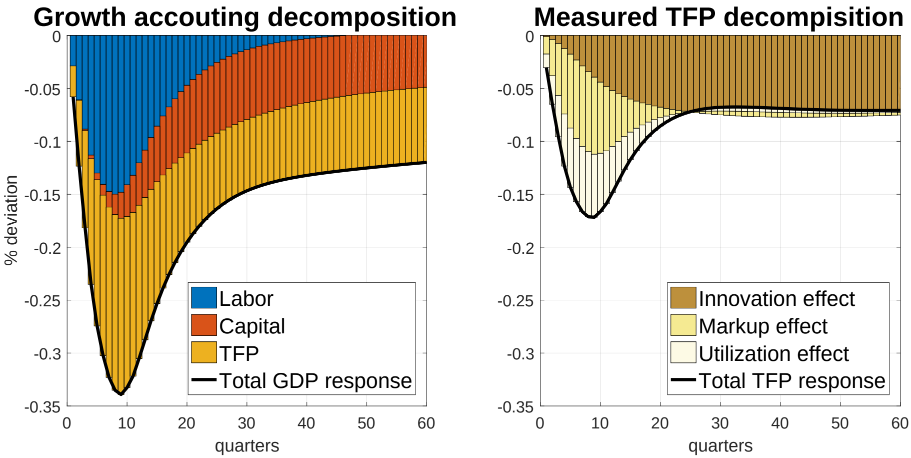
Quantitative parameters: Capital adjustment costs (ψ_K); R&D adjustment costs (ψ_N); Borrowing limit inertia (ρ_b); Labor disutility inertia (γ), Capital utilization parameter (c_2)

Housing market crash: model vs evidence



More IRFs

Model-based decomposition of output and TFP dynamics

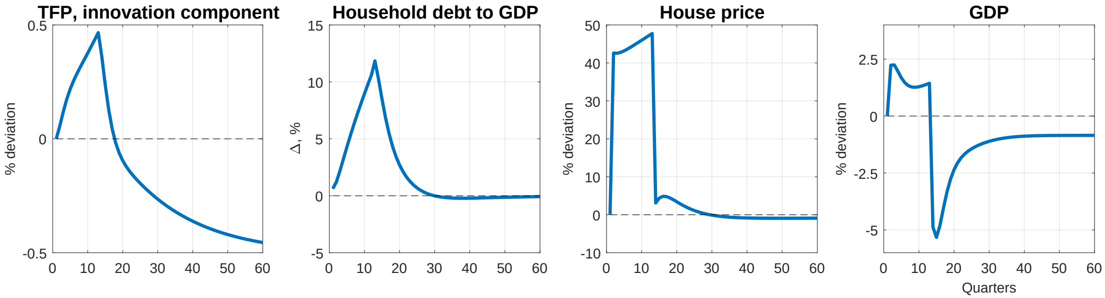


$$\Delta \text{GDP}_t = \Delta \text{TFP}_t + \underbrace{\alpha \Delta K_t}_{\text{Capital}} + \underbrace{(1-\alpha)\Delta L_t}_{\text{Labor}}$$

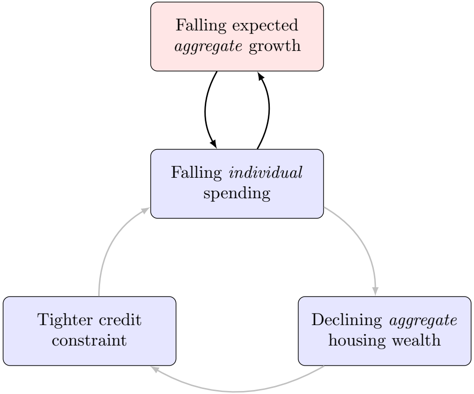
$$\Delta \text{TFP}_t = \underbrace{\Delta \Omega_t}_{\text{Markup}} + \underbrace{\alpha \Delta u_t}_{\text{Utilization}} + \underbrace{(1-\alpha)\Delta N_t}_{\text{Innovation}}$$

