HOUSING MARKET CYCLES, PRODUCTIVITY GROWTH, AND HOUSEHOLD DEBT

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June 3, 2021
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

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

$$\Delta_h y_{i,t+h} = \alpha^h_i + \alpha^h_t + \beta^h \Delta p^\text{crash}_{i,t} + X'_{i,t} \Gamma^h + \epsilon^h_{it}$$

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

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

$$\alpha^h_i, \alpha^h_t$$ – country and year fixed effects

$$X_{i,t}$$ – vector of controls

H-period response: \(\{\beta^h\}_{h=1:H}\)
Event study of housing market crashes

Deleveraging → persistent decrease in TFP and capital driving persistence
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:

\[ Y_t = F\left( K_t, L_t, \int_0^{N_t} x_t(\omega) d\omega \right) \]

New “ideas” through innovation (S):

\[ \dot{N}_t = \phi_t S_t^\rho \]

Positive externality in innovation:

\[ \phi_t = \phi N_t \quad \text{(generates growth)} \]

Monopolistic competition:

\[ x_t(\omega) \text{ are imperfectly substitutable} \rightarrow \text{positive profit} \rightarrow \text{entry subject to a sunk cost} \]

Connection to business cycles:

Entry incentives depend on cyclical conditions
Housing as collateral

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

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

Occasionally binding collateral constraint: 
$$B_t \leq \frac{m P_t^h h_t}{h_{t-1}}$$

$$\mathbb{E}_{t} \left( \beta \frac{u'_{ct+1}}{u'_c} \frac{1+r_t}{\Pi_{t+1}} \right) = \frac{1 - \chi_t}{1} \equiv \text{Lagrange multiplier w.r.t. the collateral constraint}$$

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 ($\Sigma^{LP}$) and theoretical ($\Sigma^{DSGE}$) impulse responses:

$$\min_P \left( \Sigma^{DSGE}(P) - \Sigma^{LP} \right) \Omega^{-1} \left( \Sigma^{DSGE}(P) - \Sigma^{LP} \right)'$$

**Quantitative parameters:** Capital adjustment costs ($\psi_K$); R&D adjustment costs ($\psi_N$); Borrowing limit inertia ($\rho_b$); Labor disutility inertia ($\gamma$), Capital utilization parameter ($c_2$)
Housing market crash: model vs evidence

% deviation

95% CI

Util.-adjusted TFP

House price

Housing pref. shock

More IRFs
Model-based decomposition of output and TFP dynamics

Growth accounting decomposition

\[ \Delta GDP_t = \Delta TFP_t + \alpha \Delta K_t + (1 - \alpha) \Delta L_t \]

- **Labor**
- **Capital**
- **TFP**
- **Total GDP response**

Measured TFP decomposition

\[ \Delta TFP_t = \Delta \Omega_t + \alpha \Delta u_t + (1 - \alpha) \Delta N_t \]

- **Innovation effect**
- **Markup effect**
- **Utilization effect**
- **Total TFP response**
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:

![Graphs showing TFP, household debt to GDP, house price, and GDP over time](image-url)
Housing market crash: main channels

(1) **AD channel**  
Demand effects of deleveraging

(2) **Productivity growth channel**  
Endogenous slowdown in TFP growth prolonging the crisis

(3) **Fisherman debt deflation channel**  
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 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:

$$\max_{\{C_{t+j}, L_{t+j}, e_{t+j}\}} \sum_{j=0}^{\infty} \beta^j \left( \ln(C_t) - \frac{L_t^{1+\epsilon}}{1+\epsilon} - \frac{e_t^{1+\psi}}{1+\psi} \right)$$

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: $e_t = \left( \frac{Y_t/C_t}{Y/C} \right)^{\frac{1}{1+\psi}}$
US factor utilization

Basu, Fernald, and Kimball
Author’s calculations

Back
## Event study: sample of housing market crashes

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- 63 events in total, 39 before 2006,
- Median duration: 5 years peak to though, -30.6% price decline
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)
Event study of housing market crashes, pre-2007 sample

Baseline results are not driven by the GFC
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

\[ \Delta_{2007}^{2017} \log \left( \frac{Y}{L} \right)_i = \alpha + \eta \Delta_{2007}^{2010} \log P_i^H + X_i' \Gamma + \epsilon_i \]

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

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

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: \( p_t^x(\omega) = p_t^F \xi \frac{F_t}{X_t} x_t(\omega)^{\frac{1}{\nu}} \)
Intermediate sector, full problem

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

Optimal relative price: \( p_t^x = \nu A^{-1} \)

