Understanding Booms and Busts in Housing Markets

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Motivation
Why some booms are followed by busts while others are not?
Motivation

- **Question:** Why some booms are followed by busts while others are not?
- Looking at the data is impossible to predict ex-ante whether the boom will bust or not.
- Models with homogeneous expectations fail to explain the outcome after the boom.
- **Objective:** Construct a model with heterogeneous beliefs that explains this feature, while with reasonable calibration matches well the U.S. housing market.
- **Results:** Although heterogeneous beliefs alone can generate the desired dynamic, is too stylized to match the data well.
- However, when combined with matching frictions it matches the U.S. housing market really well.
Social dynamics in a frictionless model

- How to model social dynamics?
  1. **Uncertainty**: fundamentals may change over time and the agents do not know when.
     Related to the literature of long run fundamental and long run risk: *Bansal and Yaron (2004)*, *and Hansen, Heaton, and Li (2008)*.
  2. **Heterogeneous Beliefs**: some believe that fundamentals will change, others do not. Agents agree to disagree, but there is no way to know ex-ante who is right.
     Related to: *Scheinkman and Xiong (2003)*, *Acemoglu, Chernozhukov, and Yildiz (2007)*, *Piazzesi and Schneider (2009)*.
  3. **Social dynamics**: agents meet and try to convince each other that they are right.
Social dynamics in a frictionless model

Model economy:
- Continuum of agents with measure one, with linear utility and discount $\beta$.
- Fixed stock of houses $k < 1$ and rental market $1 - k$, where $\omega$ is the price of rent. For simplicity: agents only own one house.
- Utilities of owning and renting house: $\varepsilon^h > \varepsilon^r - \omega$.
- At time $t$ decide between rent or own a house at $t + 1$: indifference condition \[ -P_t + \beta(P_{t+1} + \varepsilon^h) = \beta(\varepsilon^r - \omega) \]
- Steady-State price: $P = \frac{\beta}{1 - \beta} \varepsilon$ where $\varepsilon = \varepsilon^h - (\varepsilon^r - \omega)$
Social dynamics in a frictionless model

Experiment: changes in the value of housing fundamental.

- Begin at the SS, then $\varepsilon$ changes to $\varepsilon^*$ with probability $\phi$. Agents agree about $\phi$, disagree about the distribution of $\varepsilon^*$.
- Three types of agents: optimistic $o_t$, skeptical $s_t$ and vulnerable $v_t$. Where $E^o(\varepsilon^*) > E^s(\varepsilon^*) = E^v(\varepsilon^*) = \varepsilon$.
- Use the entropy of the pdf of $\varepsilon^*$: $e^j$ as a measure of uncertainty of the agent: $\uparrow e^j$ means $\uparrow$ uncertainty.
- Agents meet and with probability $\gamma_{lj} = \max(1 - e^l / e^j, 0)$ agent $j$ adopts the beliefs of $l$.
- Assume: the economy begins with more vulnerables: $v_0 > s_0 = o_0$. And vulnerables do not know much about house pricing: $e^v > e^s$ and $e^v > e^o$.
- If uncertainty is not realized, population converge to the agent with lowest entropy.
Social dynamics in a frictionless model

Case 1: $e^v > e^o > e^s$. Therefore the population of agents follow:

- $o_{t+1} = o_t + \gamma^{ov} o_t v_t - \gamma^{so} o_t s_t$
- $s_{t+1} = s_t + \gamma^{sv} s_t v_t + \gamma^{so} o_t s_t$
- $v_{t+1} = v_t - \gamma^{ov} o_t v_t - \gamma^{sv} v_t s_t$
Case 1: Equilibrium.

- House prices are determined by the marginal buyer.
- Sort agents in declining order of house valuations. Marginal buyer will be the \( k \)th percentile.
- In order to generate a boom-bust cycle at least \( k \) agents must be optimistic at some point of the history!

