Mortgage Debt, Consumption, and Illiquid Housing Markets in the Great Recession

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CBI/ECB Conference on Household Finance and Consumption
December 2019

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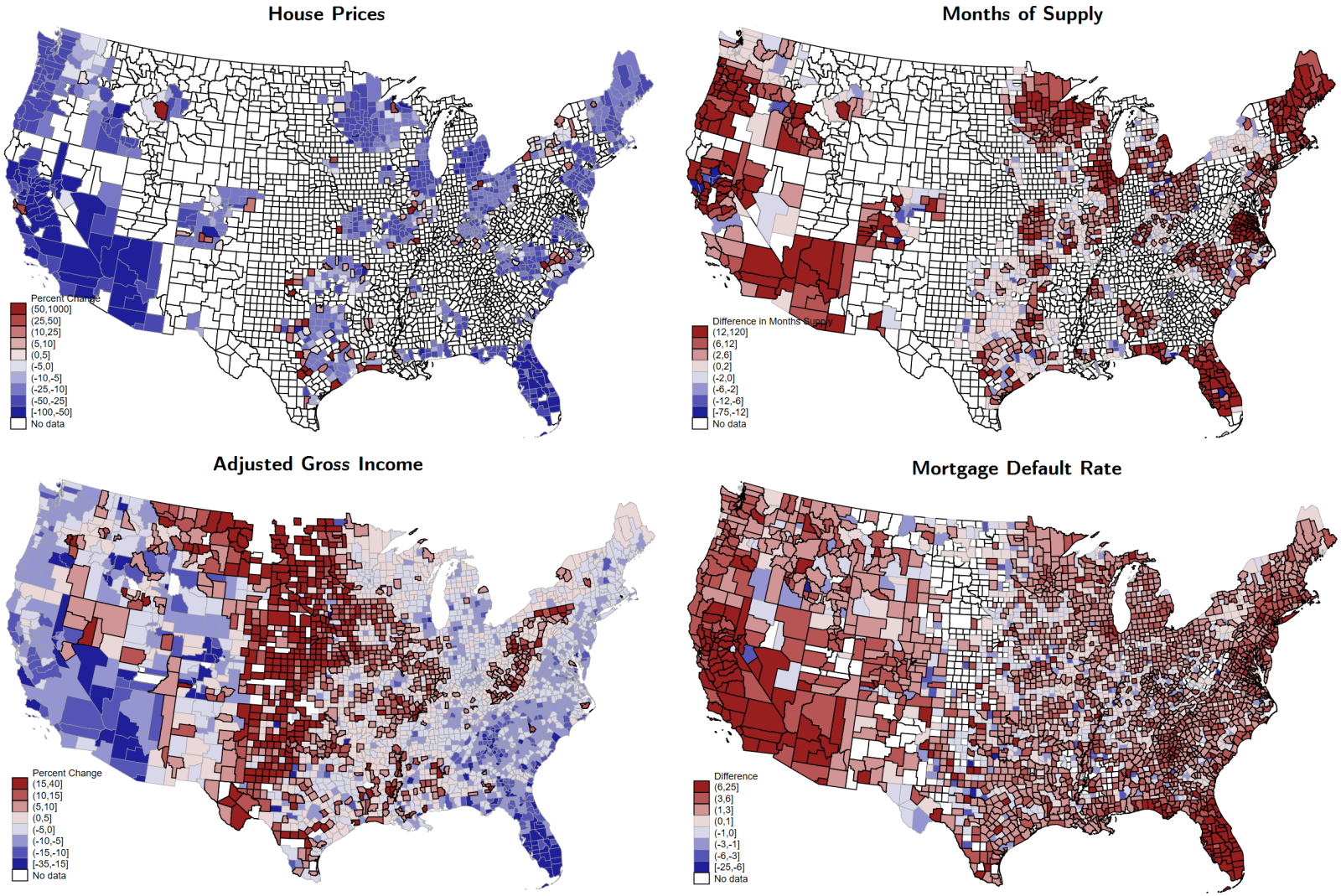
INTRODUCTION

- Deterioration in housing and macroeconomy 2006 – 2011.



LONGER TERM AGENDA

1. **What drives housing (especially prices)?**
   - Fundamentals (growth, demographics, preferences)
   - Expectations
   - Credit
   - Liquidity

$$P_t = \underbrace{R_t}_{\text{fundamentals}} + \underbrace{\mathbb{E}}_{\text{expectations}} \left\{ \Gamma_{t,t+1} \underbrace{[1 - \tau(\Omega)]}_{\text{liquidity}} P_{t+1} \right\} + \underbrace{\mu_t \theta P_t}_{\text{credit}}$$

2. **How does housing impact the macroeconomy?**
   - Spillovers to consumption and investment.
   - Fragility of the financial sector.
3. **What are the policy implications?**
   - Macroprudential regulations.
   - Transmission of monetary and fiscal policy.

TODAY'S TALK

We develop a quantitative macro-housing model with endogenous liquidity and default to address three questions:

1. **What were the drivers of the housing bust?**
   - Earnings skewness shocks (higher left tail risk) and tightening lending standards primarily to blame.
   - Productivity shocks and Fed tightening play little role.
2. **What are the key channels of macroeconomic transmission from the housing market?**
   - Balance sheet effects minor in traditional macro models.
   - Here: endogenous illiquidity + balance sheet depth amplify housing decline and transmission to consumption.
3. **How effective were mortgage rate interventions?**
   - Post-2008 lower mortgage rates boosted house prices and consumption by repairing balance sheets.

MODEL SUMMARY: I

Households

- Preferences $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t, c_{ht})$ over consumption c_t and housing services c_{ht}.
- Segmented owner and rental markets: own $h_t \in \mathcal{H}$ with $c_{ht} = h_t$ or rent apartment space $c_{ht} = a_t \in [0, \bar{a}]; \bar{a} \leq \underline{h}$.
- Income shocks $e_t \cdot z_t$ drawn from $F(e_t)$ and $\pi_z(z_{t+1}|z_t)$.

Technology

- Goods production $Y_{ct} = Z_t N_{ct} = C_t + S_{ht} + \frac{1}{A} C_{at} + \Omega_t$.
- Linear, reversible technology for producing apartment space $\Rightarrow$ rents $p_a = 1/A$ are purely supply-determined.
- New owner-occupied housing $Y_{ht} = F_h(\bar{L}, S_{ht}, N_{ht})$.

MODEL SUMMARY: II

Housing Market Frictions: search-induced trading delays.
Endogenous housing liquidity.

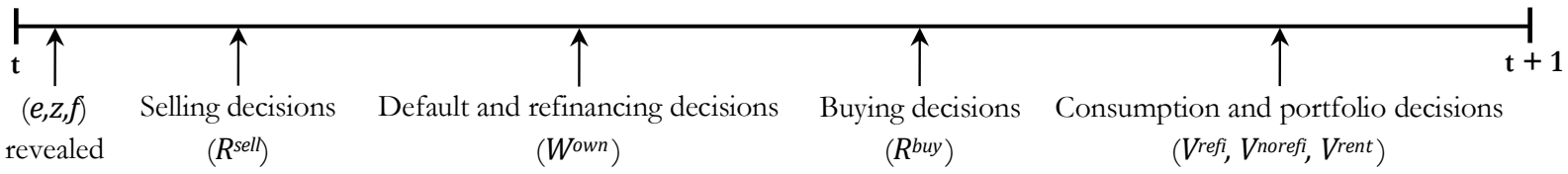
- Search by price (sellers p_t^{list}, buyers p_t^{bid}) and house type h.
- Sellers face a trade-off between price and their probability $\eta_t^{sell}(\cdot)$ of a successful transaction. Analogous for buyers.
- Probabilities $\eta^{sell}(p_t^{list}, h; \Phi_t)$ and $\eta^{buy}(p_t^{bid}, h; \Phi_t)$ depend on choices and aggregate conditions, including heterogeneity.

Search Details

Banking Sector: issues bonds for saving; mortgages.

- Long-term: no forced deleveraging if house prices drop.
- Fixed interest rate.
- Refinance to extract equity (houses as ATMs) or cut rate.
- Default and prepayment risks priced in at origination.
- Banks actively manage foreclosure inventories.

HOUSEHOLD TIMELINE



- State $(y_t, (\bar{r}, m_t), h_t, z_t, f_t)$ for owners; renters (y_t, z_t, f_t).
  - Cash at hand $y_t = w_t e_t z_t + b_t$, mortgage rate $\bar{r}$ and balance m_t, housing h_t, persistent shock z_t, credit flag f_t.
- First owners decide whether to sell; non-sellers decide whether to default.
- Then non-owners decide whether to buy.
- Lastly, consumption and portfolio choice decisions.

BORROWING, SAVING, AND CONSUMPTION

New originations ($m_{t+1} > m_t$ or to lower rate $r_{t+1} < \bar{r}$):

$$V_t^{own,0}(y_t, h, z_t) = \max_{m_{t+1}, b_{t+1}, c_t} u(c_t, h) + \beta \mathbb{E} \left[\begin{array}{c} W_{t+1}^{own,0}(y_{t+1}, (r_{t+1}, m_{t+1}), h, z_{t+1}) \\ +R_{t+1}^{sell,0}(y_{t+1}, (r_{t+1}, m_{t+1}), h, z_{t+1}) \end{array} \right]$$

subject to

$$c_t + \gamma p_t h + b_{t+1}/(1 + i_{t+1}) \leq y_t + \underbrace{q_t((r_{t+1}, m_{t+1}), b_{t+1}, h, z_t)}_{=1+r_{t+1}+\text{default premium}} m_{t+1}$$

$$q_t((r_{t+1}, m_{t+1}), b_{t+1}, h, z_t) m_{t+1} \leq \vartheta p_t h$$

Owners making a regular payment ($m_{t+1} \leq m_t$, $\bar{r}$ unchanged):

$$V_t^{amort}(y_t, (\bar{r}, m_t), h, z_t) = \max_{b_{t+1}, l_t, c_t} u(c_t, h) + \beta \mathbb{E} \left[\begin{array}{c} W_{t+1}^{own,0}(y_{t+1}, (\bar{r}, m_{t+1}), h, z_{t+1}) \\ +R_{t+1}^{sell,0}(y_{t+1}, (\bar{r}, m_{t+1}), h, z_{t+1}) \end{array} \right]$$

subject to

$$c_t + \gamma p_t h + b_{t+1}/(1 + i_{t+1}) + l_t \leq y_t$$

$$\frac{\bar{r}}{1 + \bar{r}} m_t \leq l_t \leq m_t$$

$$m_{t+1} = (m_t - l_t)(1 + \bar{r})$$

BUYING AND SELLING HOUSES

- The option value of trying to sell is

$$R_t^{sell,0}(y_t,(\bar{r},m_t),h,z_t) = \max\{0, \max_{p_t^{list}\geq 0} \eta_t^{sell}(p_t^{list},h)\left[V_t^{rent,0}\left(y_t+p_t^{list}-m_t,z_t\right)\right.$$

$$\left.+R_t^{buy,0}\left(y_t+p_t^{list}-m_t,z_t\right)-W_t^{own,0}(y_t,(\bar{r},m_t),h,z_t)\right]+\left[1-\eta_t^{sell}(p_t^{list},h)\right](-\xi)\}$$

subject to

$$p_t^{list} \geq m_t - y_t$$

- The option value of searching for a house is

$$R_t^{buy,0}(y_t,z_t) = \max\{0, \max_{\substack{h_t\in H,\\ p_t^{bid}\leq y_t-\underline{y}}} \eta_t^{buy}(p_t^{bid},h_t)[V_t^{own,0}(y_t-p_t^{bid},h_t,z_t)-V_t^{rent,0}(y_t,z_t)]\}$$

MORTGAGE PRICING

- Key features: fixed rates, default, prepayment, refinancing.

- Housing illiquidity endogenously affects default premia.

$$(1+\zeta)q_t((\bar{r}, m_{t+1}), b_{t+1}, h, z_t) = \frac{1}{1+r_{t+1}}\mathbb{E}\left\{\overbrace{\eta^{sell}_{t+1}}^{\text{sell, repay}} + \overbrace{(1-\eta^{sell}_{t+1})}^{\text{no house sale}}\left[\overbrace{d^*_{t+1}}^{\text{default}}\ \overbrace{\varphi \min\left\{1, \frac{J^{REO}_{t+1}(h)}{m_{t+1}}\right\}}^{\text{foreclosure recovery ratio}}\right.\right.$$

$$\left.\left. + \underbrace{d^*_{t+1}(1-\varphi)(1+\zeta)q^{delinq}_{t+1}}_{\text{continuation value of delinquency}} + (1-d^*_{t+1})\left\{\underbrace{\mathbf{1}_{[\text{Refi,t+1}]}}_{\text{repay in full}} + \mathbf{1}_{[\text{No Refi,t+1}]}\underbrace{\left(\frac{l^*_{t+1} + (1+\zeta)q^{cont}_{t+1}m^*_{t+2}}{m_{t+1}}\right)}_{\text{payment + continuation value}}\right\}\right]\right\}$$

such that

$$\eta^{sell}_{t+1} \equiv \eta_s(\theta_s(p^{list*}_{t+1}, h; p_{t+1})) \textbf{ (probability of house sale)}$$

$$q^{delinq}_{t+1} \equiv q_{t+1}((\bar{r}, m_{t+1}), b^{delinq*}_{t+2}, h, z_{t+1}) \textbf{ (mark-to-market price for delinquent } m_{t+1}\textbf{)}$$

$$q^{cont}_{t+1} \equiv q_{t+1}((\bar{r}, m^*_{t+2}), b^*_{t+2}, h, z_{t+1}) \textbf{ (mark-to-market price for updated } m^*_{t+2}\textbf{)}$$

$$m^*_{t+2} = (m_{t+1} - l^*_{t+1})(1+\bar{r}) \textbf{ (endogenous amortization)}$$

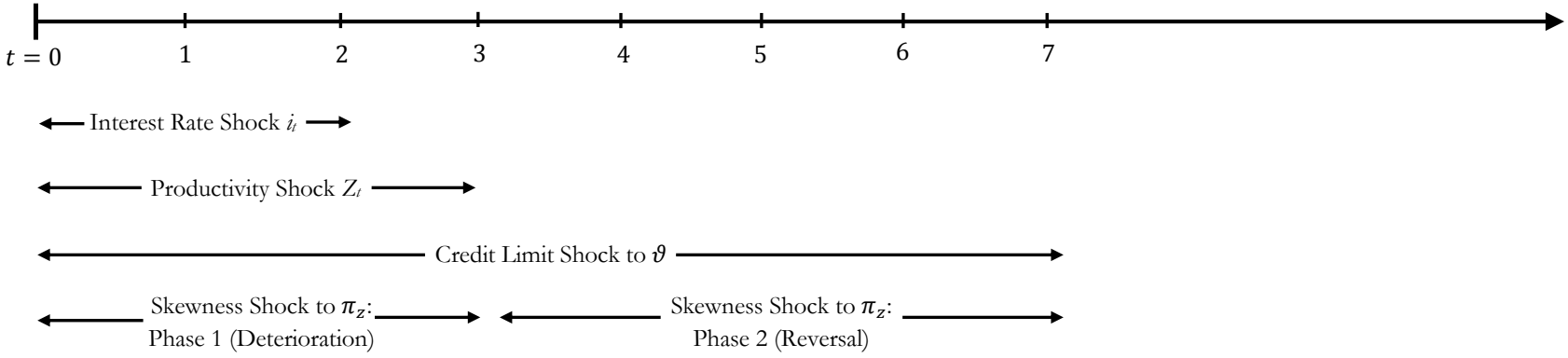
CALIBRATION

- Calibrate the economy to the mid-2000s.
- Important to match households' balance sheets (especially the LTV distribution).

