# A Theory of Housing Demand Shocks[1]

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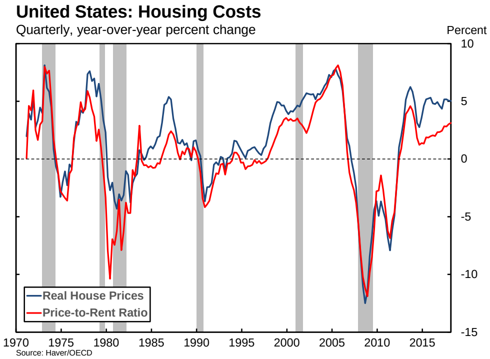
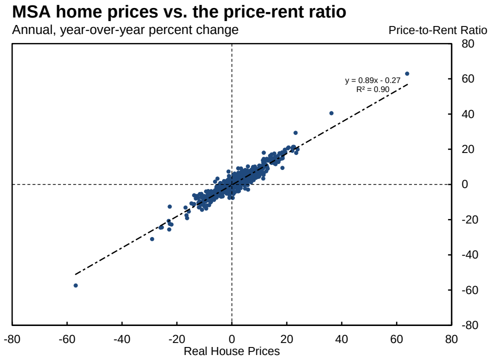
# House prices and price-rent ratio strongly comove and equally volatile



# Representative-agent (RA) model

- Rep household's problem

$$\max \quad \mathbb{E} \sum_{t=0}^{\infty} \beta^t \left\{ \log c_t + \varphi_t \frac{h_t^{1-\theta}}{1-\theta} \right\}$$

subject to

$$c_t + Q_t(h_t - h_{t-1}) \leq y_t + \frac{b_t}{R_t} - b_{t-1}$$

- House price satisfies rep agent's Euler equation

$$Q_t = \beta \mathbb{E}_t Q_{t+1} \frac{y_t}{y_{t+1}} + \varphi_t y_t$$

where $r_{ht} \equiv \varphi_t y_t$ is implicit rent

# Price-rent puzzle in RA model

- Assume $\hat{y}_t = 0$. Linearizing under $\hat{\varphi}_t = \rho\hat{\varphi}_{t-1} + e_t$:

$$\hat{Q}_t = \frac{1-\beta}{1-\beta\rho}\hat{\varphi}_t \quad \hat{r}_{ht} = \hat{\varphi}_t$$

- Housing demand shock $\varphi_t$ drives both price and rent fluctuations

**Proposition**

*Assume $\hat{y}_t = 0, \forall t$. For any covariance-stationary process of the housing demand shock $\hat{\varphi}_t$ and any arbitrary information structure, we have $\frac{\mathbb{STD}(\hat{Q}_t)}{\mathbb{STD}(\hat{r}_{ht})} < 1$.*

- Introducing credit-constrained agents does not help: house price still needs to satisfy Euler equation of unconstrained agents (Liu, Wang, and Zha 2013)

# Heterogeneity important for house price fluctuations

- RA model faces price-rent puzzle: heterogeneity needed. But what kind of heterogeneity?
- Mian and Sufi (2021) present micro evidence that
  1. During housing boom (2002-2006), areas more exposed to mortgage credit expansion had higher housing transactions and faster house price growth
  2. Increases in transaction volume and house prices mainly driven by speculator trading
  3. Speculators more optimistic about house price growth than average household
- Evidence suggests "heterogeneity in beliefs about house price growth may have been important in explaining how credit affected the housing market"
- Open question: How would heterogeneous beliefs explain the price-rent puzzle in GE model?

# A model with heterogeneous beliefs

- Household has continuum of members, with family utility

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ \log c_t + \tilde{\varphi}_t \frac{s_{ht}^{1-\theta}}{1-\theta} \right]$$

  where $\tilde{\varphi}_t$ is i.i.d.

- Each member has idiosyncratic belief $\varepsilon_t$ about future housing value $\tilde{\varphi}_{t+1}$
- Budget constraint

$$c_t + r_{ht} s_{ht} + a_t = y_t + (Q_t + r_{ht}) \int h_{t-1}(\varepsilon_{t-1}) dF(\varepsilon_{t-1}) - \int b_{t-1}(\varepsilon_{t-1}) dF(\varepsilon_{t-1})$$

- Rental market is frictionless

# Decentralized housing markets

- Flow of funds constraint for member with belief $\varepsilon_t$

$$Q_t h_t(\varepsilon_t) \leq a_t + \frac{b_t(\varepsilon_t)}{R_t},$$

- Borrowing constraint

$$\frac{b_t(\varepsilon_t)}{R_t} \leq \kappa_t Q_t h_t(\varepsilon_t),$$

where credit supply shock $\kappa_t$ reflects changes in LTV or loan approval prob