Asymmetric belief-driven boom and bust cycle

- Housing cycles driven by beliefs about future demand (Kaplan, Mitman, Violante 2020)
- Asymmetry is driven by occasionally binding collateral constants that amplify negative but not positive shocks
- **Example:** unrealized positive housing demand news shock about t=12:



Housing market crash: main channels



(1) **AD channel** Flex price IRFs Binding ZLB IRFs

Demand effects of deleveraging

(2) **Productivity growth channel** No growth IRFs

Endogenous slowdown in TFP growth prolonging the crisis

(3) **Fisherian debt deflation channel** Housing IRFs

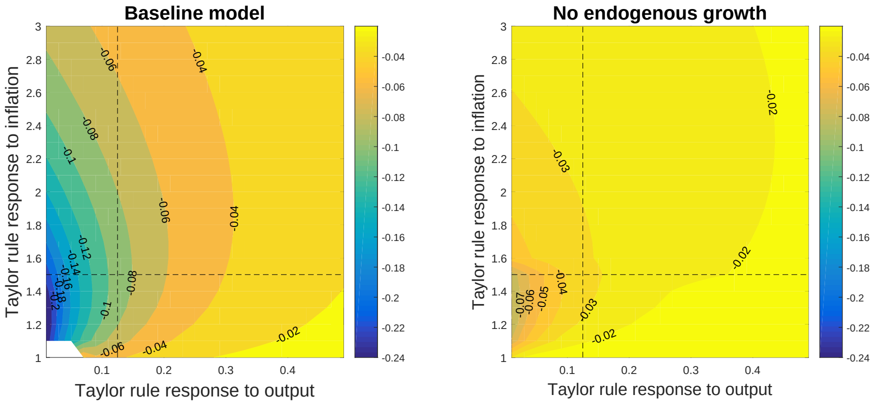
Negative feedback loop between deleveraging and the collateral price

(4) **Expected income growth channel**

Negative feedback loop between expected growth and consumption

Monetary policy and the the welfare cost of the crisis

- Counterfactual simulations under various parameters of the Taylor rule
- Welfare cost in % of the steady-state consumption



Conclusion

Housing market crashes are transitory events but they can leave long-lasting scars on economic activity...

- ...especially in the economy with a high household debt burden
- ...especially when monetary policy focuses on inflation stabilization relative to output stabilization and/or is constrained by the zero lower bound
- occasionally binding collateral constants make these effects asymmetric: housing market booms do not induce comparable increases in productivity growth

Appendix

Utilization-adjusted TFP

Utilization adjustment approach of Imbs (1999) based on a partial-equilibrium version of a model from Burnside and Eichenbaum (1996)

Firms problem:

$$\max_{K_t, u_t, e_t} \left[Z_t (u_t K_t)^{\alpha} (e_t L_t)^{1-\alpha} - w(e_t) L_t - (r_t + \delta u_t^{\phi}) K_t \right]$$

Households problem:

$$\max_{\{C_{t+j}, L_{t+j}, e_{t+j}\}_{j=0}^{\infty}} \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \left(\ln(C_t) - \frac{L_t^{1+\epsilon}}{1+\epsilon} - \frac{e_t^{1+\psi}}{1+\psi} \right) \quad \text{s.t. } C_t \leq w(e_t) L_t$$

Capital utilization: $u_t = \left(\frac{Y_t / K_t}{Y / K} \right)^{\frac{\delta}{r+\delta}}$ **Labor effort:** $e_t = \left(\frac{Y_t / C_t}{Y / C} \right)^{\frac{1}{1+\psi}}$