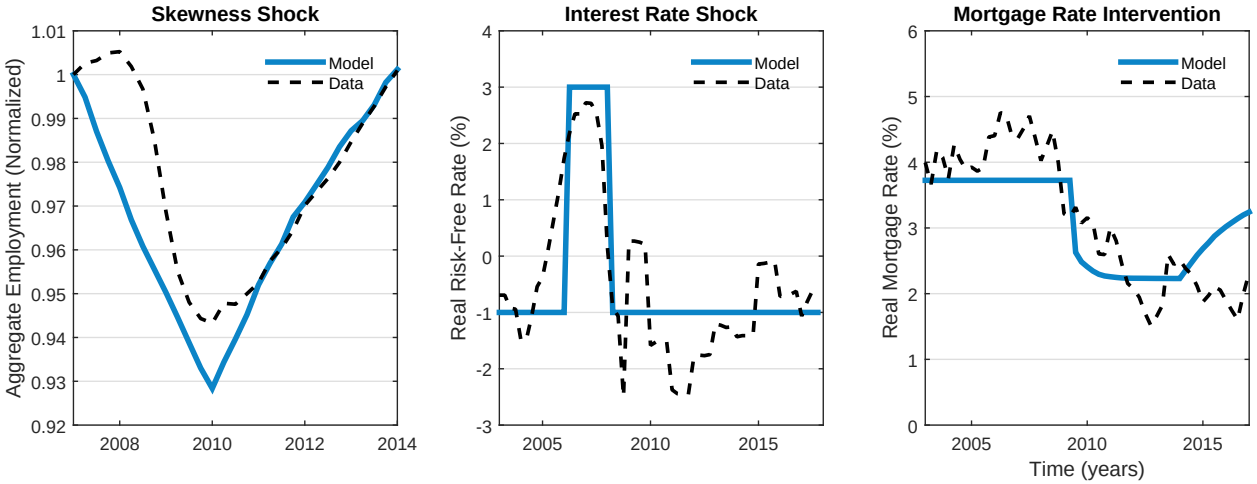
Description	Target	Model	Source/Reason
Homeownership Rate	69.2%	69.2%	Census
Mean Net Worth	2.83	2.84	2007 SCF
Housing Wealth (Owners)	3.97	3.97	2007 SCF
Borrowers with $LTV \geq 80\%$	20.6%	26.5%	2007 SCF
Borrowers with $LTV \geq 90\%$	10.8%	10.7%	2007 SCF
Borrowers with $LTV \geq 95\%$	6.7%	6.0%	2007 SCF
Mean Owner Liquid Assets	1.19	1.53	2007 SCF
Median Owner Liquid Assets	0.23	0.27	2007 SCF
Months of Supply	4.90	4.89	Nat'l Assoc of Realtors
Foreclosure Starts	1.50%	1.25%	Delinquency Survey

Full Calibration Details

DRIVERS OF THE HOUSING BUST



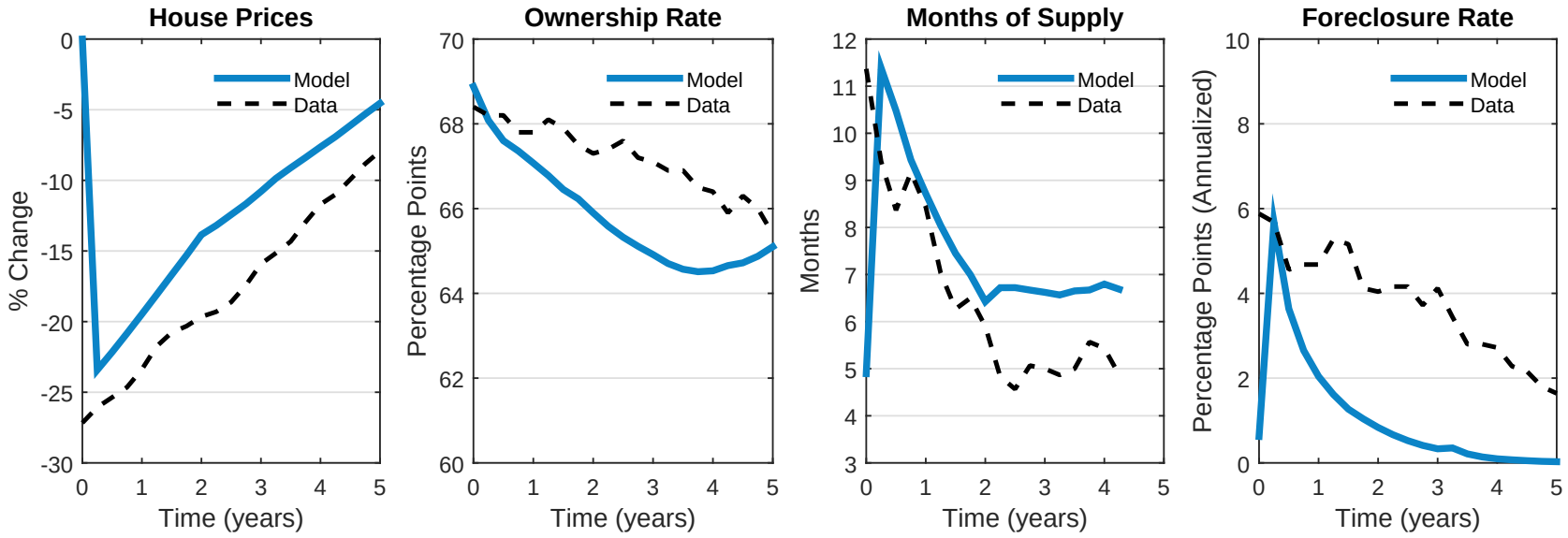
- The skewness shocks increase downside earnings risk.
- Calibrated to match path of aggregate employment.
- Interest rates follow a smoothed version of the data.



DRIVERS OF THE HOUSING BUST

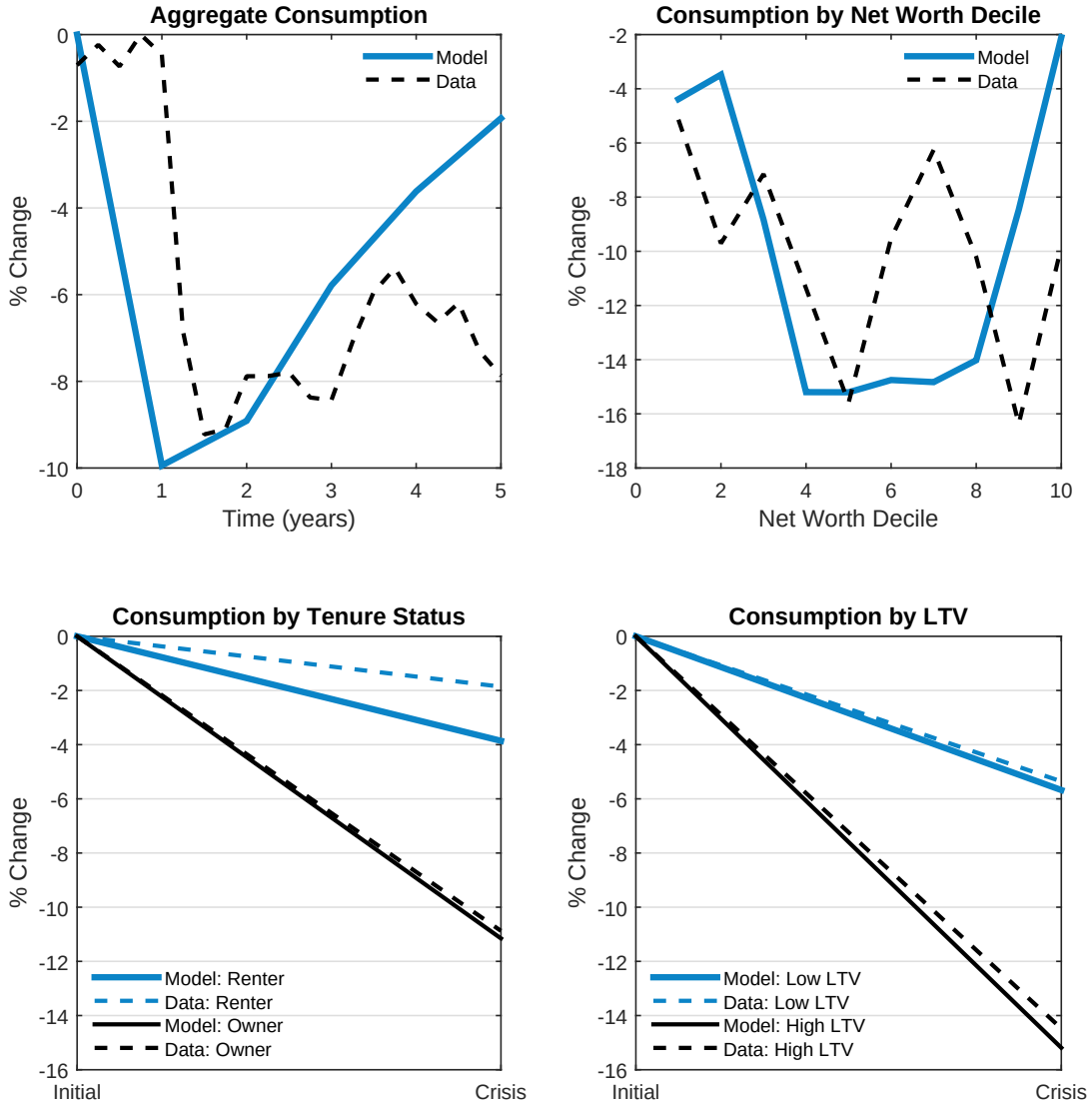
- The model replicates the severity of the housing crash.

	ΔHouse Prices	ΔOwnership	ΔMonths Supply	ΔForeclosures
Model	−23.4%	−2.8pp	+6.5 months	+5.1pp
Data	−25.7%	−3.6pp	+6.0 months	+4.2pp



Drivers of the Housing Bust

- The dynamics of consumption match the data.



Drivers of the Housing Bust

- Shocks to earnings skewness and credit are important.

	Baseline	Exclude*	Alone**	Impact Bounds
Skewness Shock				
ΔHouse Prices	−23.4%	−14.8%	−11.6%	[−11.6%,−8.6%]
ΔOwnership	−2.8pp	+1.2pp	−3.1pp	[−4.0pp,−3.1pp]
ΔMonths Supply	+6.5m	+3.0m	+1.3m	[+1.3m,+3.5m]
ΔForeclosures	+5.1pp	+1.1pp	+0.2pp	[+0.2pp,+4.0pp]
ΔConsumption	−9.9%	−6.3%	−2.8%	[−3.6%,−2.8%]
Credit Shock				
ΔHouse Prices	−23.4%	−19.1%	−5.6%	[−5.6%,−4.3%]
ΔOwnership	−2.8pp	−3.0pp	+0.9pp	[+0.2pp,+0.9pp]
ΔMonths Supply	+6.5m	+3.5m	+0.3m	[+0.3m,+3.0m]
ΔForeclosures	+5.1pp	+2.3pp	−0.2pp	[−0.2pp,+2.8pp]
ΔConsumption	−9.9%	−7.0%	−2.2%	[−2.9%,−2.2%]

Drivers of the Housing Bust

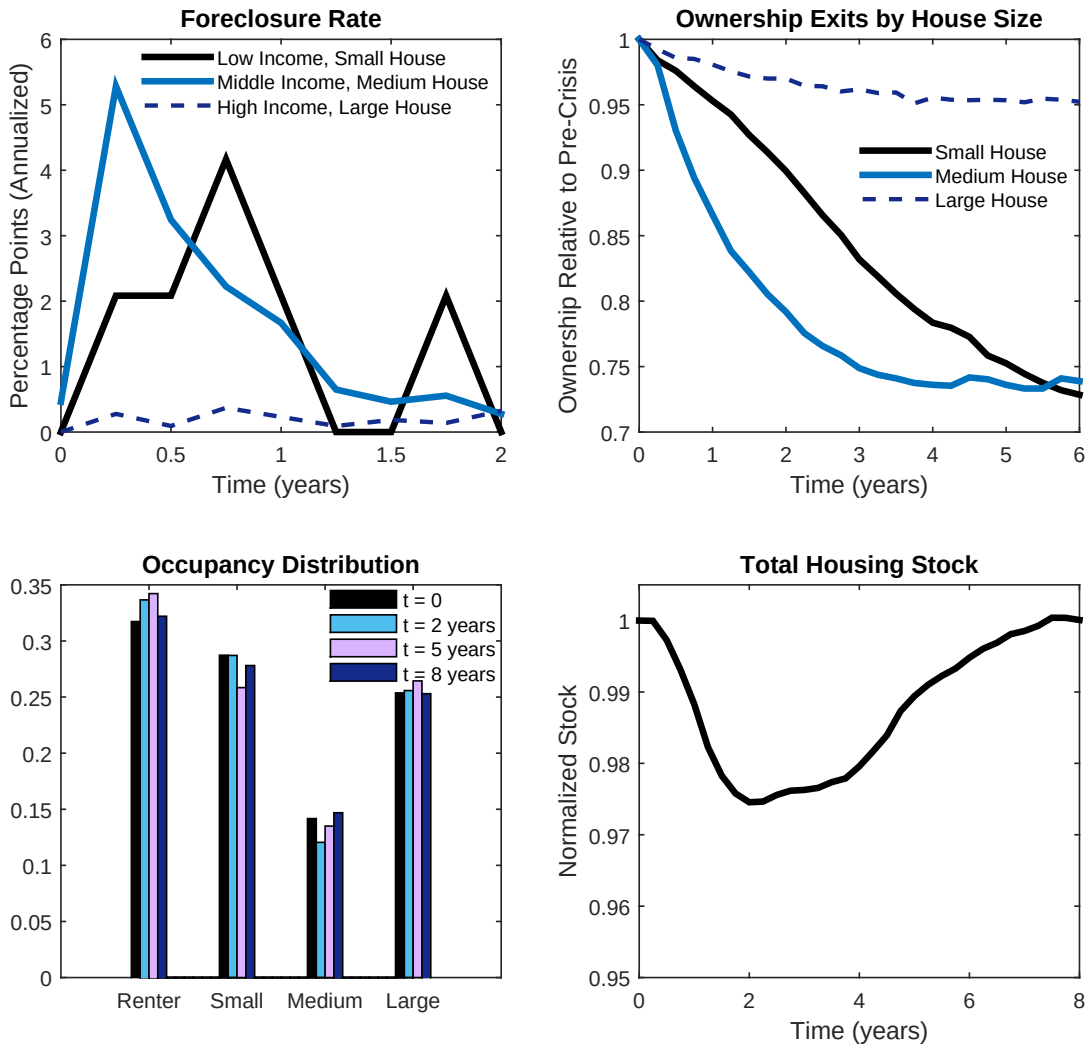
- Productivity shocks and Fed tightening play little role.

