Booms and Busts: Understanding Housing Market Dynamics

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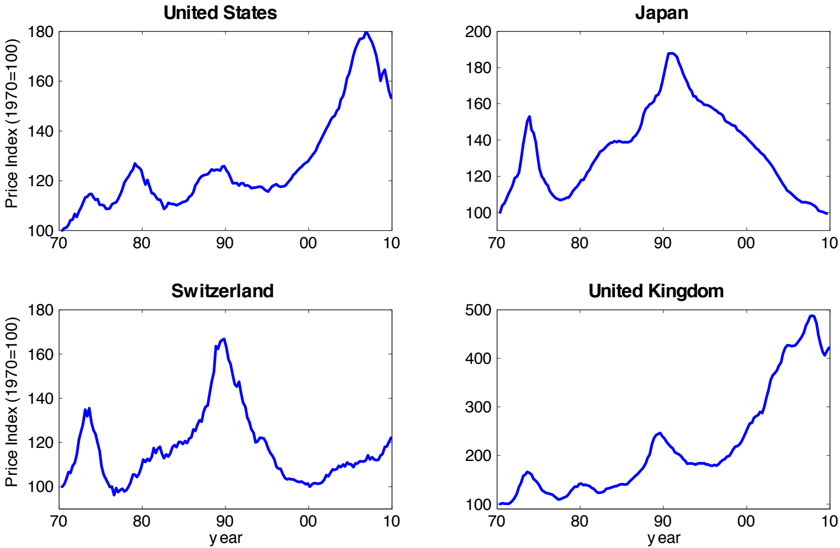
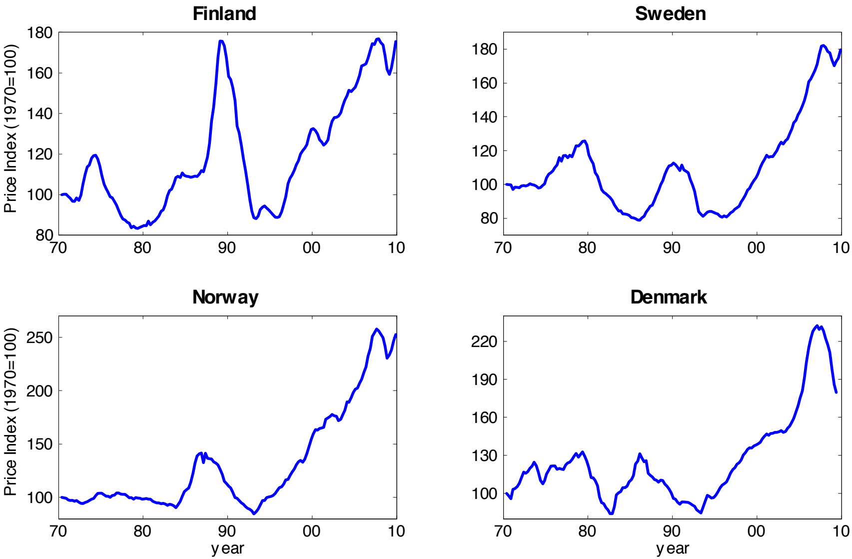
Booms and busts

- There are many episodes in which real estate prices rise dramatically.
- Sometimes protracted booms are followed by protracted busts.
    - Japan, U.S., U.K., Finland, Belgium, Denmark, Finland, New Zealand, Switzerland, Norway.
- Other times protracted booms lead to seemingly permanently higher house prices.
    - Spain (late 1980s), Canada (late 1980s), Australia (late 1980s), New Zealand (1990s).