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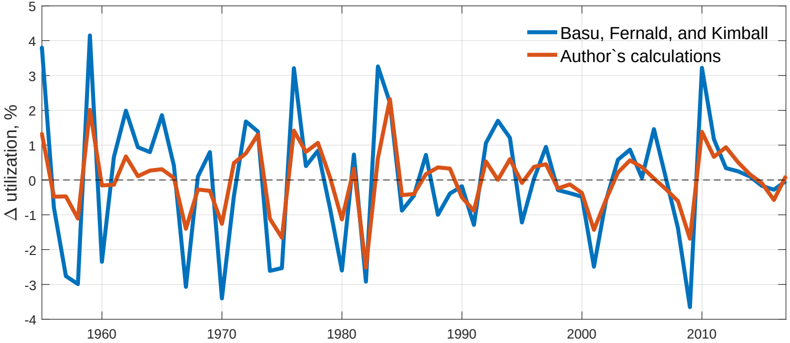
US factor utilization



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Event study: sample of housing market crashes

	Peak	Trough	3 years	Total		Peak	Trough	3 years	Total		Peak	Trough	3 years	Total
BEL	1979	1985	-26%	-38%	GBR	1973	1977	-24%	-29%	NLD	1978	1985	-34%	-48%
BGR	1996	2002	-40%	-52%	GBR	1989	1996	-22%	-30%	NLD	2008	2013	-11%	-26%
BGR	2008	2013	-39%	-44%	GBR	2007	2012	-16%	-23%	NOR	1987	1992	-29%	-43%
BRA	2014	2017	-16%	-16%	GRC	2007	2017	-15%	-45%	NZL	1974	1980	-18%	-36%
CAN	1981	1985	-26%	-30%	HKG	1981	1984	-47%	-47%	NZL	2007	2009	-11%	-11%
CHE	1973	1976	-20%	-20%	HKG	1997	2003	-42%	-57%	PER	1999	2003	-15%	-29%
CHE	1990	2000	-20%	-33%	HRV	1999	2002	-14%	-14%	PHL	1996	2004	-36%	-53%
CHE	1959	1961	-12%	-12%	HRV	2009	2015	-19%	-24%	POL	2010	2013	-16%	-16%
COL	1989	1992	-13%	-13%	HUN	2006	2013	-17%	-37%	PRT	1992	1996	-11%	-12%
COL	1995	2003	-14%	-35%	IRL	2006	2012	-30%	-46%	RUS	2008	2011	-33%	-33%
CZE	2008	2013	-15%	-19%	ISL	2007	2010	-32%	-32%	SGP	1983	1986	-31%	-31%
DEU	1981	1987	-11%	-14%	ITA	1981	1986	-21%	-31%	SGP	1996	1998	-32%	-34%
DNK	1979	1982	-34%	-34%	ITA	1992	1997	-14%	-26%	SRB	2010	2013	-29%	-29%
DNK	1986	1993	-18%	-31%	JPN	1974	1977	-23%	-23%	SVK	2008	2012	-21%	-26%
DNK	2007	2012	-19%	-28%	JPN	1991	2012	-13%	-51%	SVN	2011	2014	-21%	-21%
ESP	1991	1996	-13%	-15%	KOR	1991	1998	-25%	-43%	SWE	1979	1985	-26%	-35%
ESP	2007	2014	-15%	-36%	LTU	2007	2010	-43%	-43%	SWE	1990	1993	-30%	-30%
EST	2007	2009	-51%	-52%	LUX	1980	1984	-22%	-23%	THA	2006	2009	-30%	-30%
FIN	1974	1979	-25%	-31%	LVA	2007	2010	-47%	-47%	USA	2006	2012	-14%	-26%
FIN	1989	1993	-42%	-47%	MYS	1997	1999	-15%	-18%	ZAF	1984	1987	-39%	-39%
FRA	1980	1985	-11%	-16%	NLD	1964	1966	-27%	-29%	ZAF	2007	2012	-16%	-19%

- 63 events in total, 39 before 2006,
- Median duration: 5 years peak to though, -30.6% price decline

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Local projections, control variables

Value at the peak and one lag:

- Growth rate of the response variable
- Real per-capita investment growth
- GDP-deflator inflation rate
- Real house price growth rate
- Net exports to GDP

Value at the peak:

- Investment to GDP
- Exchange rate regime indicator (Ilzetzki et al. 2019)
- Systematic banking & currency crises indicator (Laeven and Valencia 2012)