	Baseline	Exclude*	Alone**	Impact Bounds
Productivity Shock				
ΔHouse Prices	−23.4%	−21.6%	−1.9%	[−1.9%,−1.8%]
ΔOwnership	−2.8pp	−2.9pp	+0.7pp	[+0.1pp,+0.7pp]
ΔMonths Supply	+6.5m	+5.5m	+0.5m	[+0.5m,+1.0m]
ΔForeclosures	+5.1pp	+3.6pp	−0.4pp	[−0.4pp,+1.5pp]
ΔConsumption	−9.9%	−8.0%	−1.0%	[−1.9%,−1.0%]
Interest Rate Shock				
ΔHouse Prices	−23.4%	−20.2%	−3.7%	[−3.7%,−3.2%]
ΔOwnership	−2.8pp	−2.9pp	+0.5pp	[+0.1pp,+0.5pp]
ΔMonths Supply	+6.5m	+4.8m	+0.5m	[+0.5m,+1.7m]
ΔForeclosures	+5.1pp	+4.4pp	−0.4pp	[−0.4pp,+0.7pp]
ΔConsumption	−9.9%	−8.7%	−2.0%	[−2.0%,−1.2%]

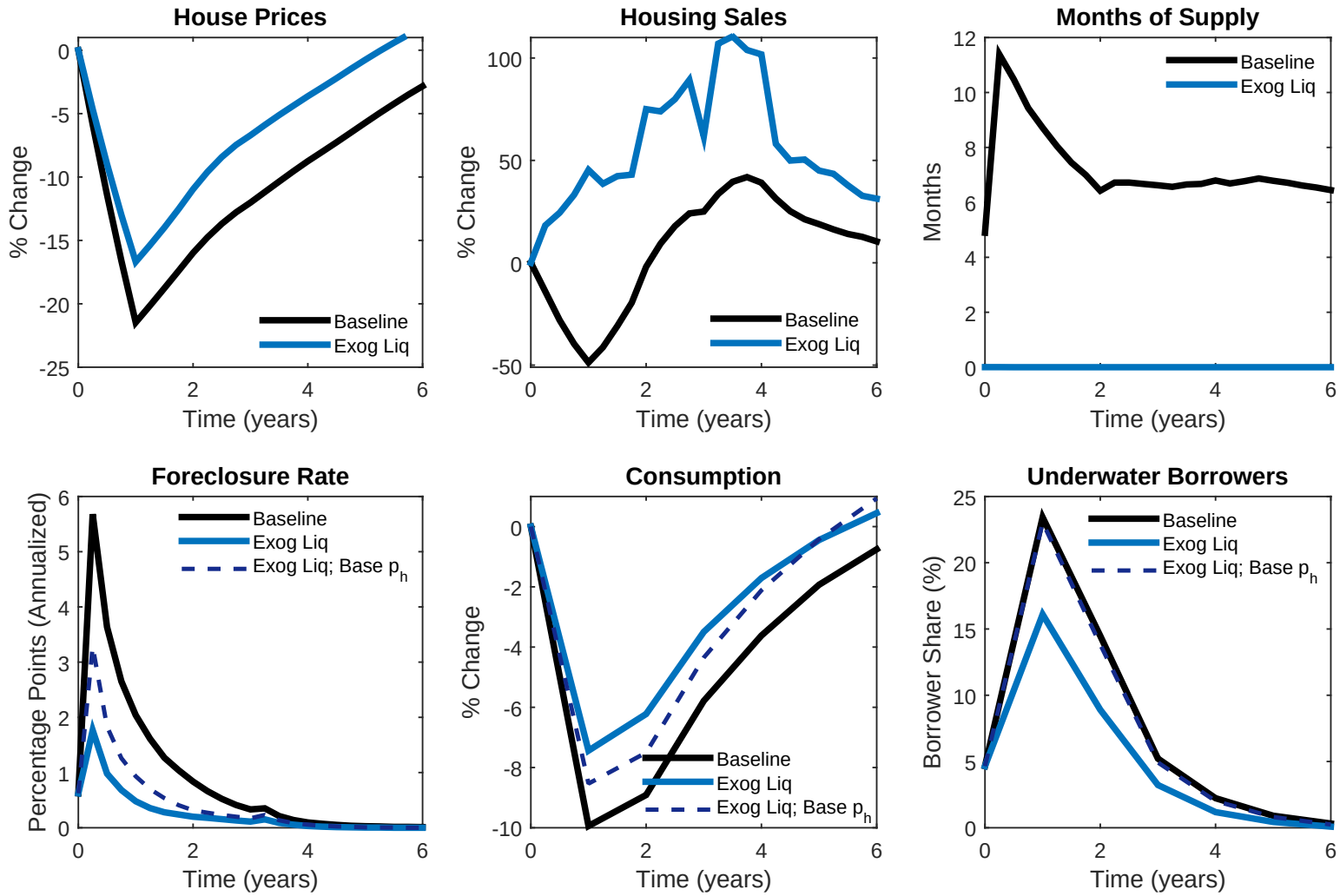
Permanent Shocks More on Skewness and Credit Alternative Drivers

THE CRISIS AND THE "NEW NARRATIVE"

- The crisis is not confined to low income owners.

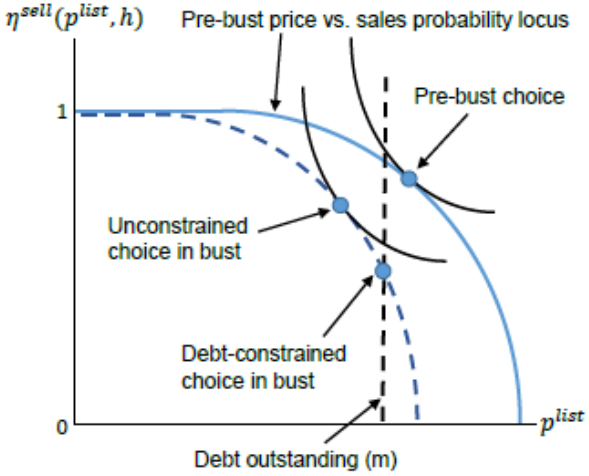


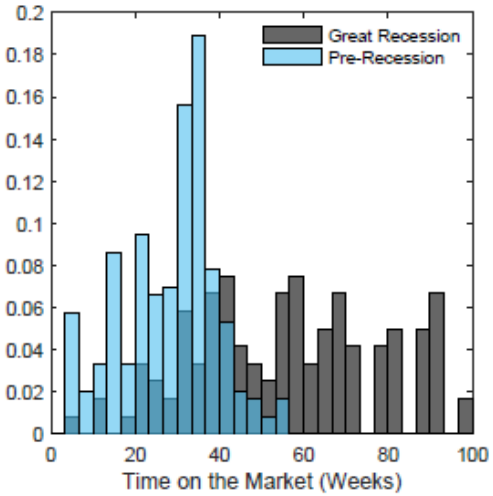
THE IMPORTANCE OF ENDOGENOUS LIQUIDITY

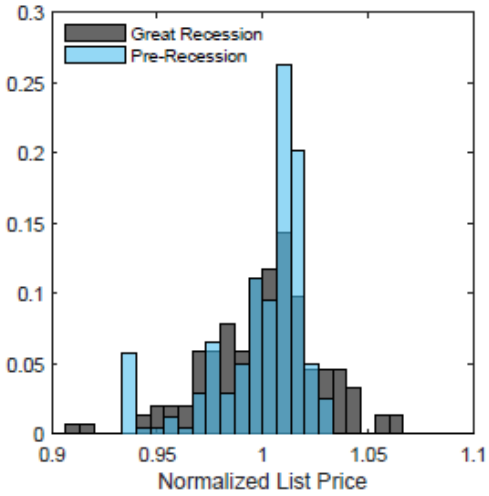


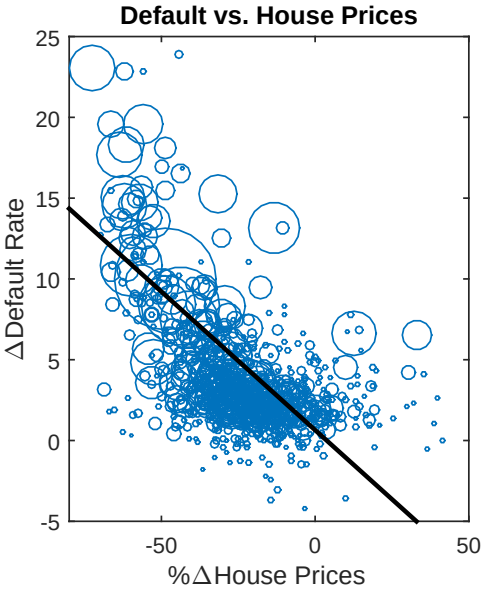
- Magnifies the ↑ in foreclosures, the ↓ in p and C, and is needed for the sales collapse.

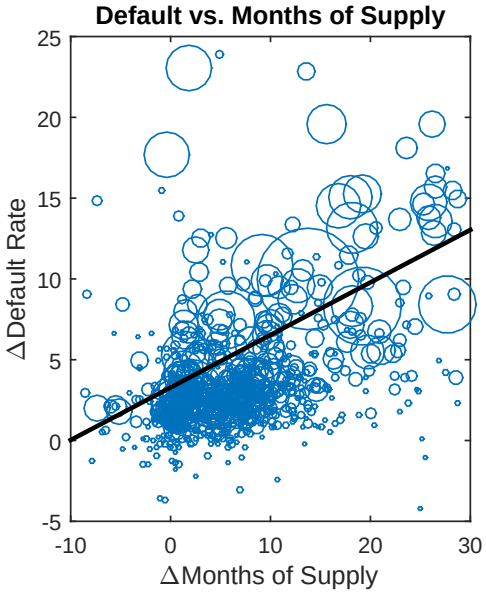
THE LIQUIDITY-ADJUSTED DOUBLE TRIGGER

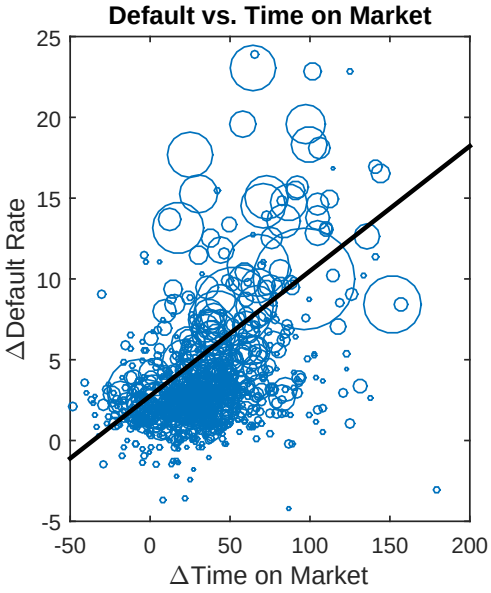












THE LIQUIDITY-ADJUSTED DOUBLE TRIGGER

$$\Delta\text{DefaultRate}^i_{06-10} = \beta_0 + \beta_1 \%\Delta\text{HNW}^i_{06-10} + \beta_2 \Delta\text{Illiquidity}^i_{05-08}$$

	(1) ΔDefault	(2) ΔDefault
$\%\Delta\text{Prices} \times \frac{H_{06}}{NW_{06}}$	-0.131^{***}	-0.140^{***}
	(0.005)	(0.005)
ΔMonths Supply	0.125^{***}	
	(0.009)	
ΔTime on Market		0.027^{***}
		(0.002)
Constant	0.891^{***}	0.872^{***}
	(0.105)	(0.110)
N	1021	935
R^2	0.540	0.545

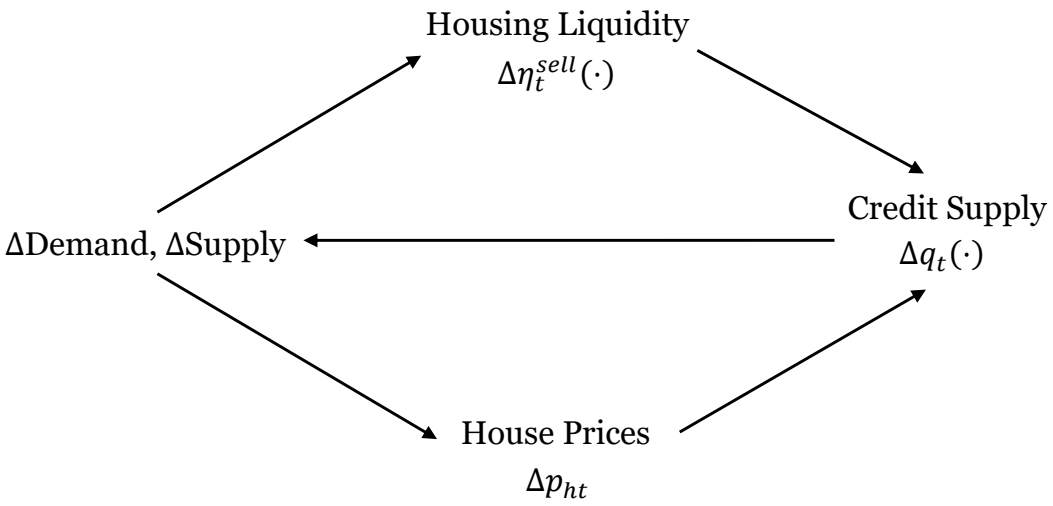
- Measure the effect of falling prices *and* rising illiquidity.
- Each additional month of time on the market is associated with a 0.81 percentage point rise in default.

3-D Maps

ENDOGENOUS LIQUIDITY: AMPLIFICATION

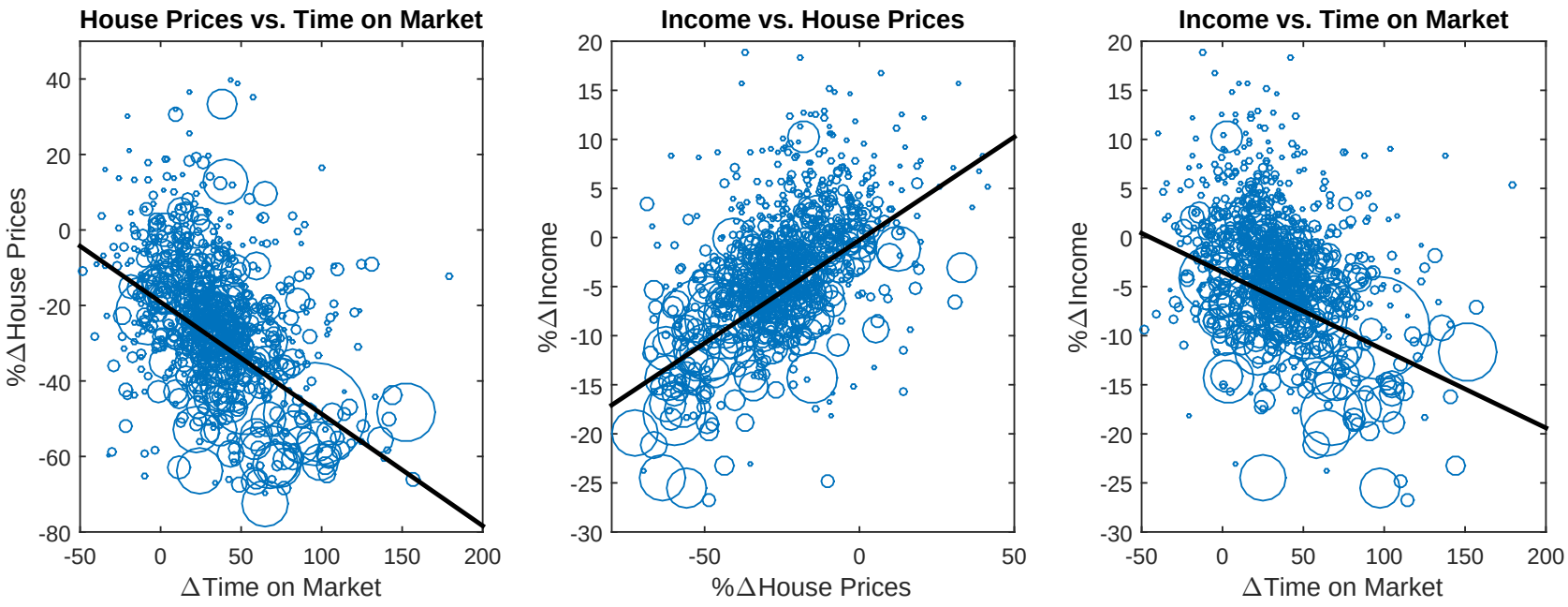
	Baseline	Exogenous Liquidity	Amplification
ΔHouse Prices	−23.4%	−18.6%	25.8%
ΔConsumption	−9.9%	−7.4%	33.6%
ΔForeclosures	+5.1pp	+1.1pp	343.5%

- Default probabilities and collateral values affect the supply of credit, i.e. the spread between $q_t(\cdot)$ and $\frac{1}{1+r}$.
- Changes in credit impact housing market conditions.



Endogenous Liquidity: Amplification

- Micro-data reveal a negative correlation between housing illiquidity and both house prices and income.
- Add housing illiquidity to Mian-Sufi regressions.