- No short-sale constraint

$$h_t(\varepsilon_t) \geq 0$$

# Equilibrium

- Market clearing

$$c_t = y_t, \quad s_t = \int h_t(\varepsilon_t) dF(\varepsilon_t) = 1, \quad \int b_t(\varepsilon_t) dF(\varepsilon_t) = 0$$

- Equilibrium rent

$$r_{ht} = \varphi s_t^{-\theta} c_t = \varphi y_t$$

- Equilibrium house price (conjectured)

$$Q_t = y_t q(\kappa_t) \equiv y_t q_t$$

- Price-to-rent ratio

$$\frac{Q_t}{r_{ht}} = \frac{q_t}{\varphi}$$

# Buyers and sellers

- Optimistic traders with high $\varepsilon_t$ assign high value to future housing services and buy houses; pessimists sell
- Buyers face binding borrowing constraints; sellers cannot short sell
- Marginal trader with $\varepsilon_t^*$ is indifferent
- Equilibrium housing allocations

$$h(\varepsilon_t) = \begin{cases} \frac{1}{1-\kappa_t} > 1, & \text{if } \varepsilon_t \geq \varepsilon_t^* \\ 0, & \text{otherwise} \end{cases}$$

- Housing market clearing $\rightarrow$ marginal trader's belief $\varepsilon_t^*$ is given by

$$F(\varepsilon_t^*) = \kappa_t$$

- Increase in credit supply ($\kappa_t$) raises marginal trader's valuation of future housing, boosting aggregate housing demand and house price

# Aggregate housing demand: a micro foundation

## Proposition

*Equilibrium house price $Q_t$ satisfies aggregate Euler equation*

$$\lambda_t Q_t = \beta \mathbb{E}_t \lambda_{t+1} Q_{t+1} + \xi(\kappa_t), \tag{1}$$

*where*

$$\xi(\kappa_t) \equiv \frac{\beta}{1 - F(\varepsilon_t^*)} \int_{\varepsilon_t^*} \varepsilon dF(\varepsilon), \tag{2}$$

*which is a function of $\kappa_t$ since $F(\varepsilon_t^*) = \kappa_t$.*

## Corollary

*If $\varphi_t = \xi(\kappa_t)$, then equilibrium house prices in HA and RA models coincide*

# Credit supply, house price, and rent

## Proposition

*An increase in credit supply $\kappa_t$ raises house price $Q_t$, with no effect on rent $r_{ht}$:*

$$\frac{\partial Q_t}{\partial \kappa_t} > 0, \quad \frac{\partial r_{ht}}{\partial \kappa_t} = 0. \tag{3}$$

- Unlike the RA model, credit supply shock $\kappa_t$ moves house price without affecting rent
- With belief heterogeneity, credit supply shocks generates large fluctuations in house prices relative to rents
- Model mechanism in line with evidence [Mian-Sufi (2021)]
- Model predictions supported by empirical evidence [see also Favilukis et al 2019]

# House trading volume

Trading volume: average number of houses bought or sold between periods

$$TV_t \equiv \frac{1}{2} \int \int |h_t(\varepsilon_t) - h_{t-1}(\varepsilon_{t-1})| dF(\varepsilon_t) dF(\varepsilon_{t-1})$$

## Proposition

*The equilibrium house trading volume is given by*

$$TV_t = \max\{\kappa_t, \kappa_{t-1}\}, \tag{4}$$

*which increases with credit supply $\kappa_t$.*

- Trading volume increases with $\kappa_t$, as does house price
- Model generates positive correlation b/n trading volume and house price, in line with empirical evidence (Ortalo-Magné and Rady, 2006; Mian and Sufi, 2021)

# Heterogeneous beliefs about future income growth

- Family members draw i.i.d belief $e_t$ about $\frac{y_{t+1}}{y_t} = g_{t+1}$ from distribution $F(\cdot)$
- Family utility function

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ \log c_t + \varphi \frac{s_t^{1-\theta}}{1-\theta} \right]$$

- Budget constraint

$$c_t + a_t + r_{ht} s_t = y_t + (Q_t + r_{ht}) \int h_{t-1}(e_{t-1}) dF(e_{t-1}) - \int b_{t-1}(e) dF(e_{t-1}),$$

- $\varphi$ kept constant; $s_t$ denotes housing services; Rental market is frictionless