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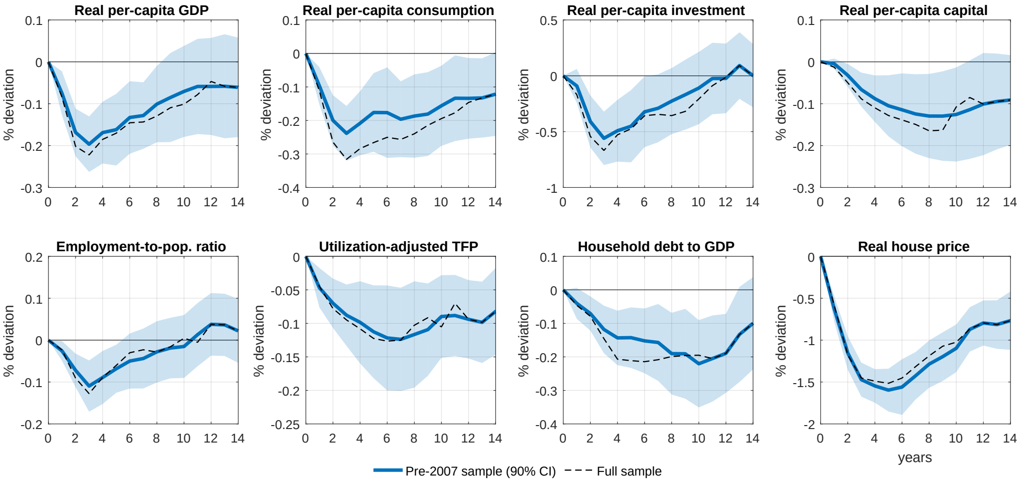
Event study of housing market crashes, pre-2007 sample



Baseline results are not driven by the GFC

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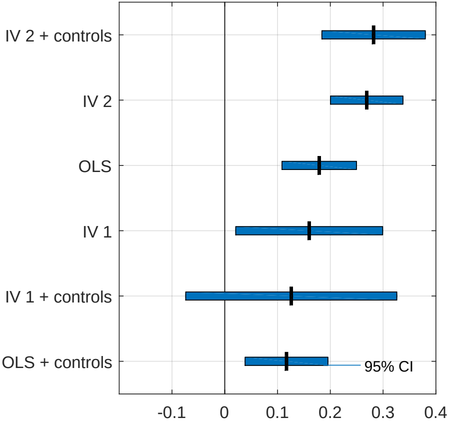
Housing market crash and productivity growth across US MSAs

Higher exposure to the crash, slower post-crisis labor productivity growth

Housing market crash and productivity growth across US MSAs

$$\Delta_{2017}^{2007} \log(Y/L)_i = \alpha + \eta \Delta_{2010}^{2007} \widehat{\log P_i^H} + X_i'\Gamma + \varepsilon_i$$



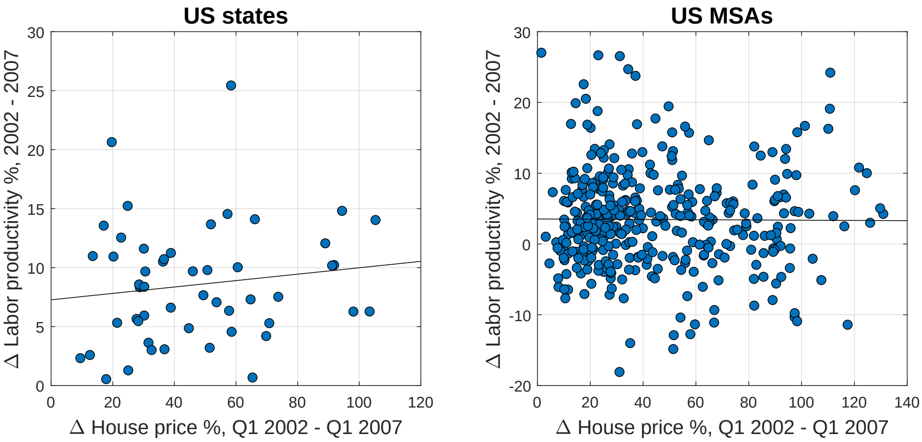
Higher exposure to the crash, slower labor productivity growth