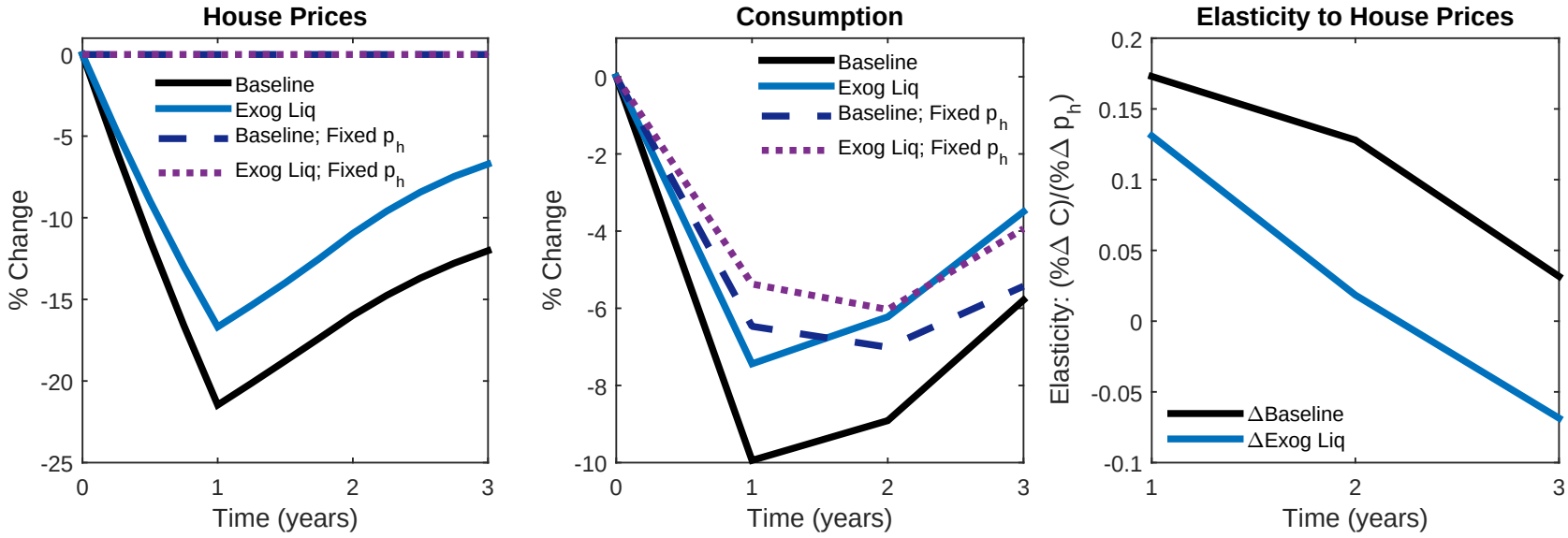
ENDOGENOUS LIQUIDITY: AMPLIFICATION

$$\%\Delta Y^i_{06-11} = \beta_0 + \beta_1 \%\Delta HNW^i_{06-11} + \beta_2 \Delta Illiquidity^i_{05-08}$$

	(1)	(2)	(3)	(4)	(5)	(6)
	$\%\Delta$AGI	$\%\Delta$AGI	$\%\Delta$AGI	$\%\Delta E_{NT}$	$\%\Delta E_{NT}$	$\%\Delta E_{NT}$
$\%\Delta$Prices$\times \frac{H_{06}}{NW_{06}}$	0.237***	0.202***	0.229***	0.118***	0.091***	0.090***
	(0.011)	(0.012)	(0.012)	(0.023)	(0.025)	(0.026)
ΔMonths Supply		−0.188***			−0.143***	
		(0.022)			(0.047)	
ΔTime on Market			−0.029***			−0.035***
			(0.005)			(0.010)
Constant	−1.803***	−0.780***	−0.859***	−0.771	0.010	0.198
	(0.241)	(0.262)	(0.275)	(0.494)	(0.553)	(0.575)
N	1023	1023	934	1023	1023	934
R^2	0.304	0.350	0.348	0.025	0.034	0.036

- The rise in months of supply during the crisis implies a 2 percentage point decline in AGI and more than a 1.5 percentage point drop in nontradable employment.

AGGREGATE SPILLOVERS



- Even with fixed prices, endogenous liquidity magnifies the consumption drop (by 20%) and is more persistent.
- \$30 decrease in AGI for every \$1,000 fall in house prices; \$31 for every one-day increase in selling delays.

$$\Delta \text{AGI}^i_{06-11} = \beta_0 + \beta_1 \Delta \text{Prices}^i_{06-11} + \beta_2 \Delta \text{Illiquidity}^i_{05-08}$$

Nonlinearities and Shock Dependence

Balance Sheet Depth

- Highly leveraged owners accounted for a disproportionate share of the aggregate consumption decline.

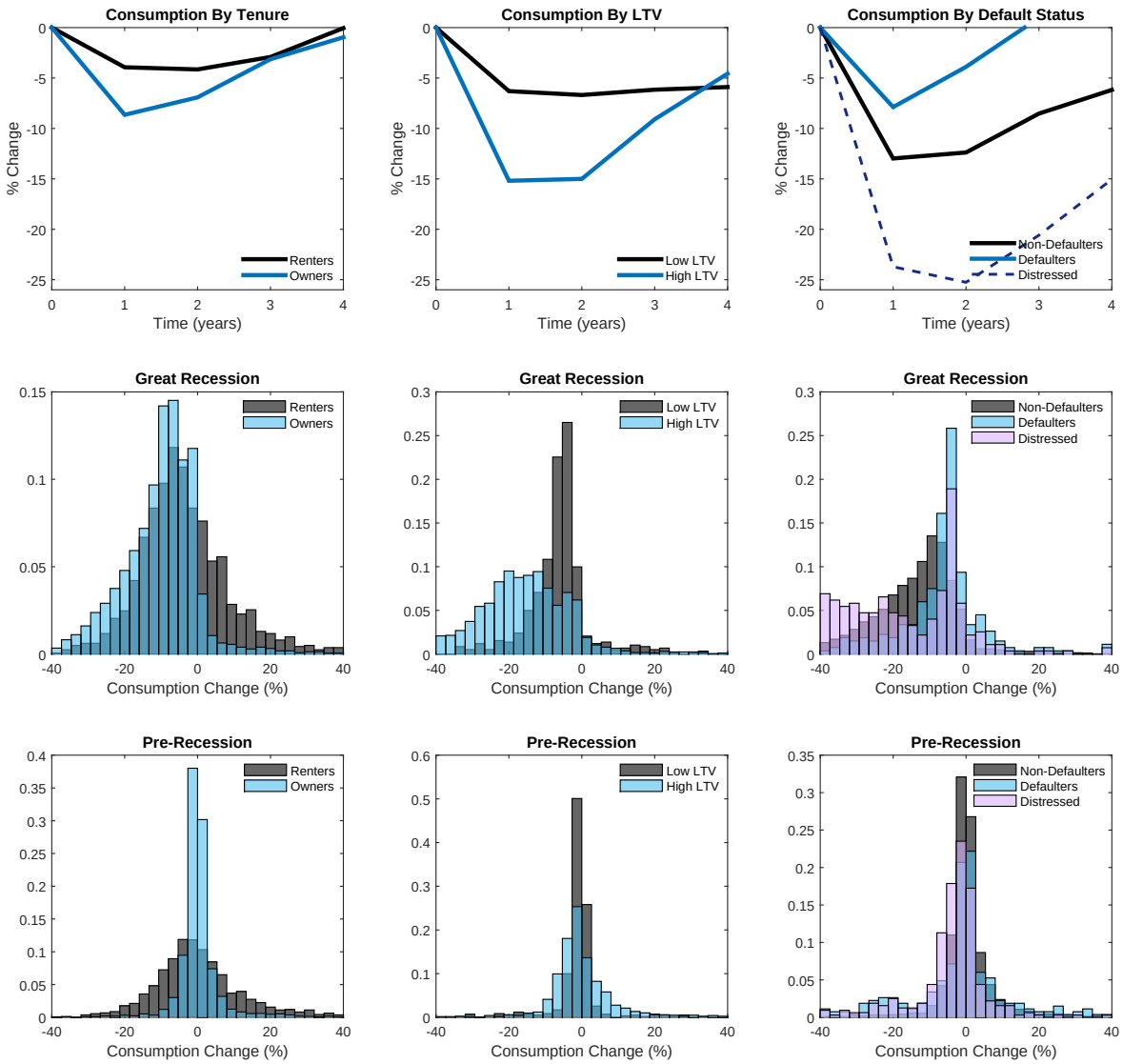
	Renters	Owners	Low LTV	High LTV
Model				
Pre-Crisis Share	16.0%	84.0%	18.9%	19.0%
Share of Decline	6.2%	93.8%	5.4%	28.9%
Data				
Pre-Crisis Share	23.9%	76.1%	13.4%	13.2%
Share of Decline	5.1%	94.9%	8.4%	22.3%

BALANCE SHEET DEPTH: GROSS VS. NET POSITIONS

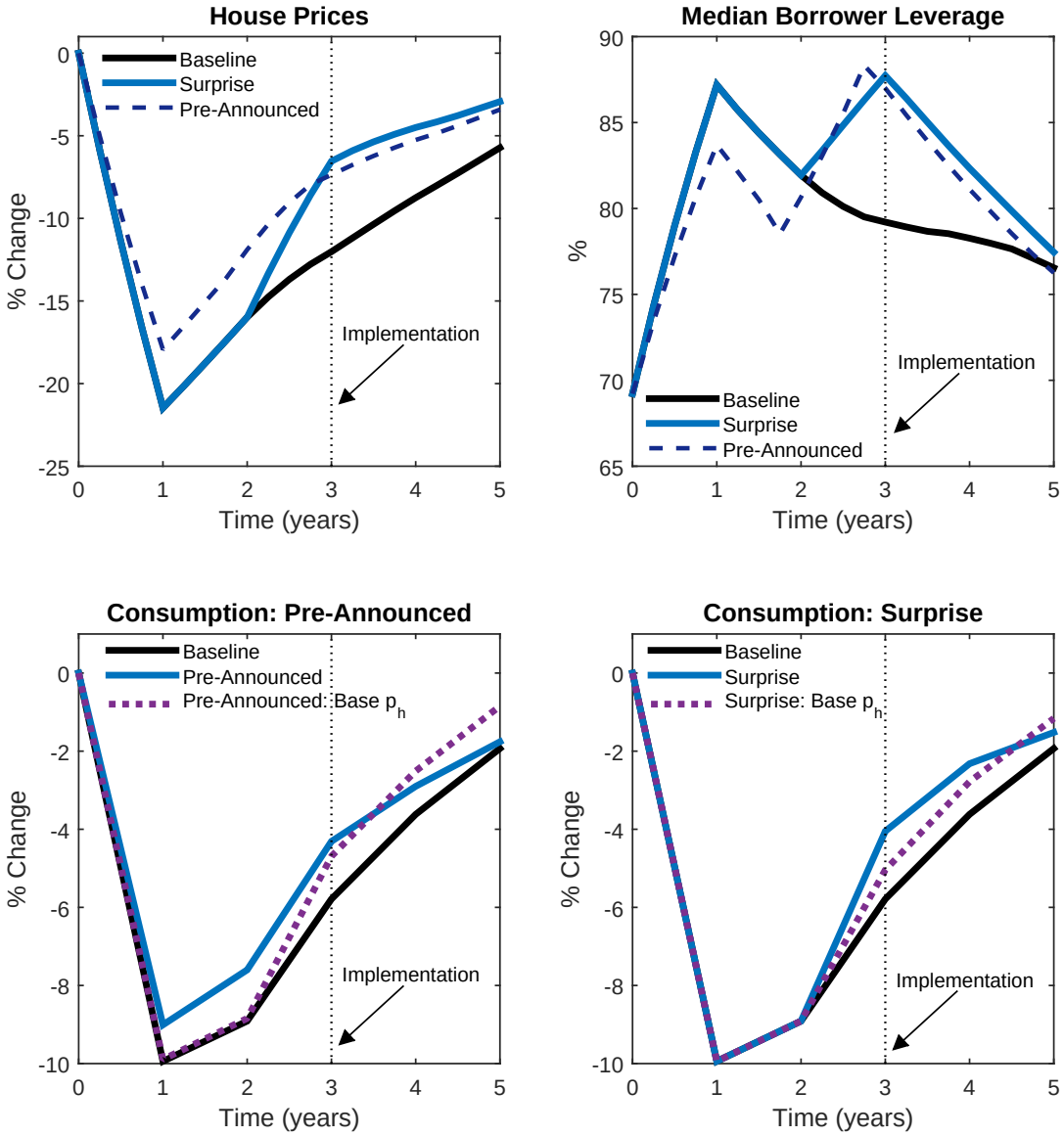
- Highly leveraged owners experience much larger drop in consumption than renters with similar net worth but shallower and more liquid balance sheets.
- Balance sheets affect higher order movements also. Owner consumption growth distribution shifts down and fans to the left during the housing bust.

	Low NW–By Tenure		*Medium NW–Owners*		*High NW–Owners*	
	Renters	Owners	Small h	Medium h	Medium h	Large h
Model						
ΔConsumption	−5.1%	−16.0%	−11.8%	−22.3%	−5.7%	−8.9%
Pre-Crisis LTV	—	84.8%	65.2%	82.3%	31.5%	58.8%
Data						
ΔConsumption	−5.5%	−13.4%	−7.4%	−30.8%	−1.8%	−7.3%
Pre-Crisis LTV	—	80.9%	75.4%	93.6%	40.1%	55.0%

BALANCE SHEET DEPTH: HIGHER ORDER MOMENTS



The Power of Mortgage Rate Reductions



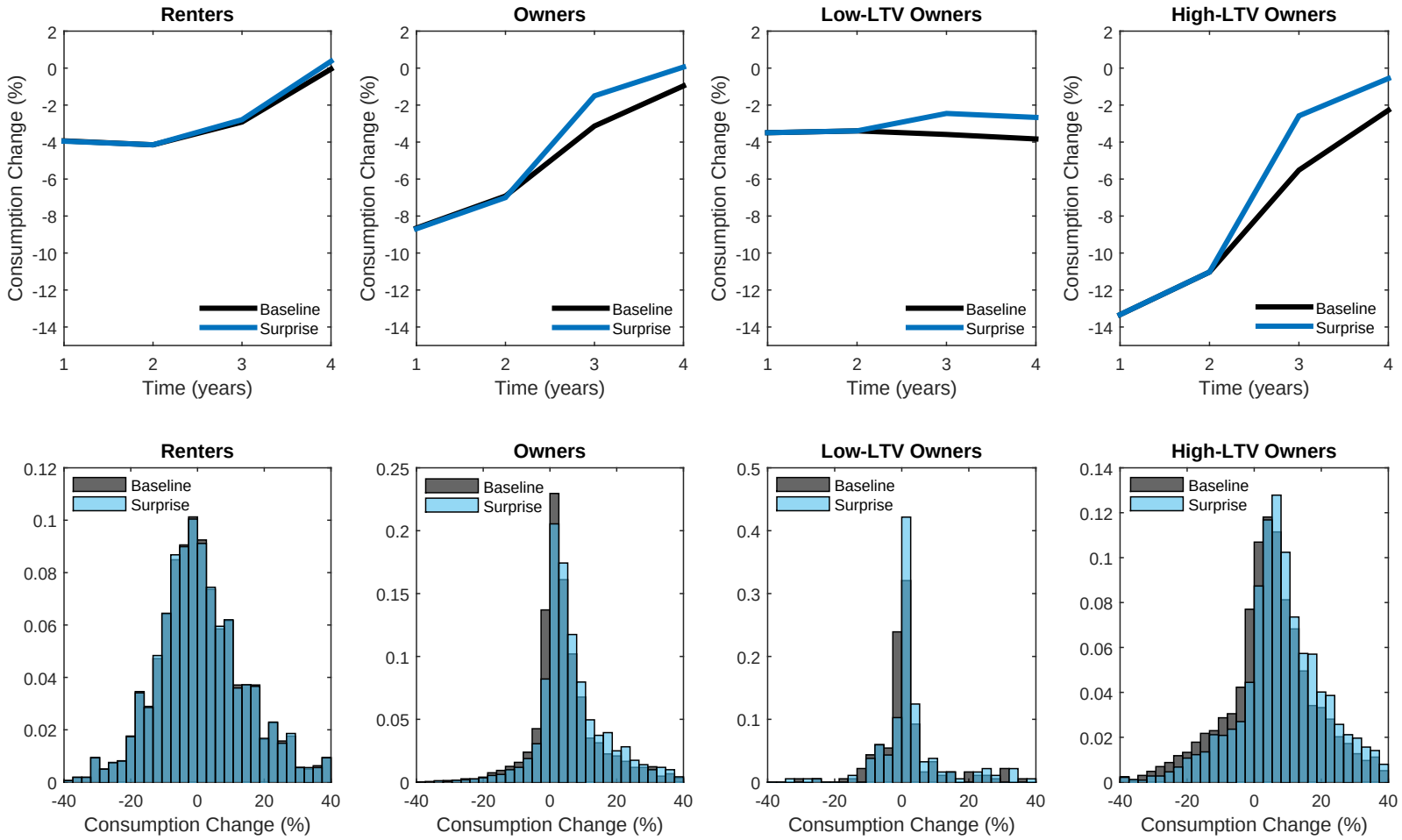
THE POWER OF MORTGAGE RATE REDUCTIONS

- Consumption responds to lower mortgage rates because of, cash flow effects, intertemporal substitution, and balance sheet repair.
- The majority (59%) of the consumption boost comes from balance sheet repair caused by the equilibrium improvement in house prices.