United States
Japan
Switzerland
United Kingdom
Price Index (1970=100)
Price Index (1970=100)
180
160
140
120
100
200
500
400
300
200
70
80
90
00
10
y ear
y ear



Finland
Sweden
Norway
Denmark
Price Index (1970=100)
Price Index (1970=100)
180
160
140
120
100
80
250
200
150
100
220
190
160
130
70
80
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year
year

Booms and busts

- It is difficult to generate protracted price movements in standard rational expectations models because expected changes in future fundamentals are quickly capitalized into prices.
- Protracted booms can be generated by assuming that agents receive increasingly positive signals about future fundamentals.
- Booms and busts can be generated by assuming that agents first receive increasingly positive signals about future fundamentals and then increasingly negative signals.
- Problem: in many episodes is difficult to find *observable* fundamentals that are closely correlated with observed movements in home prices.

A matching model

- We consider a model in which there is uncertainty about long-run fundamentals.
    - Bansal and Yaron (2004) and Hansen, Heaton, Li (2008)).
- Agents have heterogenous beliefs about these fundamentals.
    - Harrison and Kreps (1976) and Scheinkman and Xiong (2003).
- Social dynamics change the fraction of agents with different beliefs.

A matching model

- Starting point: extended version of Piazzesi and Schneider (2009).
- Key insight from their paper: in a matching model a small number of optimistic agents can have a large impact on housing prices because these agents are the marginal traders.

A matching model

- There is a continuum of agents with measure one.
- Agents are either homeowners or renters.
- All agents have quasi-linear utility and discount utility at rate β.
- There is a fixed stock of homes, $k < 1$, in the economy.
  - In practice booms and busts occur in areas in which the elasticity of home supply is limited by zoning laws, scarcity of land, and infrastructure constraints.
- There is a rental market with $1 - k$ homes.

Home owners

- In each period home owners derive utility ε from their house.
- The value function of a home owner, H_t, is given by:

$$H_t = \varepsilon + \beta \left[(1 - \eta) H_{t+1} + \eta U_{t+1} \right].$$

- With probability η the match goes sour and the home owner is forced to sell his home.
- We denote the value function of this home seller by U_t.

Home sellers

- The probability that a sale occurs is p_t.
- Once a home is sold the home seller becomes a renter.
- The value of U_t is given by:

$$U_t = p_t \left[P_t(1-\phi) + \beta R_{t+1} \right] + (1-p_t) U_{t+1}.$$

- P_t = expected price received by home seller.
- R_t = value function renter at time t.
- ϕ = sale transactions costs.

Renters

- There are two types of renters: natural home buyers and natural renters.
- Natural buyers derive more utility from owning a home than natural renters.

Natural home buyers

- These agents have a value function B_t and derive a flow utility of ε^b from renting a home.

- They choose to rent or buy.

$$\begin{aligned} B_t^{rent} &= \varepsilon^b + \beta B_{t+1}, \\ B_t^{buy} &= q_t \left\{ \varepsilon^b - P_t^b + \beta \left[(1-\eta) H_{t+1} + \eta U_{t+1} \right] \right\} + (1-q_t) B_t^{rent}, \\ B_t &= \max\left(B_t^{rent}, B_t^{buy} \right). \end{aligned}$$