# Decentralized housing markets

- Flow of funds constraint for member with belief $\varepsilon_t$

$$Q_t h_t(e_t) \leq a_t + \frac{b_t(e_t)}{R_t},$$

- Borrowing constraint

$$\frac{b_t(e_t)}{R_t} \leq \kappa_t Q_t h_t(e_t),$$

where LTV $\kappa_t$ represents credit supply shock

- No short-sale constraint

$$h_t(e_t) \geq 0$$

# House buyers and sellers

- Marginal agent (with belief $e_t^*$):

$$q_t = \frac{e_t^*}{R_t}\mathbb{E}_t\left[q_{t+1} + \varphi\right]$$

- Optimists ($e_t \geq e_t^*$) buy houses, facing binding borrowing constraints and each choosing $h_t(e_t) = \frac{1}{1-\kappa_t}$
- Pessimists ($e_t < e_t^*$) sell houses and save
- Intertemporal wedge: $\beta_t \equiv \frac{e_t^*}{R_t}$,
- Euler equation similar to Gordon's (1959) dividend discount model, but with marginal agent's belief ($e_t^*$) about future income growth ($g$) endogenous to credit conditions ($\kappa_t$)

# Price-rent dynamics

**Proposition**

*Increase in credit supply ($\kappa_t$) raises $e_t^*$, boosting house price $Q_t$, with no effect on rent $r_{ht} = \varphi y_t$.*

- Credit supply expansion makes marginal agent more optimistic ($e_t^*$ rises), boosting aggregate housing demand
- Credit supply expansion raises the house price but does not affect rent ($r_{ht} = \varphi y_t$)
- Model capable of generating large vol of house price relative to rent, as in data

# Conclusion

- Rep agent model needs to confront a price-rent puzzle:
  - House price driven primarily by reduced-form housing demand shock
  - But housing demand shocks also drive fluctuations in rents
  - Fail to generate observed large fluctuations in house prices relative to rents
- Contributions: constructing a heterogeneous-agent framework that
  1. provides micro-foundation for reduced-form housing demand shocks,
  2. generates positive correlation b/n house prices and transaction volume, and
  3. helps resolve price-rent puzzle
- Model is stylized, but mechanism is supported by micro evidence (e.g., Mian-Sufi, 2021)
- Belief heterogeneity important for understanding house price-rent dynamics and also for designing macro-prudential policy

Additional slides

# Credit supply shocks and price-rent dynamics

- Credit supply shocks: accelerated credit growth associated with low mortgage spread (Mian, Sufi, and Verner 2017)

- Local projections model

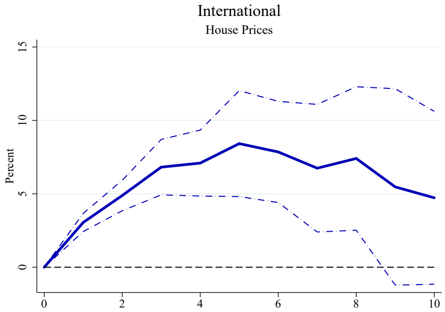
$$\log Y_{i,t+h} - \log Y_{it} = \alpha_0^h + \sum_{j=0}^{8} \beta_j^h \Delta D_{i,t-j}^{HH} + \gamma_i^h + u_{i,t+h}^h, \quad h = 0, 1, \ldots, 10$$

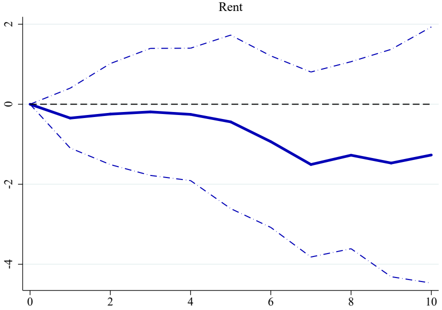
where $Y_{it} \in \{q, r_h, \frac{q}{r_h}\}$; $\Delta D_{it}^{HH}$ = credit growth; $\gamma_i^h$ = fixed effect

- Instrumental variable for credit growth: $I^{MS} = 1$ if mortgage spread below median

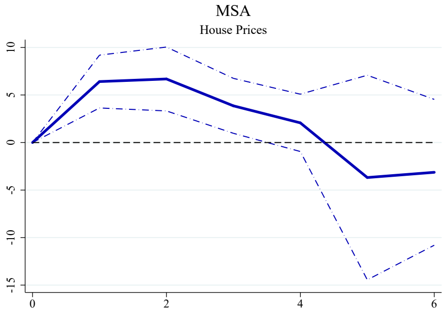
- Two samples: (i) unbalanced panel of 25 advanced economies 1965-2013; (ii) unbalanced panel of 21 MSAs 1978-2017

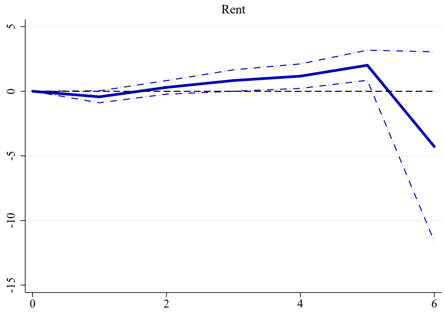
# Credit expansion boosts house prices, but not rents in cross-country data...



# ...and also in U.S. regional data



# Credit expansion leads to large and persistent increases in price/rent ratio [Go back]

International


MSA