Can explain >40% of the US GDP gap relative to the pre-GFC trend

Identification

- IV 1: housing supply elasticity
- IV 2: regional sensitivity

Housing market boom and productivity growth across US MSAs



No relation between the house price growth and productivity growth during the boom

Production sector, full problem

Production function: $F_t = Z_t \left(\tilde{K}_t^{\alpha} L_t^{1-\alpha} \right)^{1-\xi} \left(\int_0^{N_t} x_t(\omega)^{\frac{1}{\nu}} d\omega \right)^{\nu\xi}$

$$\max_{\{x_{t+j}(\omega), L_{t+j}, K_{t+j}\}_{j=0}^{\infty}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} \Lambda_{t,t+j}^{B} \left[p_t^F F_{t+j} - R_{t+j}^K \tilde{K}_{t+j} - W_{t+j} L_{t+j} - \int_0^{N_t} p_{t+j}^x(\omega) x_{t+j}(\omega) d\omega \right]$$

Labor demand: $W_t = p_t^F (1-\alpha)(1-\xi) \frac{F_t}{L_t}$

Capital demand: $R_t^K = p_t^F \alpha (1-\xi) \frac{F_t}{\tilde{K}_t}$

Intermediate-good demand: $p_t^x(\omega) = p_t^F \xi \frac{F_t}{X_t} x_t(\omega)^{\frac{1-\nu}{\nu}}$

Intermediate sector, full problem

$$\max_{p_t^x(\omega)} \left[(p_t^x(\omega) - A^{-1}) x_t(\omega) \right] \text{ s.t. } \qquad p_t^x(\omega) = p_t^F \xi \frac{F_t}{X_t} x_t(\omega)^{\frac{1-\nu}{\nu}}$$

Optimal relative price: $p_t^x = \nu \; A^{-1}$

Optimal quantity: $x_t = \left(\frac{A\xi}{\nu} \right)^{\frac{1}{1-\xi}} (p_t^F Z_t)^{\frac{1}{1-\xi}} N_t^{\frac{\nu\xi - 1}{1-\xi}} \tilde{K}_t^{\alpha} L_t^{1-\alpha}$

Real profit: $d_t = \frac{\nu - 1}{\nu} p_t^x x_t = \frac{\nu - 1}{A} x_t$

Innovators, full problem

Individual production function: $N^i_{et} = \phi^i_t S^i_t$ Aggregate productivity: $\phi_t = \phi \frac{N_t}{N^\rho_t S^{1-\rho}_t}$

$$\max_{\{S^i_{t+j}\}_{j=0}^{\infty}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} \Lambda^B_{t,t+j} \left(p^{i,b}_{t+j} \phi^i_{t+j} S^i_{t+j} - (1 + AC_{S,t+j}) S^i_{t+j} \right)$$

Optimal blueprint price: $$p^{i,b}_t = \frac{1}{\phi^i_t} \left(1 + AC_{S,t} + AC'_{S,t} S^i_t - \mathbb{E}_t \left(\Lambda^B_{t,t+1} AC'_{S,t+1} S^i_{t+1} \right) \right)$$

Downstream sectors: retailers and wholesalers, full problem

$$\max_{\{P(j)_{t+k}\}_{k=0}^{\infty}} \quad \mathbb{E}_t \sum_{k=0}^{\infty} \Lambda_{t,t+k} \left[\frac{P_{t+k}(j)}{P_t} Y_{t+k}(j) - \frac{P^F_{t+k}}{P_t} F_{t+k}(j) - AC_{p,k}(j) - \Gamma \right], \qquad \text{s.t}$$

Production fucntion: $\quad Y_t(j) = F_t(j)$

Retailers demand: $\quad Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\eta} Y_t$