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

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: \( \phi_t = \phi \frac{N_t}{N^\rho_t S^{1-\rho}_t} \)

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

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

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

s.t

Production function: \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

$$P_t(j) = \mu_t P^F_t$$

$$\mu_t = \frac{\eta}{(\eta - 1) + \psi_p \frac{\Pi_t}{\Pi} \left( \frac{\Pi_t}{\Pi} - 1 \right) - \psi_p \mathbb{E}_t \Lambda_{t,t+1} \left( \frac{\Pi_{t+1}}{\Pi} - 1 \right) \frac{\Pi_{t+1}}{\Pi} Y_{t+1}}$$
Households: savers

\[
\max_{\{C^S_j, L^S_j, h^S_j, B^S_{j+1}\}_{j=t}^{\infty}} \mathbb{E}_t \sum_{j=t}^{\infty} \beta^j \left( u(C^S_j, L^S_j) + g(h^S_j) \right) \quad \text{s. t.}
\]

Budget constraint: \[ C^S_t + P^h_t \Delta h^S_t + (1 + r_{t-1}) \frac{B^S_t}{P_t} = W_t L^S_t + \frac{B^S_{t+1}}{P_t} \]
Households: borrowers

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

Budget constraint:

$$C_t^B + I_t + P_t^h \Delta h_t^B + (1 + r_{t-1}) \frac{B^B_t}{P_t} + \iota_{t+1} v_t (N_t + N_{et}) =$$

$$= \iota_t (v_t + d_t) N_t + W_t L_t^B + R_t^K K_t + \frac{B^B_{t+1}}{P_t}$$

Capital accumulation:

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

Collateral constraint:

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

Capital utilization:

$$\delta_K(u_t) = \delta_K + c_1 (u_t - 1) + (c_2/2)(u_t - 1)^2$$
## Calibration summary

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<tr>
<td>( \kappa )</td>
<td>0.03</td>
<td>Share of housing in utility</td>
</tr>
<tr>
<td>( \xi )</td>
<td>0.5</td>
<td>Intermediate good share</td>
</tr>
<tr>
<td>( -1/\varepsilon_h )</td>
<td>-0.2</td>
<td>Elasticity of housing demand</td>
</tr>
<tr>
<td>( m )</td>
<td>0.75</td>
<td>Max leverage</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.4</td>
<td>Capital share</td>
</tr>
<tr>
<td>( \delta_K )</td>
<td>0.025</td>
<td>Steady state capital depreciation</td>
</tr>
<tr>
<td>( \phi )</td>
<td>0.11</td>
<td>R&amp;D productivity</td>
</tr>
<tr>
<td>( \kappa )</td>
<td>0.03</td>
<td>Share of housing in utility</td>
</tr>
<tr>
<td>( \xi )</td>
<td>0.5</td>
<td>Intermediate good share</td>
</tr>
</tbody>
</table>

### Sources

- \( \beta_B = \beta_S - 0.005 \)
- \( \beta_B = \beta_S - 0.005 \)
- BGP requirement \( \xi(\nu - 1)/(1 - \xi) = 1 - \alpha \)
- Conventional
- Comin and Gerlter (2006)
- Conventional
- Normalization
- Comin and Gerlter (2006)
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Conventional
- Comin and Gerlter (2006)
- Hanushek and Quigley (1980)
- Warnock and Warnock (2008)
- Data median, PWT 9.1
- Annual per-capita TFP growth = 0.8% (data median, PWT 9.1)
- Mortgage debt to GDP = 0.55
- Comin and Gerlter (2006)
Utility function

GHH preference:  \[ u(C^H_t, L^H_t) = \left( \left( C^H_t - \gamma_t(L^H_t)^{1+\epsilon_L} / (1 + \epsilon_L) \right)^{1-\sigma} - 1 \right) / (1 - \sigma) \]

Housing utility:  \[ g(h^H_t) = (h^H_t)^{1-\epsilon_h} / (1 - \epsilon_h) \]

Labor supply:  \[ W_t = \gamma_t(L^H_t)^{\epsilon_L} \]

\[ \gamma_t = \gamma^\gamma_{t-1} N^1_{t-1} \]

Time-varying disutility of labor  \hspace{1cm} (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
Aggregate demand channel: baseline vs flexible price economy

Nominal frictions matter
Aggregate demand channel: baseline vs binding ZLB

The amplification role of the binding zero lower bound constraint
Endogenous productivity growth is key for generating the empirically-relevant persistent response of TFP, consumption, and output.
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