	House Prices		*Consumption*	
	Change	Recovery	Change	Recovery
Surprise				
Fixed Prices	—	—	+0.7pp	12.9%
Equilibrium	+5.3pp	47.2%	+1.7pp	30.0%
Pre-Announced				
Fixed Prices	—	—	+1.1pp	18.9%
Equilibrium	+4.4pp	39.6%	+1.5pp	25.5%

Rate Reductions and Heterogeneity

- Highly leveraged owners experience a 2.9 percentage point increase in consumption compared to only 1.2 percentage points for less indebted owners.

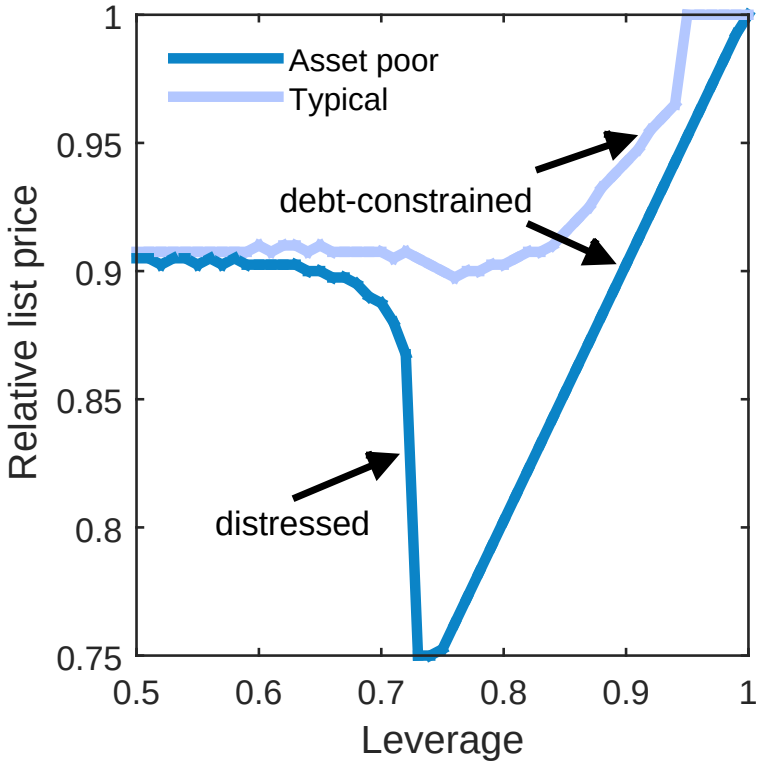


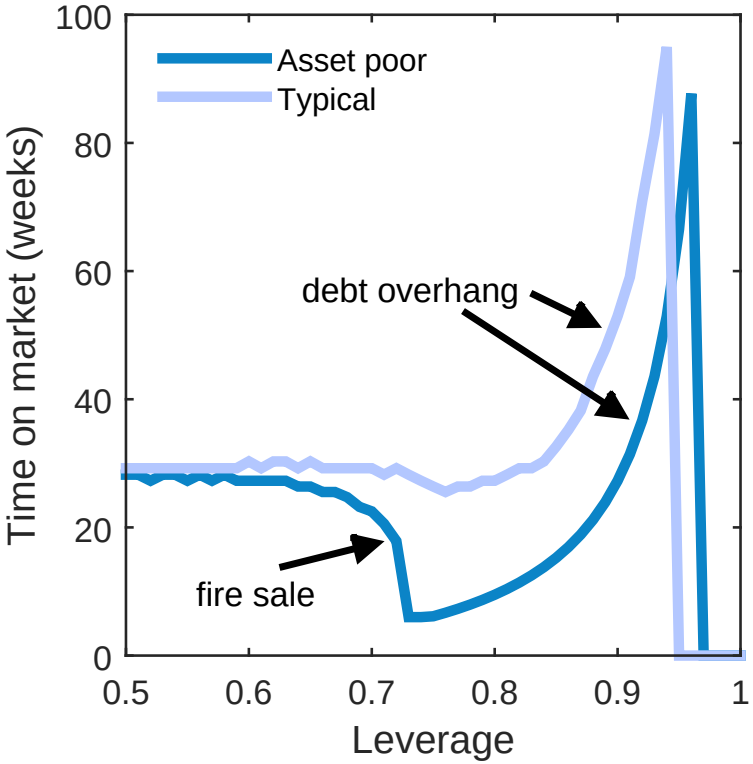
Conclusions

- Shocks to earnings skewness (higher left tail risk) and borrowing constraints needed to rationalize the bust.
- Higher foreclosure activity from the liquidity-adjusted double trigger induces liquidity spirals that amplify the drop in house prices and consumption.
- Endogenous liquidity needed to generate sales drop.
- Balance sheet depth (i.e. gross rather than net positions) critically shapes transmission of housing to consumption.
- Lowering mortgage rates accelerates the recovery in house prices and consumption primarily through balance sheet repair rather than intertemporal substitution.

Housing Search Frictions: I

- At low leverage, list prices insensitive to mortgage debt.
- Distressed sellers with some equity cushion who cannot borrow on good terms set firesale price.
- Debt overhang for very high leverage ⇒ long delays.





HOUSING SEARCH FRICTIONS: II

- Sellers choose p_t^{list}; sell w/prob $\eta_t^{sell} = \eta_s(\theta_s(p_t^{list}, h; \Phi_t))$.
- Buyers choose p_t^{bid}; buy w/prob $\eta_t^{buy} = \eta_b(\theta_b(p_t^{bid}, h; \Phi_t))$.
- Dynamic sorting problem simplified by brokers $\Rightarrow \theta_{st}$ and θ_{bt} depend on $\Phi_t(\cdot)$ only through sufficient statistic p_t:

$$\kappa_b h_t \geq \overbrace{\alpha_{bt}(\theta_{bt}(p_t^{bid}, h_t))}^{\text{prob of match}} \overbrace{(p_t^{bid} - p_t h_t)}^{\text{net revenue}}$$

$$\kappa_s h_t \geq \underbrace{\alpha_{st}(\theta_{st}(p_t^{list}, h_t))}_{\text{prob of match}} \underbrace{(p_t h_t - p_t^{list})}_{\text{net revenue}}$$

$$\Rightarrow \eta^{sell}(p_t^{list}, h) = \left(\frac{p_t h - p_t^{list}}{\kappa_s h}\right)^{\frac{\gamma_s}{1-\gamma_s}} \quad \eta_t^{buy}(p_t^{bid}, h) = \left(\frac{p_t^{bid} - p_t h}{\kappa_b h}\right)^{\frac{\gamma_b}{1-\gamma_b}}$$

- Equilibrium determination of sufficient statistic $p_t(\Phi_t)$:

$$\int h_t^* \eta_b(\theta_b(p_t^{bid*}, h_t^*; p_t)) d\Phi_t^{rent} = \overbrace{Y_{ht}(p_t)}^{\text{new housing}} + \overbrace{S_t^{REO}(p_t)}^{\text{REO housing}} + \overbrace{\int h \eta_s(\theta_s(p_t^{list*}, h; p_t)) d\Phi_t^{own}}^{\text{sold by owner}}$$

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CALIBRATION I

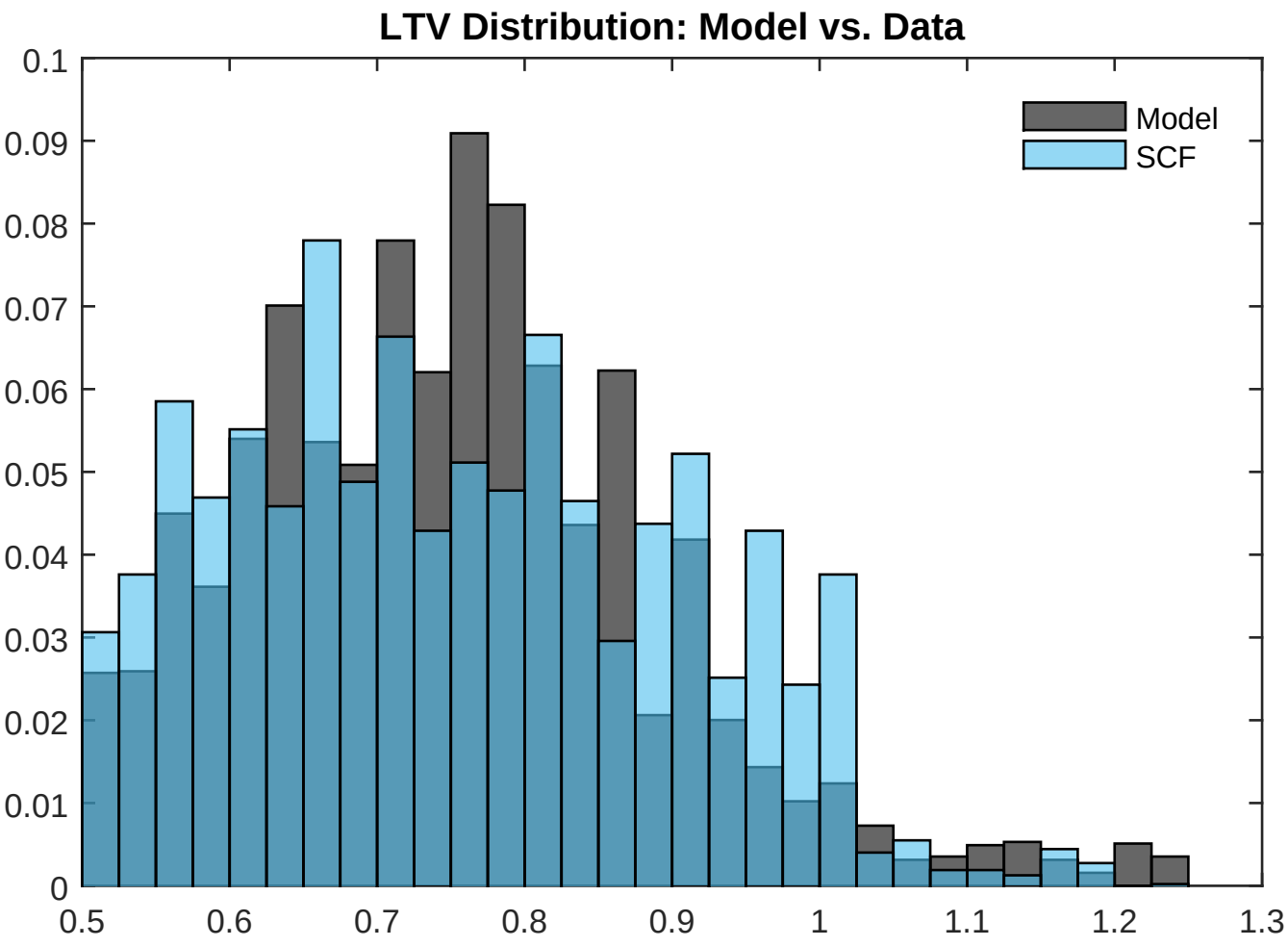
- Parametrize the economy to match key statistics from before the housing bust and Great Recession.

Description	Parameter	Value	Source/Reason
	External Parameters		
Autocorrelation	ρ	0.952	Storesletten et al (2004)
SD of Persistent Shock	σ_ϵ	0.17	Storesletten et al (2004)
SD of Transitory Shock	σ_e	0.49	Storesletten et al (2004)
Transition to Top 1%	$\pi_{3,4}$	0.0041	Kuhn and Ríos-Rull (2013)
Persistence of Top 1%	$\pi_{4,4}$	0.9	Kuhn and Ríos-Rull (2013)
Intratemp. Elas. of Subst.	ν	0.13	Flavin and Nakagawa (2008)
Risk Aversion	σ	2	Standard Value
Structures Share	α_S	30%	Favilukis et al (2017)
Land Share	α_L	33%	Lincoln Inst Land Policy
Taxes/Maintenance (Annual)	γ	2.8%	Moody's
Depreciation (Annual)	δ_h	1.4%	BEA
Rent-Price Ratio (Annual)	r_a	3.5%	Sommer et al (2013)
Risk-Free Rate (Annual)	r	-1.0%	Federal Reserve Board
Servicing Cost (Annual)	ϕ	3.6%	3.6% Real Mortgage Rate
Mortgage Origination Cost	ζ	0.4%	FHFA
Maximum LTV	ϑ	125%	Fannie Mae
Prob. of Repossession	φ	0.5	2008 OCC Mortgage Metrics
Credit Flag Persistence	λ_f	0.9500	Fannie Mae

Calibration II

Description	Parameter	Value	Target	Model	Source/Reason
		Jointly Determined Parameters			
Homeownership Rate	$\bar{a}$	2.7100	69.2%	69.2%	Census
Starter House Value	h_1	3.2840	2.75	2.75	Corbae and Quintin (2015)
Mean Net Worth	z_4/z_3	5.500	2.83	2.84	2007 SCF
Housing Wealth (Owners)	ω	0.8159	3.97	3.97	2007 SCF
Borrowers with $LTV \geq 90\%$	β	0.9737	10.8%	10.7%	2007 SCF
Months of Supply	ξ	0.0013	4.90	4.89	Nat'l Assoc of Realtors
Avg. Buyer Search (Weeks)	γ_b	0.0940	10.00	9.98	Nat'l Assoc of Realtors
Maximum Bid Premium	κ_b	0.0209	2.5%	2.5%	Gruber and Martin (2003)
Maximum List Discount	κ_s	0.1256	15%	15%	RealtyTrac
Foreclosure Discount	χ	0.1370	20%	20%	Pennington-Cross (2006)
Foreclosure Starts (Annual)	γ_s	0.6550	1.50%	1.25%	MBAA Delinquency Survey
		Model Fit			
Borrowers with $LTV \geq 80\%$			20.6%	26.5%	2007 SCF
Borrowers with $LTV \geq 95\%$			6.7%	6.0%	2007 SCF
Mean Owner Liquid Assets			1.19	1.53	2007 SCF
Median Owner Liquid Assets			0.23	0.27	2007 SCF

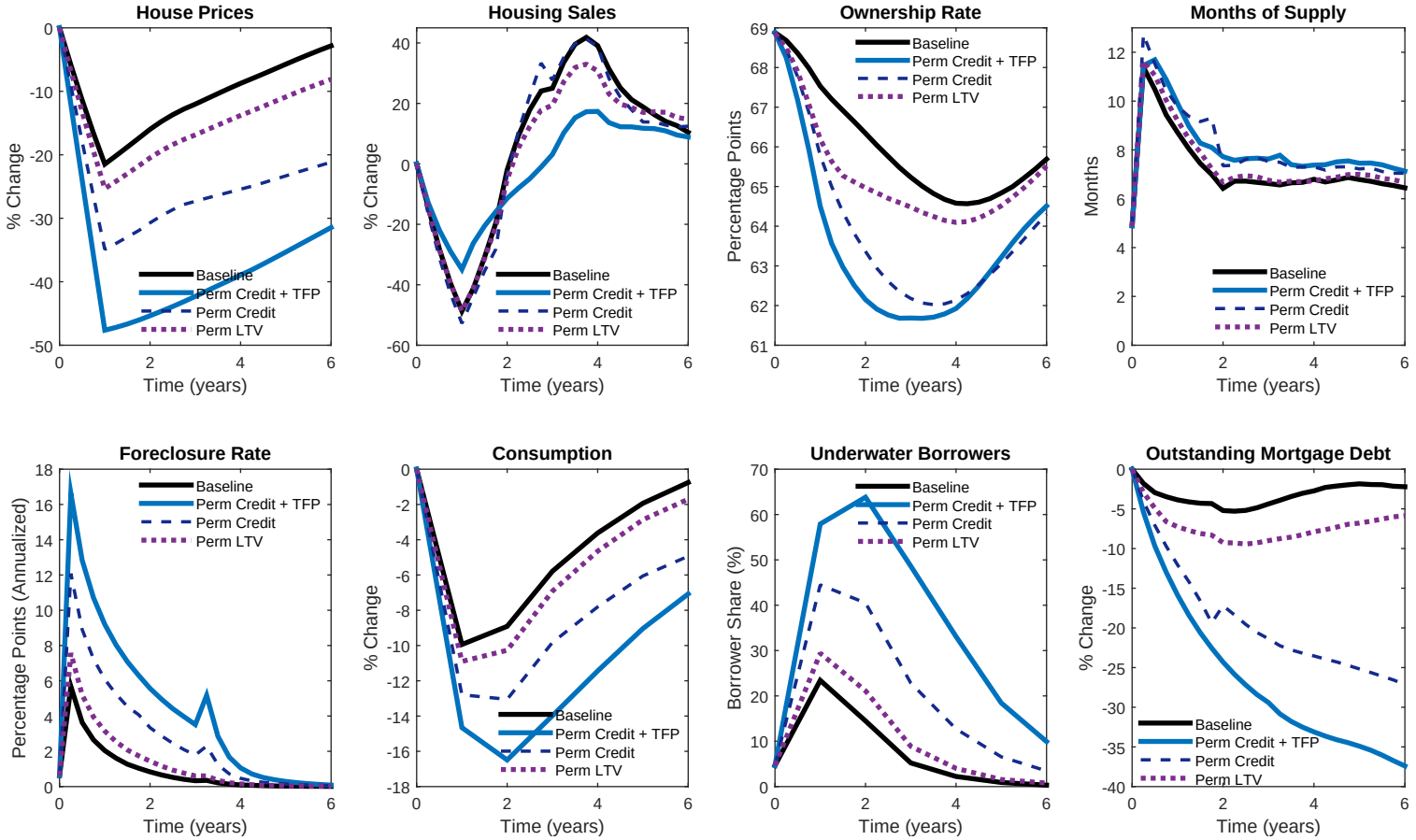
Calibration III



Calibration Summary

MAKING THE SHOCKS PERMANENT

- Expectations of terminal conditions matter for the crisis.