Suppose that between \( t_1 \) and \( t_2 \) the marginal buyer is optimistic (before and after she is a skeptical/vulnerable):

- \( P_t = P^s \), for \( t \geq t_2 + 1 \)
- \( P_t = \beta \left\{ \phi E^o (\varepsilon^* + P^*_{t+1}) + (1 - \phi)(\varepsilon + P_{t+1}) \right\}, \) for \( t_1 \leq t \leq t_2 \)
- \( P_t = \beta \left\{ \phi E^s (\varepsilon^* + P^*_{t+1}) + (1 - \phi)(\varepsilon + P_{t+1}) \right\}, \) for \( t < t_1 \)
Social dynamics in a frictionless model

Then, solving recursively, the equilibrium price path when uncertainty is not realized is given by:

\[
P_t = \begin{cases} 
  P^s + (\beta(1 - \phi))^{t_1-t}(P_{t_1} - P^s), & t < t_1 \\
  P^o - (\beta(1 - \phi))^{t_2+1-t}(P^o - P^s), & t_1 \leq t \leq t_2 \\
  P^s, & t > t_1 
\end{cases}
\]

Where \( P^j \) is the SS fundamental value of agent type \( j \):

\[
P^o > P^s = P^v = \frac{\beta}{1 - \beta} \varepsilon.
\]

When uncertainty is realized: \( P_t = \frac{\beta}{1 - \beta} \varepsilon^* \)
Social dynamics in a frictionless model

Intuition:

- Optimistics are willing to buy the house at a value that exceeds $P^s$ because with probability $(1 - \phi)^{t_1 - t}$ they realize capital gain: $P_{t_1} - P^s$ in $t_1$.
- Therefore, price rises before $t_1$ because the expected discounted capital gain increases at the rate $\beta(1 - \phi)$.
- Similarly, between $t_1$ and $t_2$ price is decreasing since at $t_2 + 1$ the marginal buyer is a skeptical agent. This discounted capital lost is reflected in prices.
- Before $t_1$ all newly optimistics buy houses. At $t_1$ they own all houses and transactions sharply decrease.
- Rate of return is always six percent (the calibrated value) regardless of the marginal buyer.
Social dynamics in a frictionless model
Preliminary conclusions:

- The social dynamics model can simulate booms-bust (case 1) and booms without busts (case 2: $e^v > e^s > e^o$).
- Also, in any given economy the econometrician cannot predict what is the episode he would see.
- However, 65 percent of American households owned homes. This requires that at least 65% of the agents are optimistics at some point.
- Price jumps at $t=0$. In the data the transition is smooth.
- The model cannot take into account the high correlation between transactions and avg. house price.
- **Solution:** Add matching frictions.
Matching frictions

Let’s first think about the economy without social dynamics. The structure is the same as before (utility, rent price, etc).

- Four type of agents: home owners \((h_t)\), unhappy home owners \((u_t)\), natural home buyers \((b_t)\) and natural renters \((r_t)\): \(h_t + u_t = k\) and \(b_t + r_t = 1 - k\).

- Matching tech: \(m(z_t) = \mu \text{Sellers}(z_t)\alpha \text{Buyers}(z_t)^{1-\alpha}\) where \(z_t = (h_t, b_t)'\) is the state.

- Probabilities of selling and buying: \(q^s = m/\text{Sellers}\) and \(q^b = m/\text{Buyers}\).

- Home owner value function: \(H = \varepsilon + \beta((1 - \eta)H' + \eta U')\).

- Unhappy home owner VF: \(U = \max(U^{\text{sell}}, U^{\text{stay}})\), where: \(U^{\text{sell}} = q^s [p_t + \beta((1 - \lambda)R' + \lambda B')] + (1 - q^s)\beta U'\) \(U^{\text{stay}} = \beta U' - \psi\).
Matching frictions

- Natural home buyers VF: $B = \max(B^{\text{rent}}, B^{\text{buy}})$, where:
  
  $B^{\text{rent}} = \bar{\epsilon} - \omega + \beta B'$
  
  $B^{\text{buy}} = \bar{\epsilon} - \omega + q^b \left[ -p_t^b + \beta((1 - \eta) H' + \eta U') \right] + (1 - q^b) \beta B'$.

- Natural renter VF: $R = \max(R^{\text{rent}}, R^{\text{buy}})$, where:
  
  $R^{\text{rent}} = \bar{\epsilon} - \omega + \beta((1 - \lambda) R' + \lambda B')$
  
  $R^{\text{buy}} = \bar{\epsilon} - \omega + q^b \left[ -p_t^r - \kappa \varepsilon + \beta((1 - \eta) H' + \eta U') \right] + (1 - q^b) \beta((1 - \lambda) R' + \lambda B')$.