Price adjustment cost: $\quad AC_{p,t}(j) = \frac{\psi_p}{2} \left(\frac{P_t(j)}{P_{t-1}(j)\Pi} - 1 \right)^2 Y_t$

$$P_t(j) = \mu_t P^F_t \qquad \mu_t = \frac{\eta}{(\eta - 1) + \psi_p \frac{\Pi_t}{\Pi} \left(\frac{\Pi_t}{\Pi} - 1 \right) - \psi_p \mathbb{E}_t \Lambda_{t,t+1} \left(\frac{\Pi_{t+1}}{\Pi} - 1 \right) \frac{\Pi_{t+1}}{\Pi} \frac{Y_{t+1}}{Y_t}}$$

Households: savers

$$\max_{\{C_j^S, L_j^S, h_j^S, B_{j+1}^S\}_{j=t}^{\infty}} \quad \mathbb{E}_t \sum_{j=t}^{\infty} \beta_S^{j-t} \left(u(C_j^S, L_j^S) + g(h_j^S) \right) \quad \text{s. t.}$$

Budget constraint: $$C_t^S + P_t^h \Delta h_t^S + (1 + r_{t-1}) \frac{B_t^S}{P_t} = W_t L_t^S + \frac{B_{t+1}^S}{P_t}$$

Households: borrowers

$$\max_{\{C_j^B, L_j^B, h_j^B, B_{j+1}^B, I_j, K_{j+1}, \iota_{j+1}, u_j\}_{j=t}^{\infty}} \mathbb{E}_t \sum_{j=t}^{\infty} \beta_B^{j-t} \left(u(C_j^B, L_j^B) + g(h_j^B) \right) \quad \text{s. t.}$$

Budget constraint: $$C_t^B + I_t + P_t^h \Delta h_t^B + (1 + r_{t-1}) \frac{B_t^B}{P_t} + \iota_{t+1} v_t (N_t + N_{et}) =$$
$$= \iota_t (v_t + d_t) N_t + W_t L_t^B + R_t^K K_t + \frac{B_{t+1}^B}{P_t}$$

Capital accumulation: $$K_{t+1} = (I_t - AC_{I,t}) + (1 - \delta_K(u_t)) K_t$$

Collateral constraint: $$B_t^B \leq \rho_B \frac{B_{t-1}^B}{\Pi_t} + (1 - \rho_B) m P_t^h h_t^B$$

Capital utilization: $$\delta_K(u_t) = \delta_K + c_1 (u_t - 1) + (c_2/2)(u_t - 1)^2$$

Calibration summary

	Calibrated parameters	Value	Source / target
β_S	Savers discount factor	0.9968	4% annual real interest rate
β_B	Borrowers discount factor	0.9918	$\beta_B = \beta_S - 0.005$
σ	Relative risk aversion	2	Conventional
$1/\epsilon_L$	Elasticity of labor supply	1	Conventional
$\nu/(\nu-1)$	Intermediate-good elasticity of subst.	1.6	BGP requirement $\xi(\nu-1)/(1-\xi) = 1-\alpha$
η	Retail-good elasticity of subst.	11	10% steady-state markup
$1/A$	Intermediate sector marginal cost	1	Normalization
ρ	R&D output elasticity	0.8	Comin and Gerlter (2006)
δ_N	Intermediate sector exit rate	0.025	Bilbiie et al. (2012)
ϕ_y ; ϕ_π ; ρ_r	Taylor rule: output; inflation: inertia	0.5/4; 1.5; 0.7	Conventional
$\bar{Z}$	Final sector productivity	1.74	Normalization, $Y^{GDP} = 1$
ψ_p	Price adjustment cost	120	4-quarter average Calvo price ridigity equivalent
$-1/\epsilon_h$	Elasticity of housing demand	-0.2	Hanushek and Quigley (1980)
m	Max leverage	0.75	Warnock and Warnock (2008)
α	Capital share	0.4	Data median, PWT 9.1
δ_K	Steady state capital depreciation	0.025	Conventional
ϕ	R&D productivity	0.11	Annual per-capita TFP growth = 0.8% (data median, PWT 9.1)
κ	Share of housing in utility	0.03	Mortgage debt to GDP = 0.55
ξ	Intermediate good share	0.5	Comin and Gertler (2006)

