Discussion of:
“Monetary policy and herd behavior in new-tech investment”

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Environment

- $t = 0, 1, ...$

- State of nature: $\{H, L\}$, determined at $t=0$, fixed throughout, with $\Pr\{H\} = p$.

- World ends each period w.p. $1-\beta$, at which time state is fully revealed.

- Each period, one investor makes investment decision, two options
  - Old tech: invest $\kappa$, return $A$ when world ends (no uncertainty)
  - New tech: invest $\kappa + \Delta(\kappa)$, return $A + \Delta(A)$ in state $H$, $A$ in state $L$,

- Each investor receives signal $x$: $\Pr(x=s) = \lambda > \frac{1}{2}$. 
Assumptions:

• No discounting between periods, all returns realized when world ends.

• In good state, new technology is optimal:

\[ \Delta(\kappa) < \Delta(A). \]

• Return always suffices to pay for initial investment:

\[ A > \kappa + \Delta(\kappa). \]

Allocation: maps signal histories \( x^t \) to current investment action \( a(x^t) \).
Social planning problem

- Consider Utilitarian Social Planner:

\[ v(p) = \max_{\{a(x^t)\}_{t=0}^\infty} \sum_{t=0}^\infty \beta^t \Pr(x^t) a(x^t) \left( \Pr(H | x^t) \Delta(A) - \Delta(\kappa) \right) \]

- Suppose first that signals commonly observable

- Recursive solution:

\[ v(p) = \max_{\{a(x_H), a(x_L)\}} \Pr(x_H) \left\{ a(x_H) \left( \Pr(H | x_H) \Delta(A) - \Delta(\kappa) \right) + \beta v(p'(x_H, p)) \right\} + \Pr(x_L) \left\{ a(x_L) \left( \Pr(H | x_L) \Delta(A) - \Delta(\kappa) \right) + \beta v(p'(x_L, p)) \right\} \]
Social planning problem

• **Solution** to planning problem:
  
  – exogenous learning through $x^t$
  – optimal decisions are ‘myopic’ (i.e. only consider current period payoffs).
  – Invest if and only if $\Pr(H|x) > p^*$.

• **Decentralization:** contingent payment contracts
  
  – Uncontingent loan for investment plus
  – Option to bet on aggregate state

• Notice: consistent with incentive compatibility, even if signals are privately observed!
  
  – Implies contracting restrictions important for herding behavior.
Planning problem with ‘herding restriction’:

• **Suppose next that planner can only learn from actions:**
  - \( a(x_H) = a(x_L) = 0 \) or \( a(x_H) = a(x_L) = 1 \) implies \( p'(x,p) = p \)
  - Updating only if \( a(x_H) = 1 = 1 - a(x_L) \) or \( a(x_H) = 0 = 1 - a(x_L) \)

• Mimicks updating rule from simple herding models.

• Same planning problem as above, but with additional restriction on updating of beliefs.

• Again, possible to solve recursively, using \( p \) as state variable

• Preliminary leg work:
  - Separation: \( a(x_H) = 1 = 1 - a(x_L) \) dominates \( a(x_H) = 0 = 1 - a(x_L) \) (always best to have high signal invest to achieve separation)
  - Pooling: if actions are pooled then choose myopically optimal.
Planning problem with ‘herding restriction’:

• **Solution:**
  
  \[
  a(x_H) = 0, a(x_L) = 0 \quad a(x_H) = 1, a(x_L) = 0 \quad a(x_H) = 1, a(x_L) = 1
  \]

  \[
  0 \quad p_L \quad p^* \quad p_H \quad 1
  \]

  • Separation in middle region, as soon as belief hits \( p_L \) or \( p_H \), absorbing state.

  • Experimentation:
    – Tradeoff: foregone myopic profits vs gains from additional information

  • As \( \beta \) goes to 1, limits \( p_L \) and \( p_H \) approach 0 and 1.
Pure herding equilibrium

- Consider market environment in which investors borrow from deep-pocketed outsiders

  \[ a(x_H) = 0, a(x_L) = 0 \quad | \quad a(x_H) = 1, a(x_L) = 0 \quad | \quad a(x_H) = 1, a(x_L) = 1 \]

- Same structure, but eq. thresholds much tighter

- Why?
  - Suppose initial belief near \( p^* \), first investor just indifferent before receiving private signal \( \rightarrow \) Signal breaks tie.
  - Second investor: if signal opposes first action, belief back to initial belief Otherwise, signal reinforces first...
  - As soon as two separating investors take identical decisions, they outweigh all further private info, so herd starts.

- Social learning externality: investors don’t internalize informational benefits to subsequent investors (think of problem with \( \beta = 0 \)).
Interest Policy

*How policy can correct herding externality*

- Interest policy: alter tradeoff between initial investment cost and return.

- Replace $\kappa$, $\Delta(\kappa)$ with $\gamma(x^t) \kappa$, $\gamma(x^t) \Delta(\kappa)$.

- Idea: change tradeoff in such a way that indifference point $p^*$ always lines up with current posterior $p$.

- Then, signals are pivotal.

- Remark: can use this to implement any investment plan (including optimal one).
Back to planning problem:

- Key for social learning externality, herding problem:
  - Uncontingent contracts, limit learning from actions (restriction on contract space)

- Contingent contracts improve separation
  - Glosten-Milgrom: zero-sum best on good outcomes fully reveal information through prices

- Separation of investment/debt decision from information aggregation/secondary markets:
  - Use bets in secondary markets to aggregate info
  - Separate from investment and uncontingent loan.
Comments (ctd):

• Restriction to primary loan contracts
  – One-sided screening possible if a(x)=1 (use different upsides to separate signals)
  – Not feasible if a(x)=0 is chosen (uncontingent return)
  – One-sided experimentation problem
  – Intervention to foster investment when p is low… (not a story about bubbles, but about busts)

• Similar argument, if investment activity generates additional signals to private sector (learning from outcomes)
Conclusion:

• Interesting herding story for investment

• ‘usual’ critiques of herding models apply (robustness, role of prices etc.)

• Interest rate policy as ‘poor’ substitute for richer contract spaces that avoids herding.

• Key for overall efficiency: separating learning about signals from actual investment decisions

• Is learning externality really a first order concern?