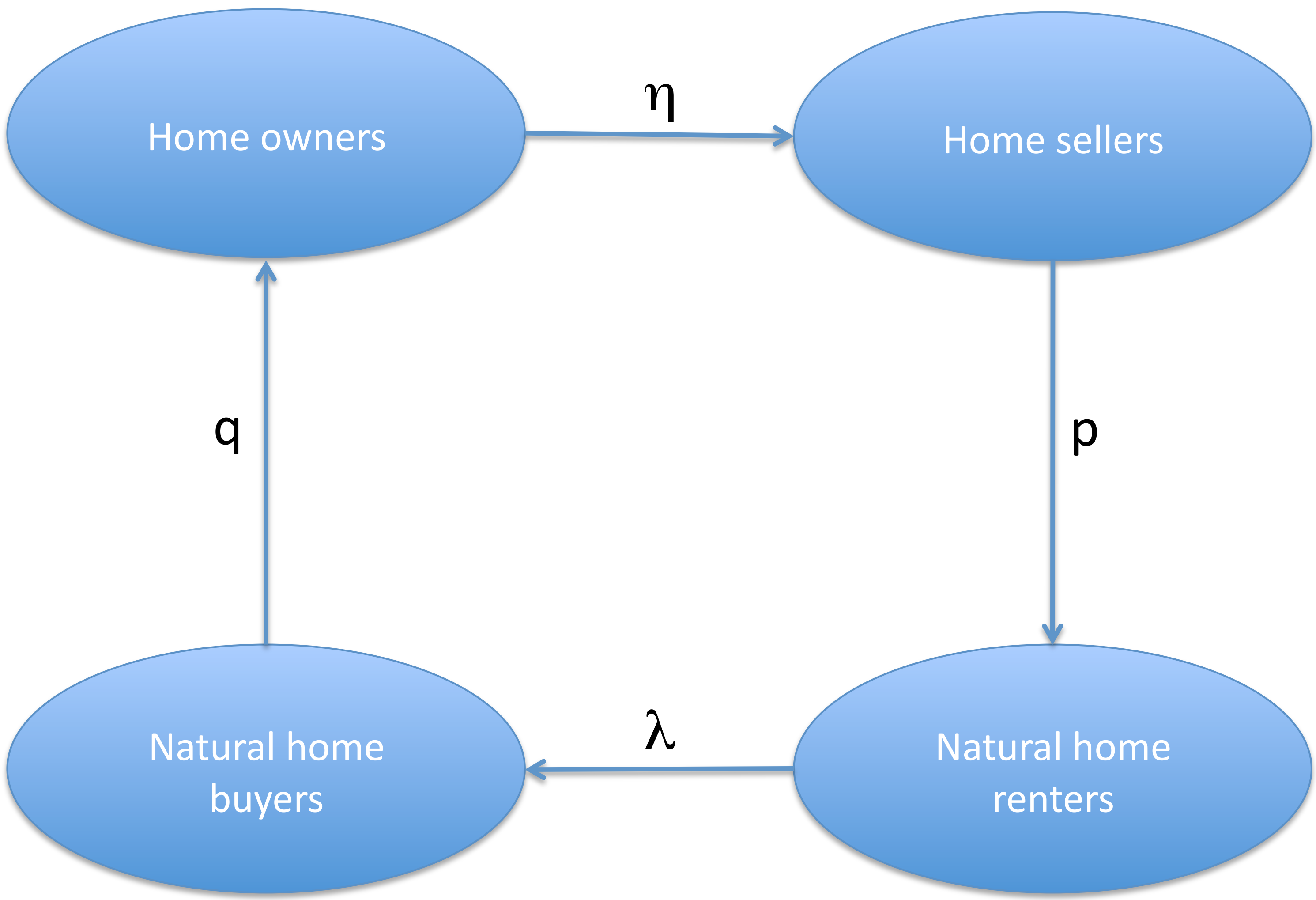
- q_t = probability of buying a home.
- P_t^b = expected price paid by a natural home buyer.

Natural renters

- Their value function is R_t.
- In present-value terms their expected utility of owning a home is lower than that of a natural buyer by an amount $\kappa\varepsilon$.
- In each period a fraction λ of natural renters have a preference shock and become natural home buyers.

$$
\begin{aligned}
R_t^{rent} &= \varepsilon^r + \beta\left[(1-\lambda)R_{t+1} + \lambda B_{t+1}\right], \\
R_t^{buy} &= q_t\left\{\varepsilon^r - P_t^r + \beta\left[(1-\eta)H_{t+1} + \eta U_{t+1} - \kappa\varepsilon\right]\right\} + (1-q_t)R_t^{rent}, \\
R_t &= \max\left(R_t^{rent}, R_t^{buy}\right).
\end{aligned}
$$

- P_t^r = expected purchase price for a natural renter.