Utility function

GHH preference: $u(C_t^H, L_t^H) = \left(\left(C_t^H - \Upsilon_t (L_t^H)^{1+\epsilon_L}/(1+\epsilon_L) \right)^{1-\sigma} - 1 \right) /(1-\sigma)$

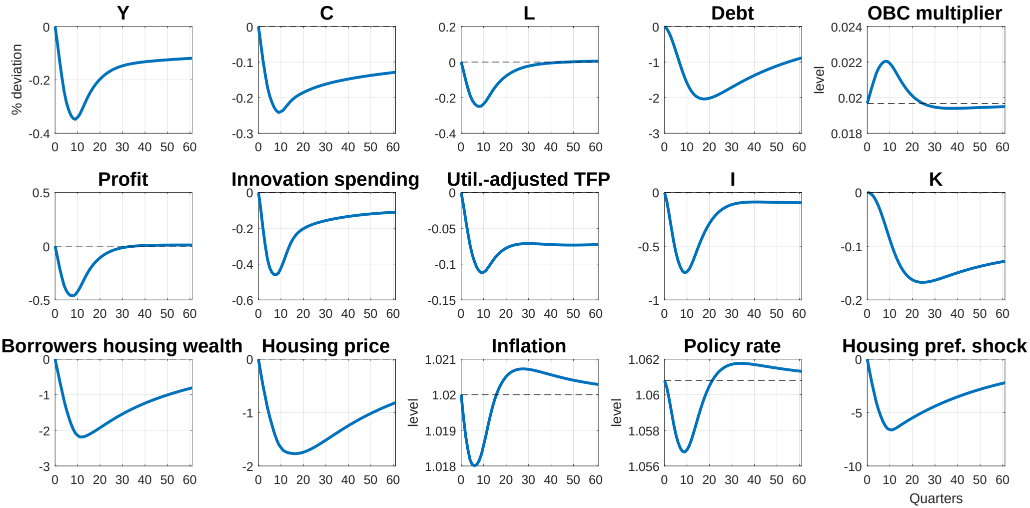
Housing utility: $g(h_t^H) = (h_t^H)^{1-\epsilon_h}/(1-\epsilon_h)$

Labor supply: $W_t = \Upsilon_t (L_t^H)^{\epsilon_L} \qquad \Upsilon_t = \Upsilon_{t-1}^{\gamma} N_t^{1-\gamma}$

Time-varying disutility of labor (Queralto 2019; Jaimovich and Rebelo 2009)

BGP with constant hours exists but the short-run effect of growth on labor supply is limited

Baseline simulation, extended set of impulse responses



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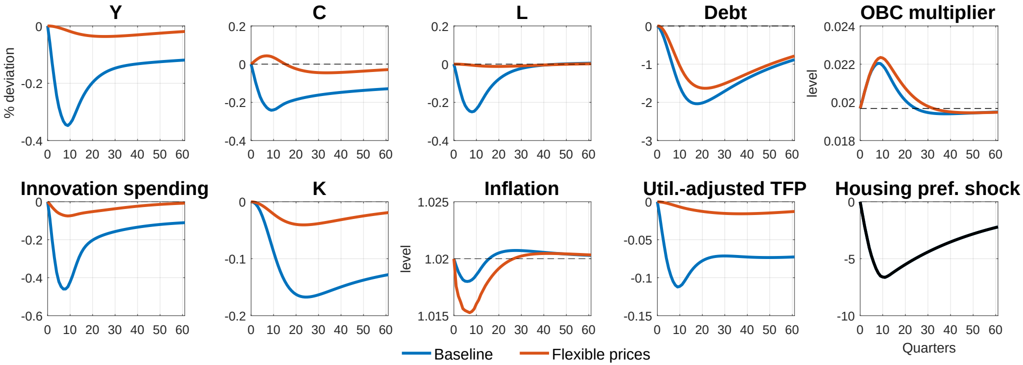
Aggregate demand channel: baseline vs flexible price economy