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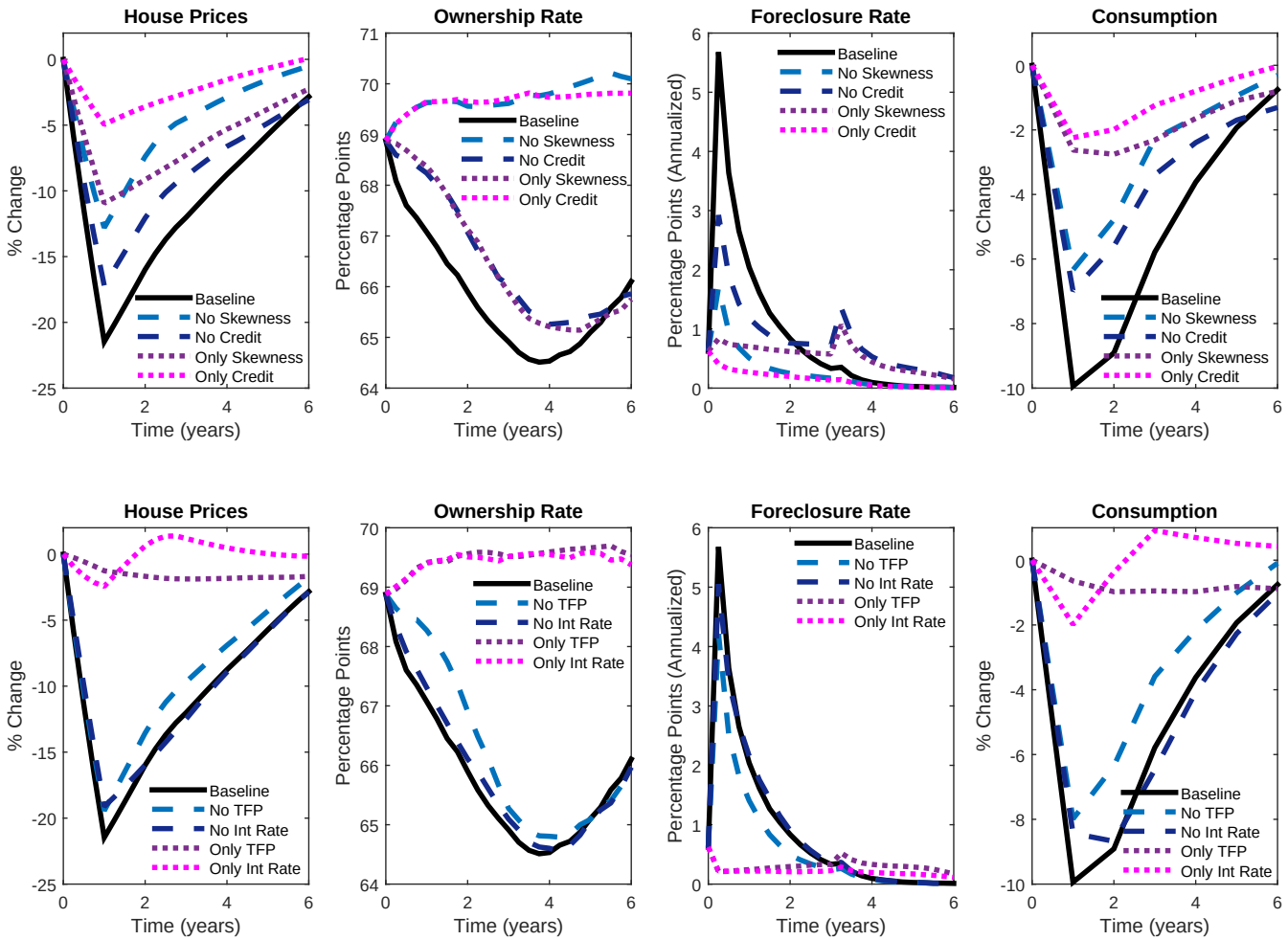
THE IMPORTANCE OF EARNINGS SKEWNESS SHOCKS

- Higher left tail risk necessary for homeownership decline.



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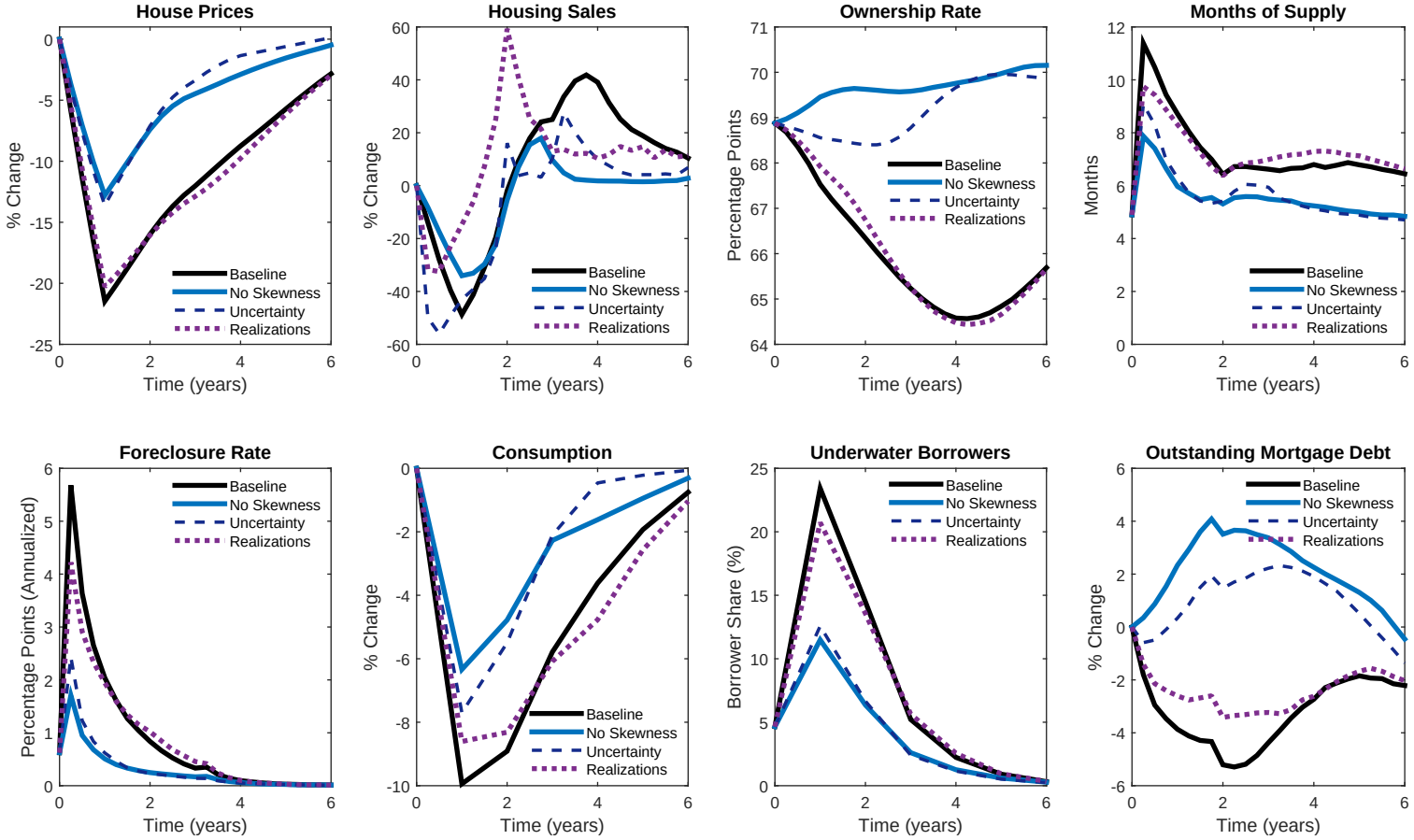
EARNINGS REALIZATIONS VS. UNCERTAINTY

- Bad earnings realizations have a larger effect, though uncertainty matters.



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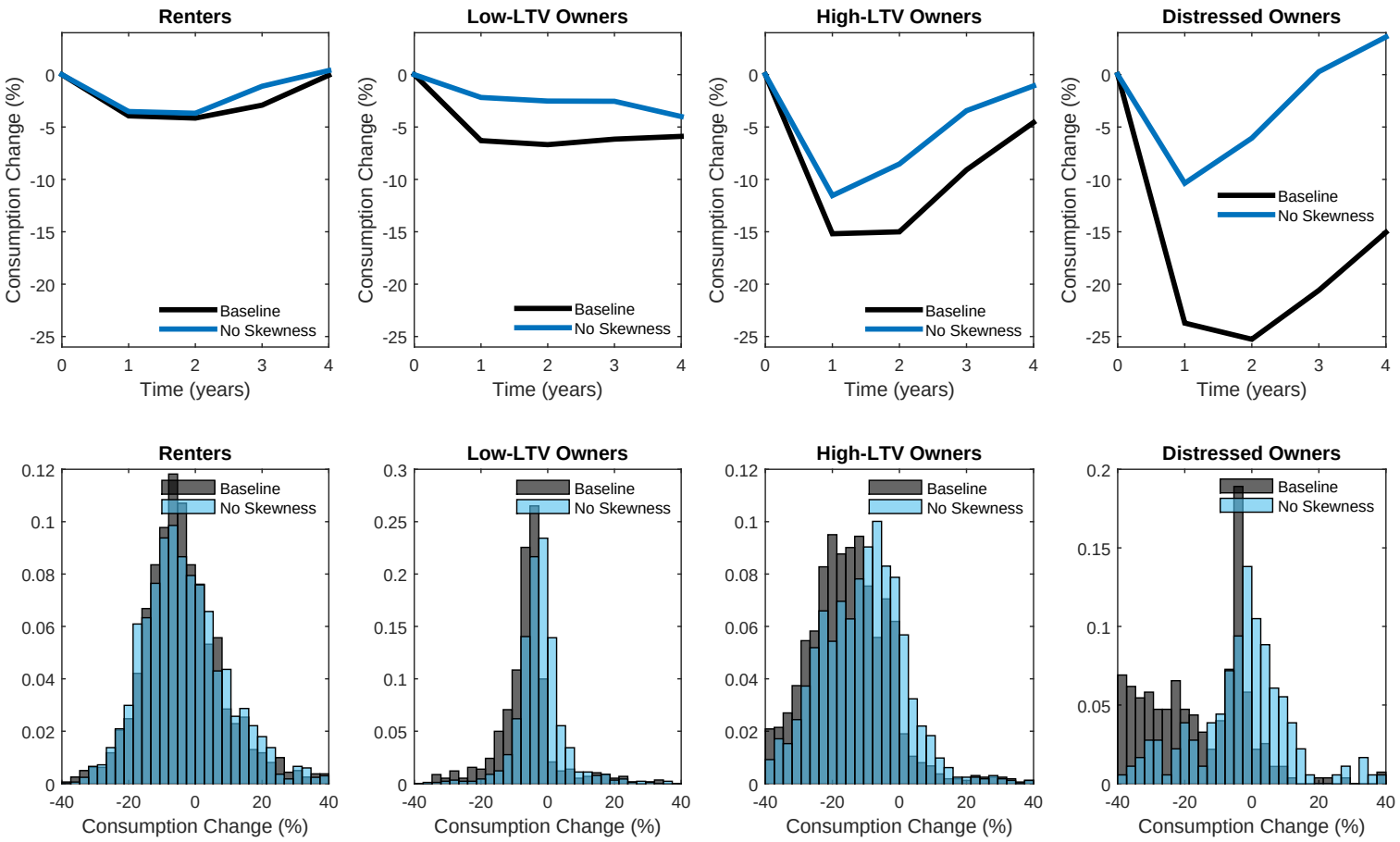
DISTRIBUTIONAL EFFECTS OF SKEWNESS SHOCKS

- Distressed owners are most affected by skewness shocks.



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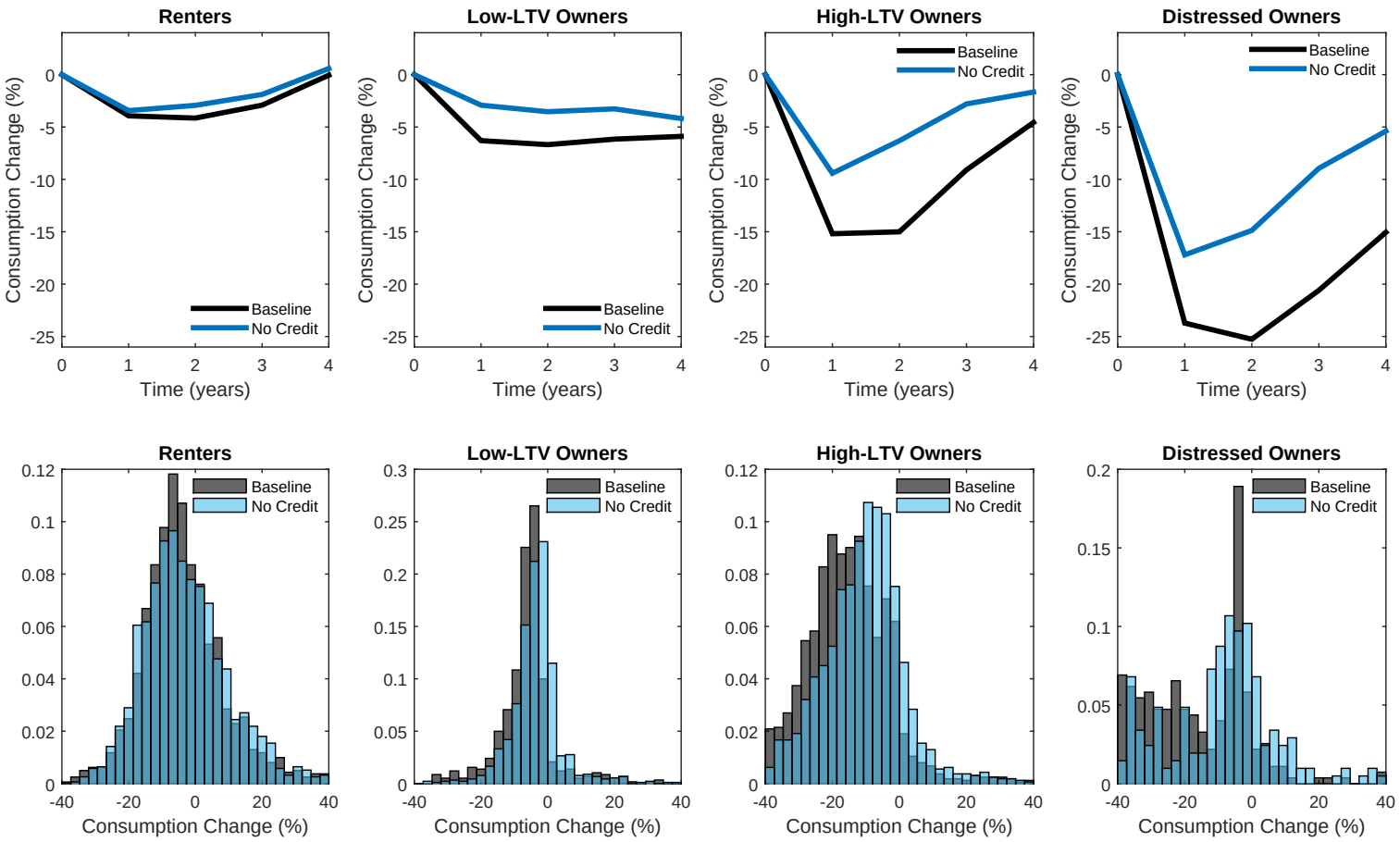
DISTRIBUTIONAL EFFECTS OF CREDIT SHOCKS

- High-LTV owners are most affected by tighter borrowing.