Home owners
η
Home sellers
q
p
λ
Natural home buyers
Natural home renters

Composition of the population

- h_t = fraction of home owners.
- u_t = fraction of home sellers.
- b_t = fraction of natural buyers.
- r_t = fraction of natural renters.

$$h_t + u_t = k.$$

$$b_t + r_t = 1 - k.$$

- The state of the system is represented by two of these four variables.

Price determination

- The number of homes sold, m_t, is determined by the matching function:

$$m_t = \mu\left(\text{Sellers}_t\right)^{\alpha}\left(\text{Buyers}_t\right)^{1-\alpha}.$$

- When a match occurs the transactions price is determined by generalized Nash bargaining.

- The bargaining power of buyers and sellers is θ and $1-\theta$, respectively.

- There are two types of matches:
  - A natural buyer and a seller;
  - A natural renter and a seller.

- To determine transactions prices we need to compute the reservation prices of buyers and sellers.

A simple experiment

An expected improvement in fundamentals

- Suppose that at time zero agents suddenly anticipate that, with probability $1 - a$, the utility of owning a home rises from ε to $\varepsilon^* > \varepsilon$.
- The result is a large instantaneous jump in P_t.
- There are no transition dynamics. The economy converges immediately to a new steady state with a higher price.
- So, even with matching frictions, when beliefs are homogeneous, anticipated future changes in fundamentals are immediately reflected in today's price.

Social dynamics

- We modify the model so that the number of potential home buyers changes over time even though the population and its demographic composition are constant.
- We do this by incorporating social dynamics into the model.
- In our model people can change their views about future long-run fundamentals when they interact with other agents.
- These changes can lead natural renters to become potential home buyers, leading to variations in the demand for homes.
- Unlike Bayesian learning, social dynamics can generate:
  - strong differences of opinion that persist over time;
  - fluctuations in the fractions of the population with different views in the absense of new information.

Social dynamics

- Before time zero the economy is in a steady state where agents share the same priors.
- At time zero agents learn that, with probability $(1 - a)$, long-run fundamentals will change.
- Agents fall into three categories depending on their priors about these fundamentals.
- Borrowing from the terminology used in the epidemiology literature we call these agents "infected," "cured," and "vulnerable."
- We denote by i_t, c_t, and v_t the time t fraction of infected, cured and vulnerable agents, respectively.

Social dynamics

- Agent types are publicly observable.
- Priors are common knowledge, so higher-order beliefs do not play a role.
- Agents can Bayesian update but there is no useful information to update their priors about long-run risk.
- Priors and the laws of social dynamics are public information.
- In today's talk we consider only the case in which agents do not take into account that they might change their views as a result of social interactions.

A simple experiment

- At time zero:
  - Almost everybody in the population is vulnerable, i.e. they have diffuse priors about future fundamentals.
  - There is a very small fraction of cured and infected agents.

- Infected agents expect an improvement in fundamentals.

$$E^i(\varepsilon^*) > \varepsilon.$$

- Cured and vulnerable do not expect an improvement in fundamentals.

$$E^c(\varepsilon^*) = E^v(\varepsilon^*) = \varepsilon.$$

An epidemic model of social dynamics

- We use the entropy of an agent's pdf to measure the uncertainty of an agents' views.
- Agents meet randomly at the beginning of the period.
- When two different agents meet, the high-entropy agent adopts the priors of the low-entropy agent with probability γ, which depends on the entropy ratio:

$$\gamma_{lj} = \max(1 - e^l / e^j, 0).$$

- We adopt this assumption for three reasons.
  - It strikes us as plausible.
  - It is consistent with evidence from the psychology literature (e.g. Price and Stone (2004) and Sniezek and Van Swol (2001)).
  - It is a reduced form way of capturing environments in which some agents have private signals or different data processing capabilities.

An epidemic model of social dynamics

- To simplify we assume that the pdfs of "infected" and "cured" agents are different but have the same entropy, $e^i = e^c$.

- So, when infected and cured agents meet no one changes their views about long-run fundamentals.