Nominal frictions matter

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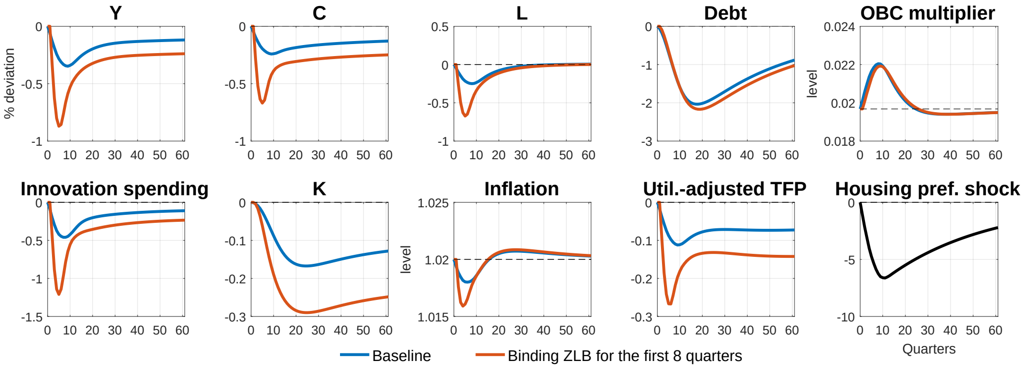
Aggregate demand channel: baseline vs binding ZLB



The amplification role of the binding zero lower bound constraint

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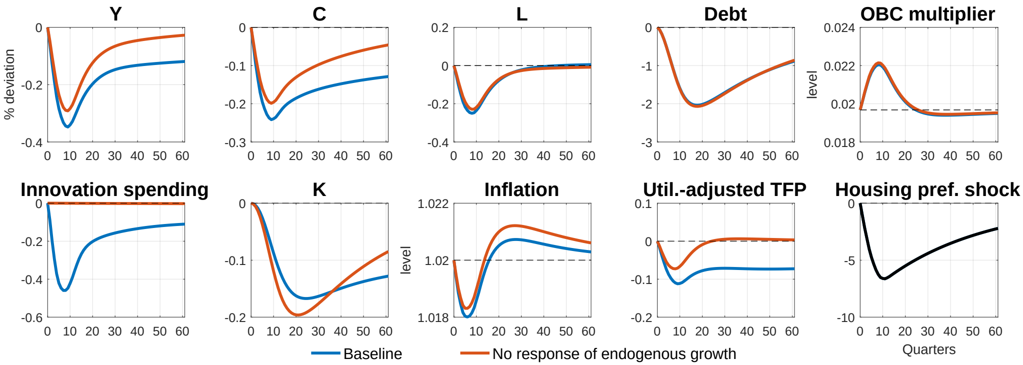
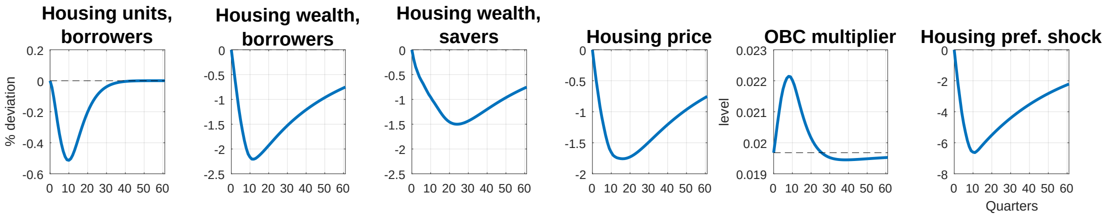
Productivity growth channel: baseline vs no growth response



Endogenous productivity growth is key for generating the empirically-relevant persistent response of TFP, consumption, and output Back

Fisherian debt deflation: details of the housing mrkt dynamics



- The aggregate shock has an asymmetric effect across borrowers and savers
- Credit-contained borrowers reduce their housing demand by more than savers
- GE effects amplify the fall in borrowers housing wealth and exacerbate deleveraging

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