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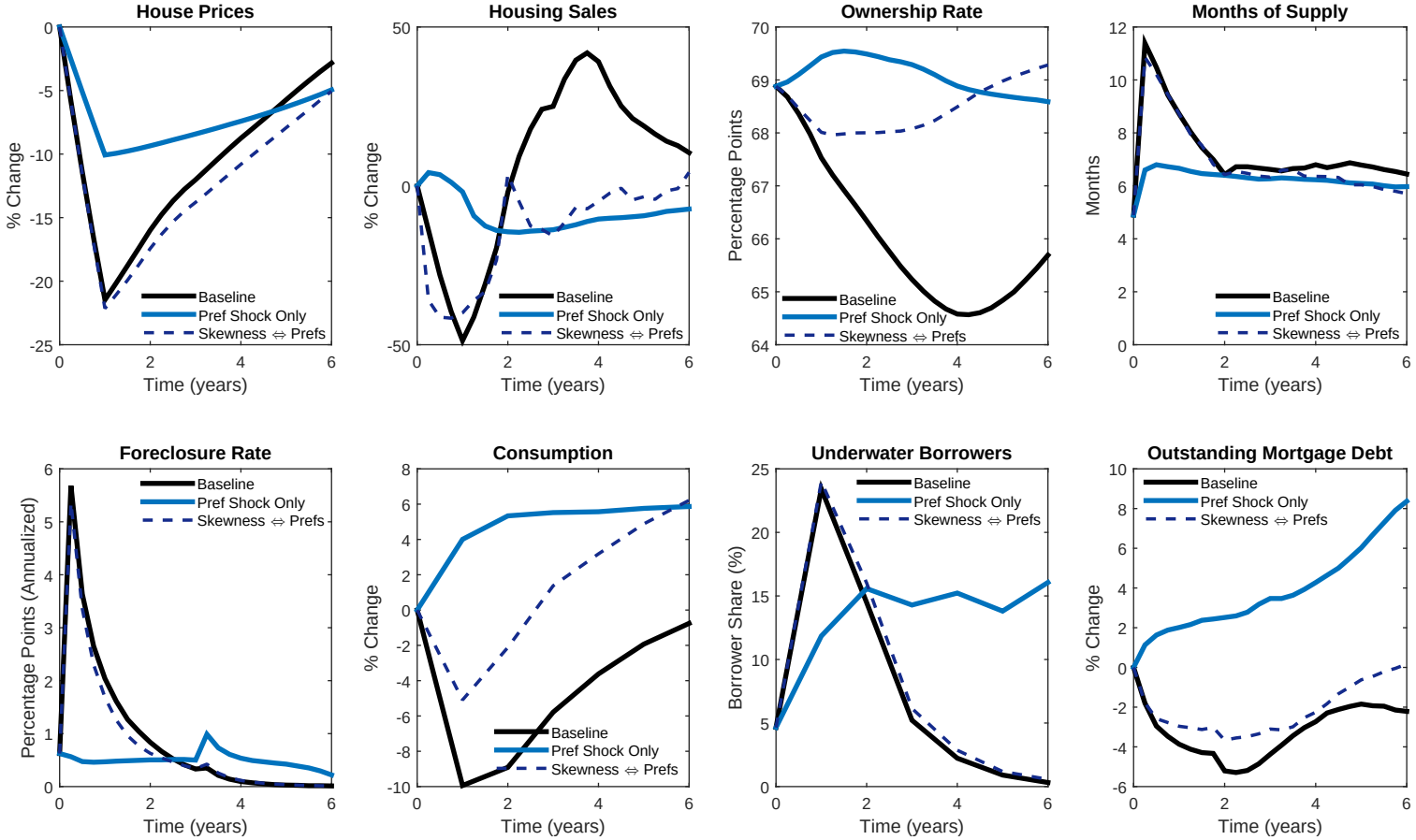
ALTERNATIVES: PREFERENCE SHOCKS

- Counterfactual homeownership and consumption dynamics.



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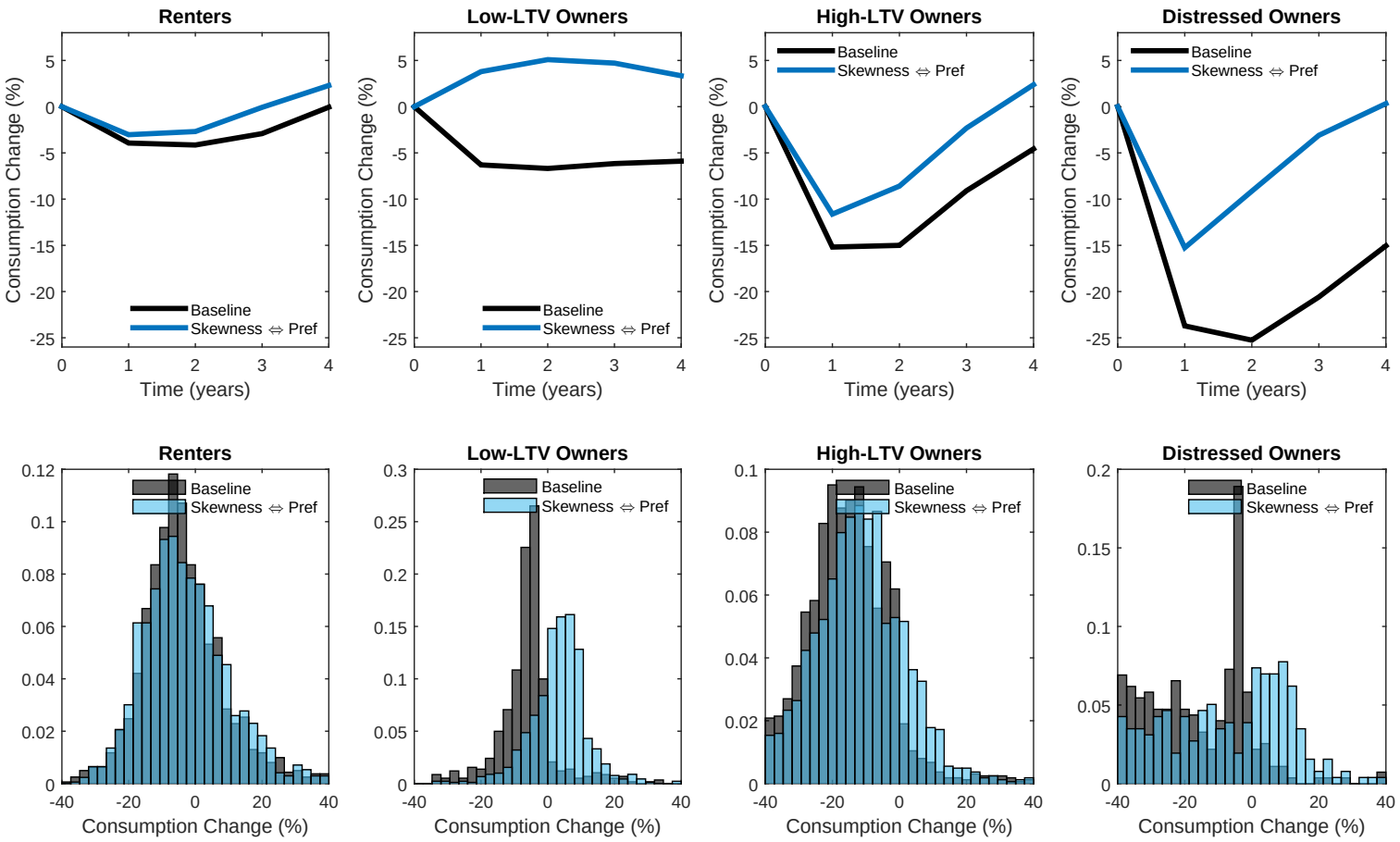
SWAPPING SKEWNESS WITH PREFERENCE SHOCKS

- Counterfactual consumption for low-LTV owners.



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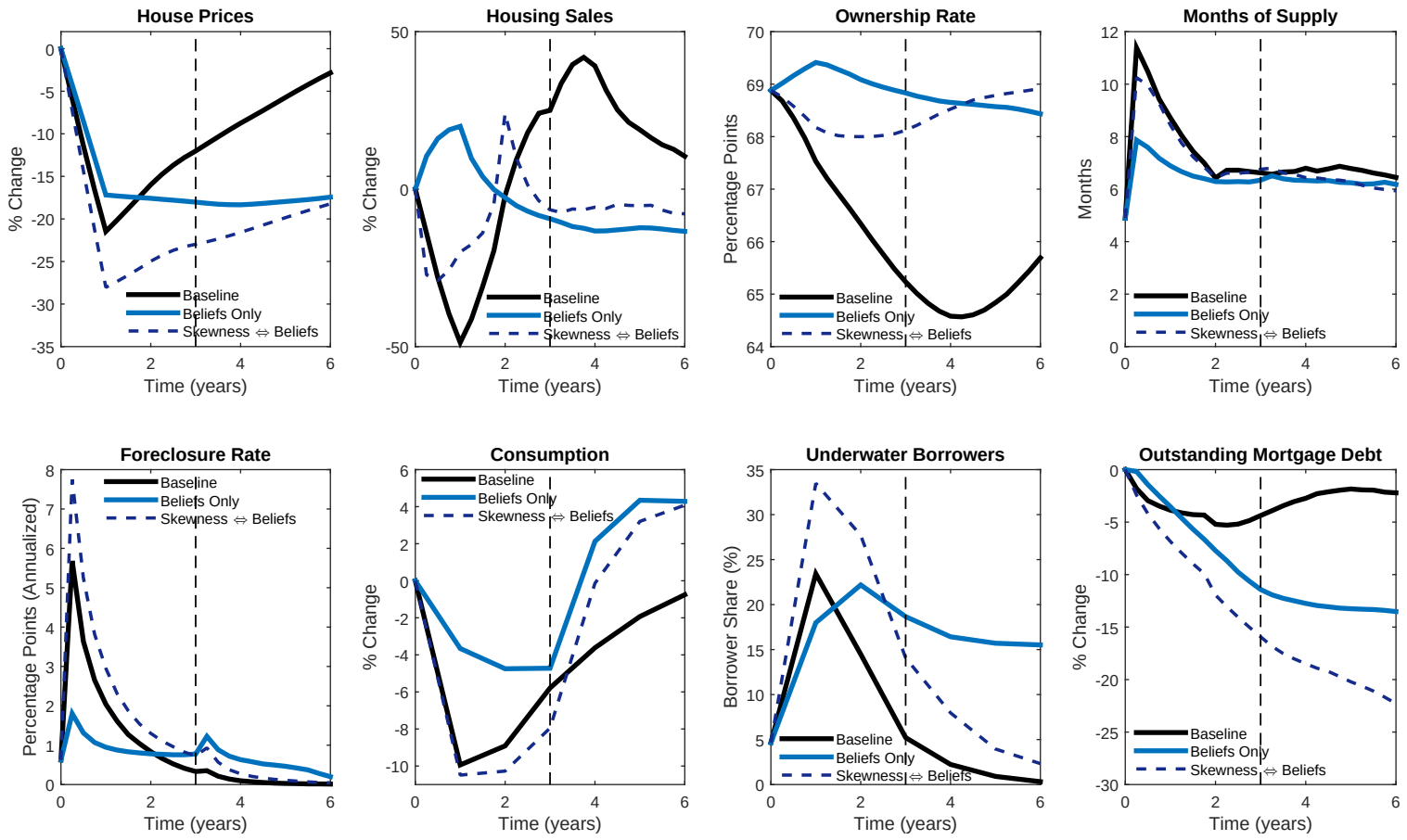
ALTERNATIVES: HOUSING PESSIMISM

- Counterfactual homeownership and debt dynamics.
- Bhutta (2015): debt decline due to fewer first-time buyers.



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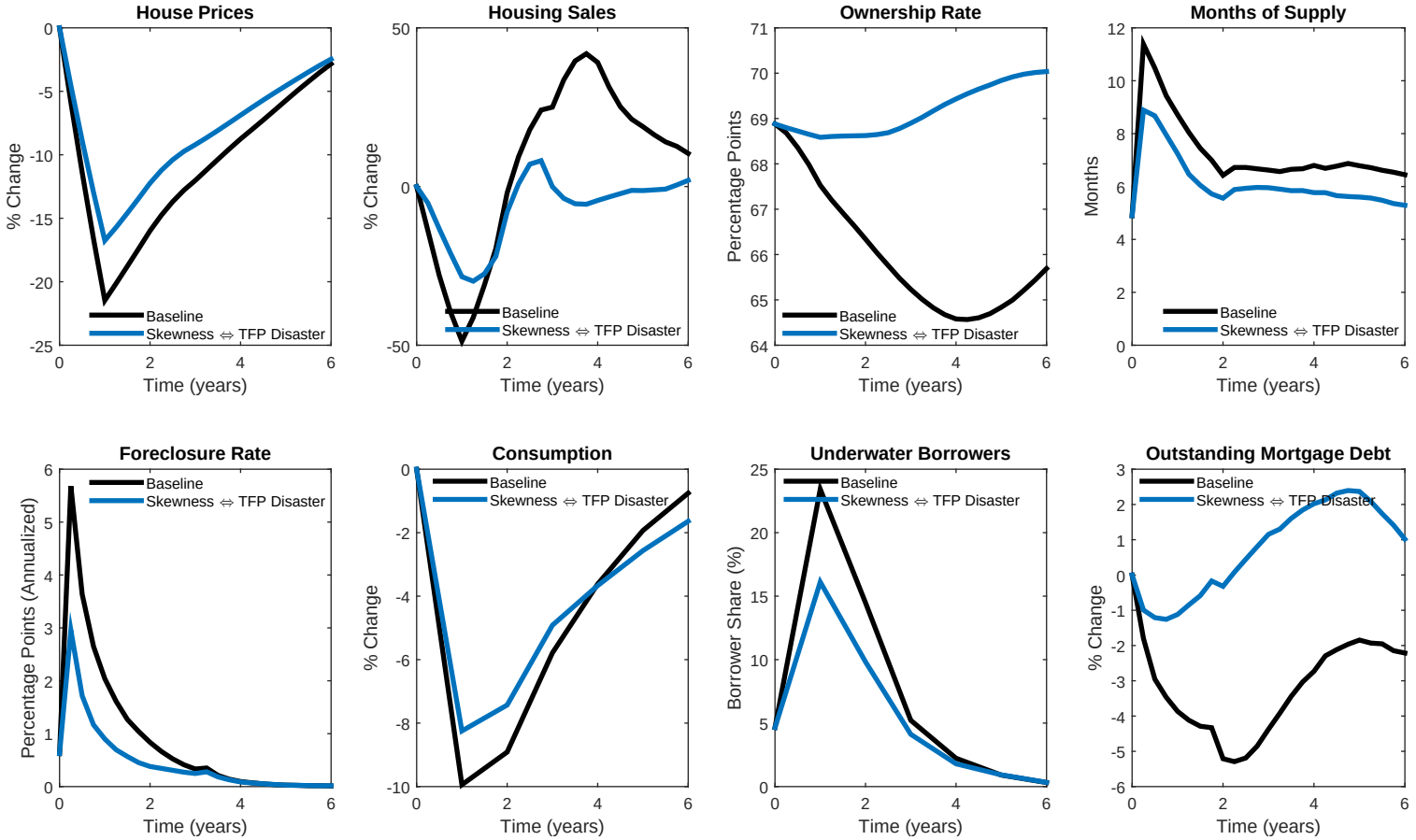
Alternatives: Productivity Disasters

- Insufficient volatility and counterfactual homeownership.