- The pdf of the vulnerable agents is diffuse, so it has high entropy.

$$e^v > e^c = e^i.$$

- When a vulnerable agent meets an infected or cured agent he is converted to their views with probability:

$$\gamma = 1 - e^i / e^v = 1 - e^c / e^v.$$

- We assume that with a very small probability δ_i, infected agents become cured.

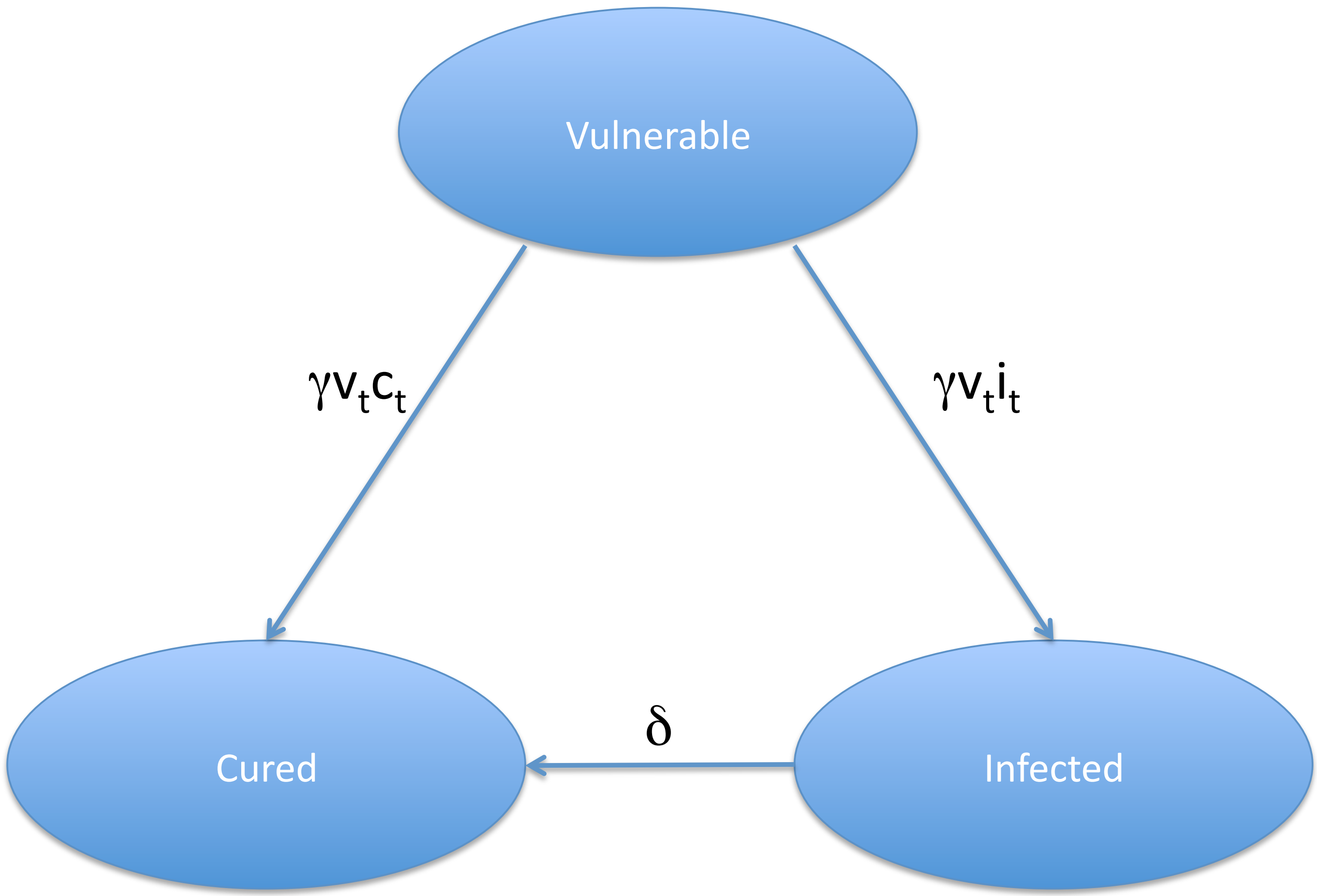
An epidemic model of social dynamics

- The model generates dynamics that are similar to those of the epidemic models of Bernoulli (1766) and Kermack and McKendrick (1927).