- From the value functions we can derive reservations prices: $
\bar{P}^b > \bar{P}^r > \bar{P}^u$. Which are function of the VF and parameters.

- Then, the amount of buyers and sellers each period:
  
  Sellers = $(u_t + \eta h_t) 1^u$ and Buyers = $(b_t + \lambda r_t) 1^b + r_t (1 - \lambda) 1^r$, where $1^j$ is indicating whether prices are s.t. the agents participate in the market.

- Prices come from generalized Nash-Bargaining as usual.
Experiments:

1. **Expected improvement in fundamentals**: Suppose agents expect: $\varepsilon^* > \varepsilon$. Since beliefs are homogeneous there is no transitional dynamics and prices jump to the new SS!

2. **Exogenous increase in the number of buyers**: Suppose $b_0 > b$ and $r_0 < r$. Probability of selling the house is higher and probability of buying is lower than in the SS! Prices are higher than in the steady state!

- The model can generate a boom-bust cycle if for some reason there is a persistent increase in the number of buyers followed by a persistent decrease.
- Our previous social dynamics model can generate that!
Matching frictions
Experiments
Social dynamics with matching frictions

- Combine both models: 12 types of agents.
- Timing: First, uncertainty about $\varepsilon^*$ is realized or not. Second, preference shocks occur. Third, social interactions occur. Last, transactions occur.
- A generic value function will be of the form:
  \[ V^j_{e} = (1 - \phi) V^j + \phi \sum_{\varepsilon^*} f^j(\varepsilon^*) V \]
  where: $V^j$ can be: $H^j, U^j, B^j$ and $R^j$.
In the boom phase the number of buyers drives up for two reasons:

▶ First: Optimistic renters enter the market.
▶ Second: As they enter the market: $\uparrow q^s$ and $\downarrow q^b$.
▶ As $\downarrow q^b$ the natural buyers cannot buy houses, they start to accumulate over time: $\downarrow \downarrow q^b$.
▶ Similarly: $\uparrow q^s$, this effect reduces the stock of unhappy home owners and reinforce the $\uparrow \uparrow q^s$.

The effect begun to fade out as the agents become skeptical.

Reservation prices go up $\Rightarrow$ prices go up.

Highly comovement between price and buyers.
Social dynamics with matching frictions
Conclusion

When calibrated as the U.S. economy (1997-2012) the model can capture the following features:

- Difference of mean-median $\Rightarrow$ presence of heterogeneous beliefs and social dynamics.
- Slow and smooth price increase right at the beginning of cycle.
- Length of the boom-bust episodes: price peaks 10 years in the data and 13 years in the model.
- Mean value of the maximum percentage rise prices: data 144%, model 289%. After computed the distribution: 144% lies at the 23 percentile.
Propose a new way to model how agents have different beliefs.

Social dynamics alone can generate different types of housing price boom, although it cannot fit the data very well.

When combined with matching frictions the model can get close to the data.

... How about financial frictions?

... Welfare improving policies?
Annex

Reservation prices:

\( \bar{P}^u = \frac{\beta}{1 + \psi} (U' - ((1 - \lambda)R' + \lambda B')) \)

\( \bar{P}^b = \beta((1 - \eta)H' + \eta U' - B')) \)

Law of motion of types:

\( h_{t+1} = (1 - \eta)h_t + q^b((b_t + \lambda r_t)1^b + r_t(1 - \lambda)1^r) \)

\( u_{t+1} = (u_t + \eta h_t)(1 - q^s1^u) \)

\( b_{t+1} = (b_t + \lambda r_t)(1 - q^b1^b) \)

\( r_{t+1} = (1 - \lambda)r_t(1 - q^b1^r) + (u_t + \eta h_t)q^s1^u \)

Nash-Bargaining prices:

\( P^b = \theta \bar{P}^b + (1 - \theta)\bar{P}^u \)

\( P^r = \theta \bar{P}^r + (1 - \theta)\bar{P}^u \)