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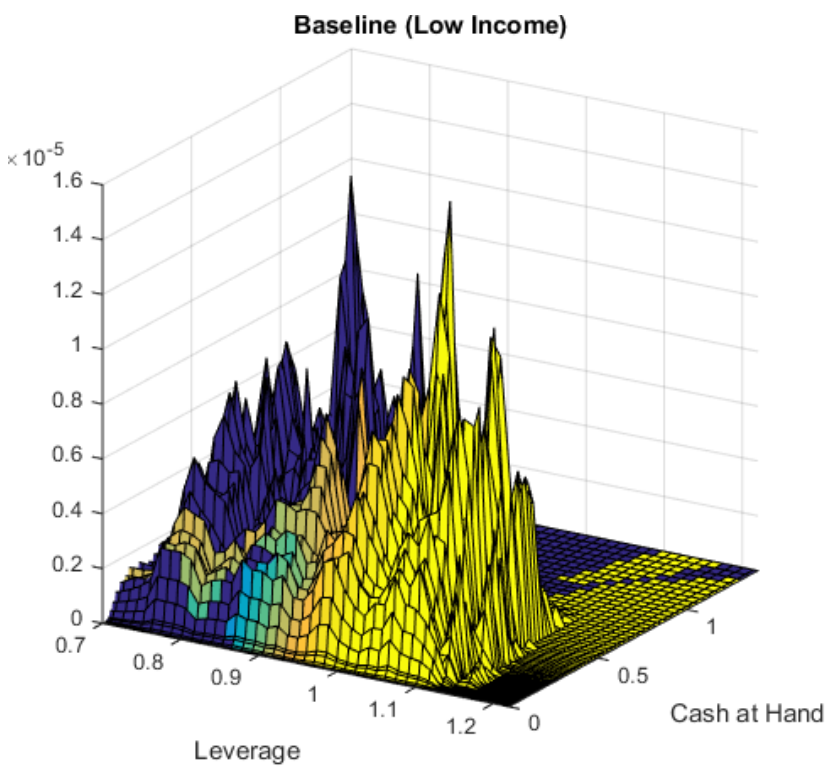
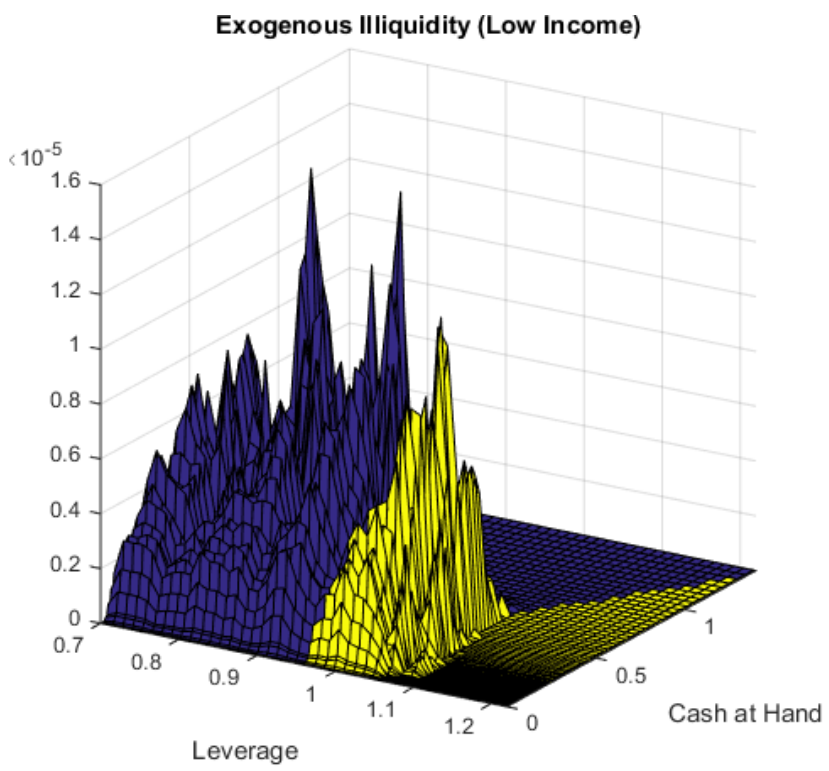
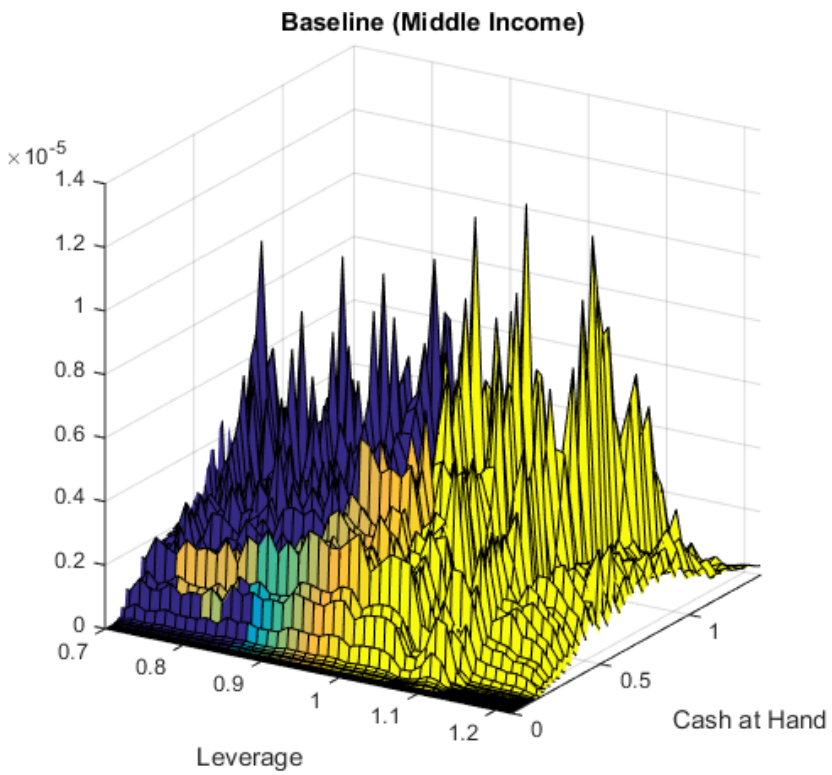
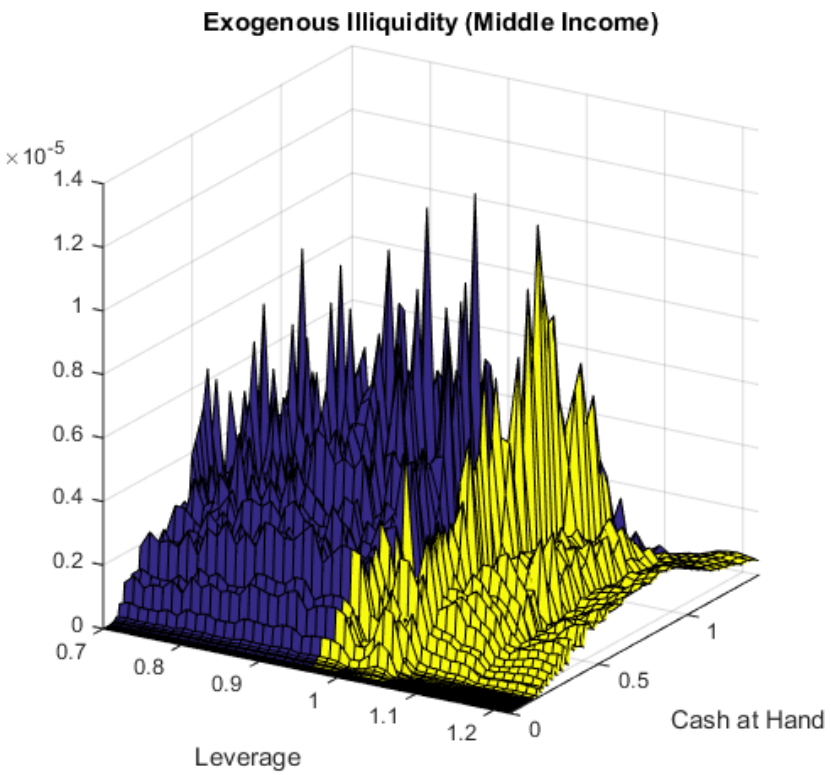
The Liquidity-Adjusted Double Trigger





The Liquidity-Adjusted Double Trigger





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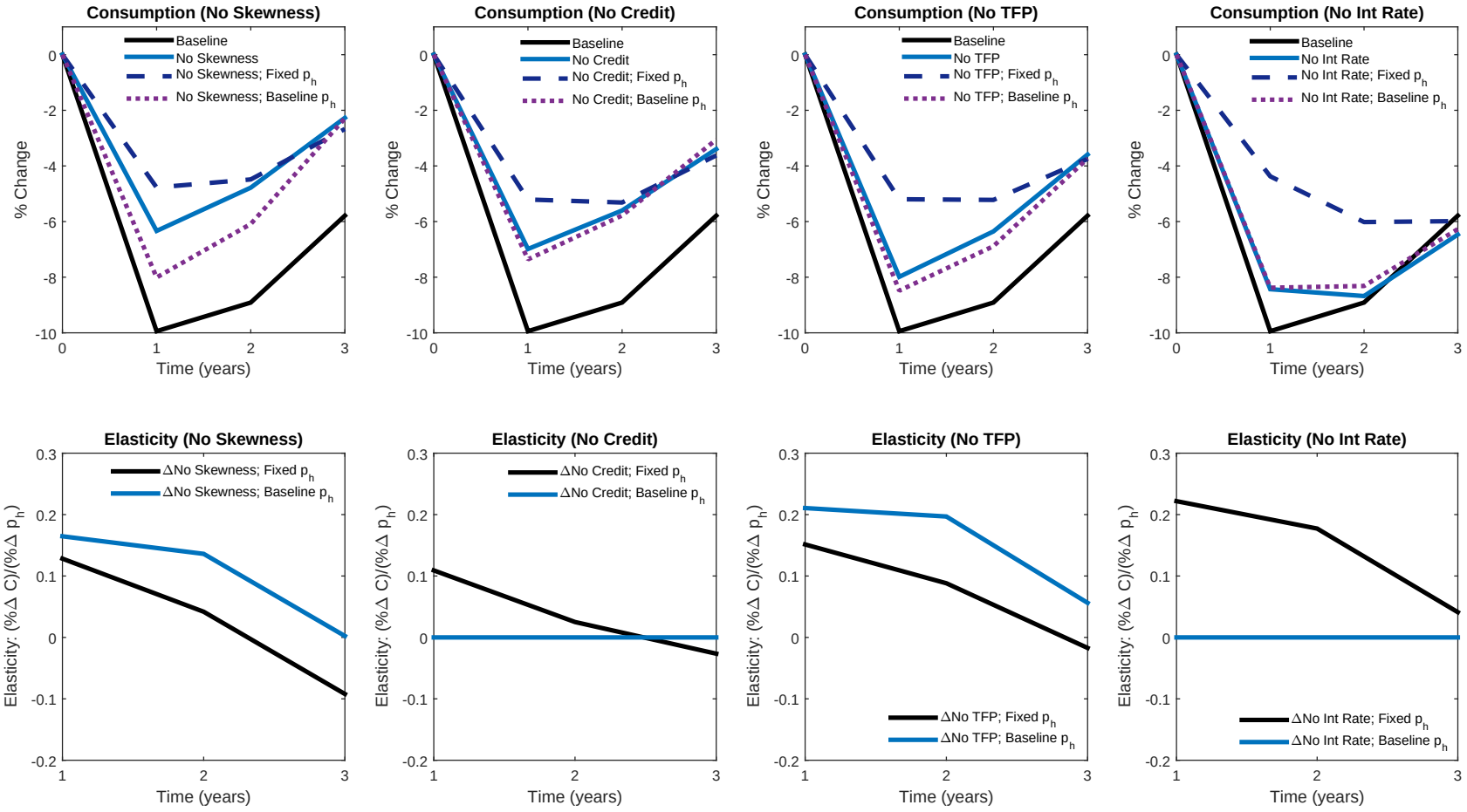
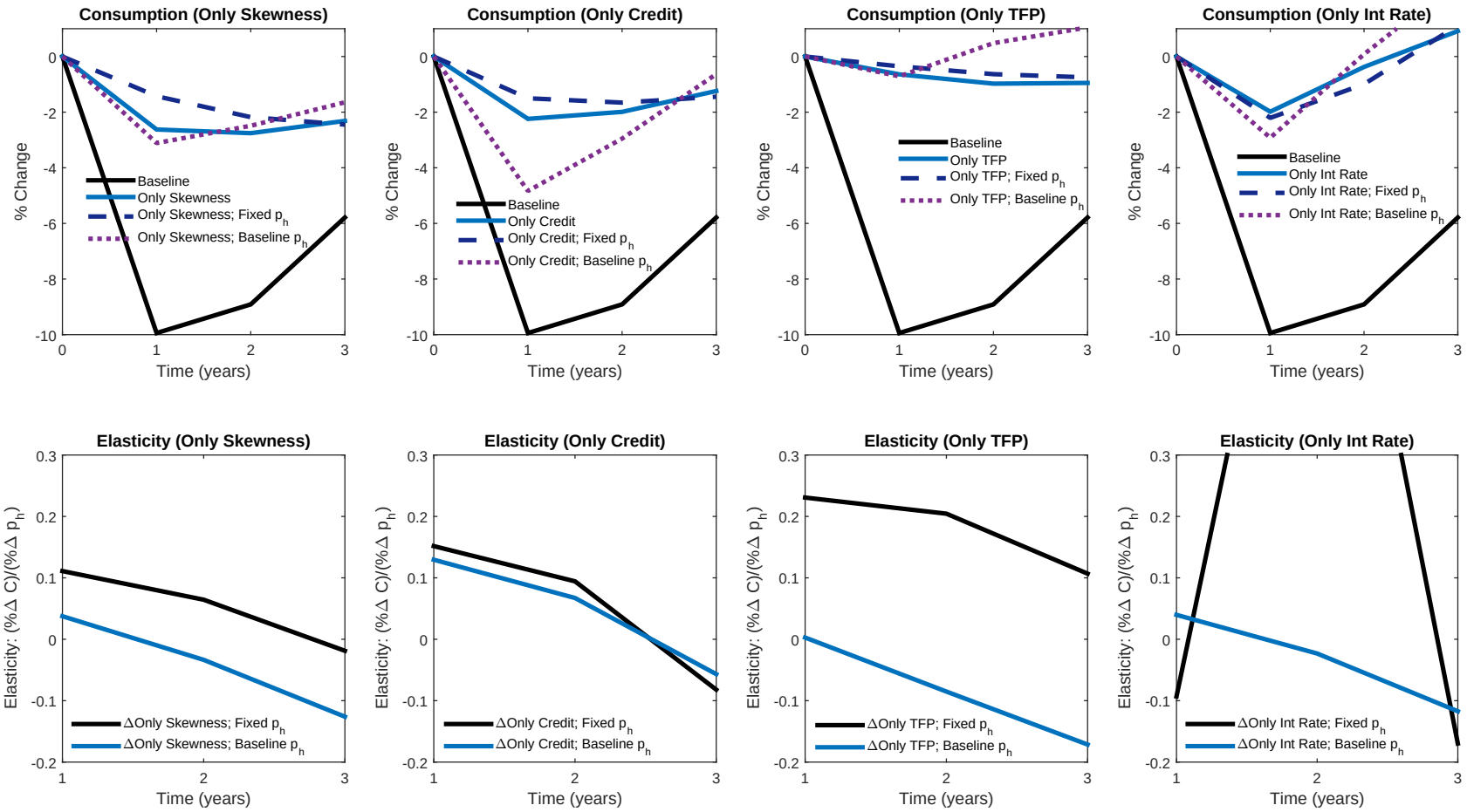
Nonlinearities and Shock Dependence



Nonlinearities and Shock Dependence



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