$$i_{t+1} = i_t + \gamma i_t v_t - \delta_i i_t,$$

$$c_{t+1} = c_t + \gamma c_t v_t + \delta_i i_t,$$

$$v_{t+1} = v_t - \gamma v_t (c_t + i_t).$$



Vulnerable
$\gamma v_t c_t$
$\gamma v_t i_t$
δ
Cured
Infected

Parameters for numerical example

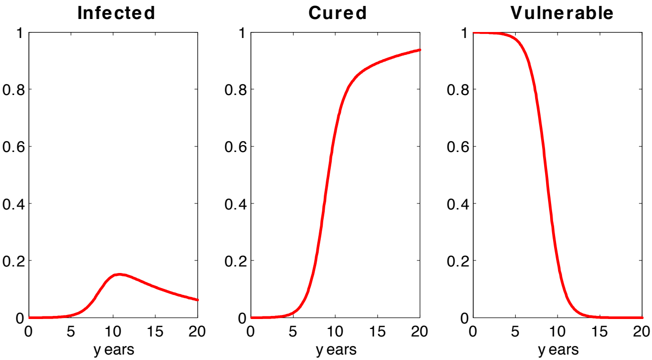
- Time period = one month.
- $\mu = 1/6$
  - Average time to sell a house in steady state = 6 months.
- $\alpha = 0.5$;
- $\lambda = 0.02$;
  - Chosen so that in a steady state in which $p = q$ the value is η is 0.008.
  - This value of η implies that home owners sell their house on average every 10 years.
- $k = 0.7$;
  - 70 percent of the population owns homes.
- $\beta = 0.995$;
  - Implies 6 percent annual mortgage rate.

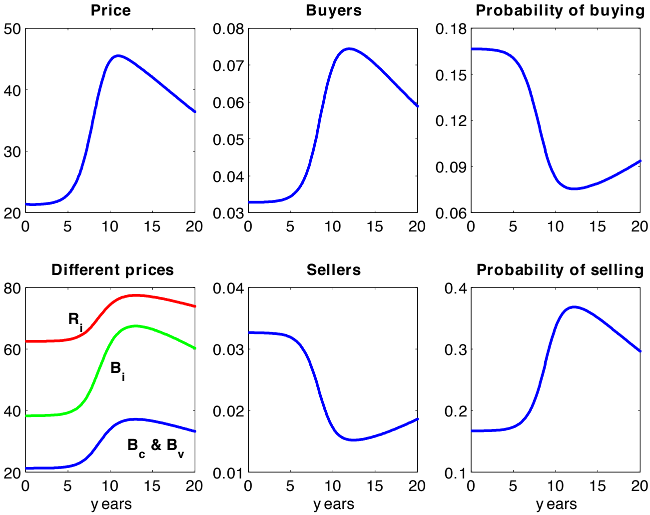
Parameters for numerical example

- $\phi = 0.05$;
  - Transactions costs of selling a home (percentage of sale price).
- $\varepsilon = 5$.
  - Controls level of steady state price but does not affect dynamics.
- $\varepsilon^b = \varepsilon^r = 1$.
  - Values chosen so that in steady state only natural buyers buy homes.
- $\kappa = 40$.
  - Value chosen so that it is not optimal for natural renters to buy homes in the steady state.
  - The steady state utility of a natural renter who buys a home is 28 percent lower than that of a natural home buyer.

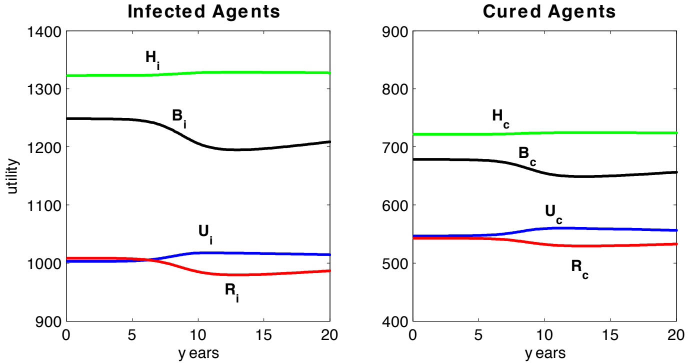
Social dynamics parameters

- $\delta = 0.009$.
- $\gamma = 0.0854$.
- $E^i(\varepsilon^*) = 2\varepsilon$.


Infected
Cured
Vulnerable
0
0.2
0.4
0.6
0.8
1
0
5
10
15
20
y ears



Price
Buyers
Probability of buying
Different prices
Sellers
Probability of selling
R_i
B_i
B_c & B_v
years
years
years



Infected Agents
Cured Agents
utility
y ears
y ears
H i
B i
U i
R i
H c
B c
U c
R c
1400
1300
1200
1100
1000
900
800
700
600
500
400
0
5
10
15
20

An epidemic model of social dynamics

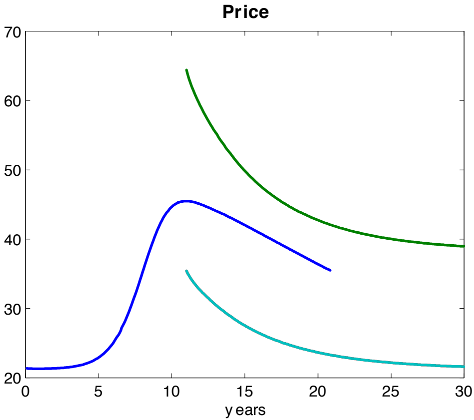
- Despite the absence of any new information, the average home price rises and falls.
- Even though agents have perfect foresight up to the resolution of long-run uncertainty, the initial rise in price is very small (less than one percent).
- The number of transactions is positively correlated with the average home price.
- The boom features a "sellers market," the probability of selling is high and the probability of buying is low.
- The bust features a "buyers market," the probability of selling is low and the probability of buying is high.

Analyzing price dynamics

- The rise and fall in prices is caused by a rise and fall in the number of potential buyers.
- A subset of agents who have high expectations about long-run fundamentals exhibit speculative behavior.
- The speculators are natural renters who enter the housing market because they became infected.

What happens when uncertainty is resolved?

- There is a discontinuous jump up or down in housing prices.
  - The price rises if the expectations of the infected agents are correct;
  - It falls if the expectations of the cured agents are correct.
- We don't observe these types of jumps in the data.
- The discontinuity reflects the stark nature of information revelation.
- This feature can be eliminated if more information about long-run fundamentals is gradually revealed.



Price
70
60
50
40
30
20
0
5
10
15
20
25
30
y ears

What does the matching model contribute?

- We do not need a large fraction of the population to be infected to generate a large boom and bust.
  - At the peak of the infection less than 20 percent of the population is infected.
  - Small movements in the extensive margin generate large movements in prices.
  - Without matching we need more than 70 percent of the population to be infected and the boom is much smaller (20 percent versus 100 percent).

- The initial price response is small in a matching model and much larger in a model without matching.

- The matching model generates a host of other implications
  - The correlation between prices, number of transactions, and the probability of buying and selling.

Conclusion

- It is generally difficult to generate boom-bust episodes that are weakly correlated with observable fundamentals.
- In this paper we present a model which generates boom-bust episodes.
- In our model agents have different views about long-run fundamentals.
- Social dynamics lead to changes in the fraction of the population that hold a particular view.
- Changes in these fractions induce variation in the demand for assets and equilibrium prices even in the absence of any new information.