Feedback Effects and the Limits to Arbitrage

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Introduction

- Broad definition of arbitrage: trading on private information
- LTA arises because *the value of the asset being arbitrated is endogenous to the act of arbitrage*
  - If speculator knows that state is bad, shorting stock may convey this to the manager and induce a corrective action (feedback effect literature). Improves firm value and harms the short position
- Real-life example: Coca-Cola’s attempted acquisition of Quaker Oats
  - Nov 20, 2000: WSJ reported acquisition talks; Coca-Cola’s shares fell
  - Board rejected acquisition on Nov 21
  - Coca-Cola’s shares rebounded 8%. Investors who shorted on the rumors may have lost overall
This LTA is asymmetric

- Trading in either direction (buying on good news and selling on bad news) improves price informativeness, increasing firm value
- Increases the profitability of a long position, but decreases the profitability of a short position

Not only is speculator’s trading behavior asymmetric, but also price impact is asymmetric – even though market maker is rational and takes into account the LTA

- Bad news has a smaller impact than good news: “bad news travels slowly” (Hong, Lim and Stein (2000))
- May have real consequences – if bad news is not incorporated in prices, overinvestment arises even though the manager is value-maximizing
Literature Review: LTA

- Existing LTAs are based on market frictions, irrationality, risk aversion, or delegation
  - Short-sale constraints: Geczy, Musto and Reed (2002), Lamont and Thaler (2003)
  - Trade may become more profitable in future: Kondor (2009)

- Such LTAs may attenuate over time as markets develop
  - Our LTA arises as the fundamental value of the asset being arbitrated is endogenous to the act of arbitrage
  - Feedback effect occurs as manager wishes to learn from investors, which may increase over time as investors become more sophisticated
  - Arises when market performs its utmost efficient role – guiding allocation of resources
Financial markets convey information that is not otherwise available to corporate decision makers

- Hayek (1945): market agglomerates opinions of many investors


Goldstein and Guembel (2008): feedback effect can reduce firm value

- Consider manipulation by an *uninformed* trader. Here, an informed trader chooses not to trade on information
Model can also apply to corrective actions taken by other stakeholders:

- Replacement of manager (by board, or lobbying shareholders)
- Disciplinary takeover (by acquirer)
- Granting of subsidy or bail-out (by government)
The Model

- **$t = 0$: start of game**
- **$t = 1$:**
  - State of nature $\theta \in \Theta \equiv \{H, L\}$ realized. Common prior that $\theta = H$ is $y = \frac{1}{2}$
  - W.p. $\lambda < 1$ there is a speculator who sees $\theta$ and trades $s \in \{-1, 0, 1\}$. If $|s| = 1$, she pays trading cost $\kappa$
  - With certainty there is a noise trader who trades $n \in \{-1, 0, 1\}$ with uniform probability
  - Market maker observes total order flow $X = s + n$ and sets $p = E(\nu|X)$, where $\nu$ is firm value
  - Manager observes $X$. (1-to-1 correspondence between $p$ and $X$ in most cases). Uses information in $X$ to form posterior $q$ to guide decision $d \in \{i, n\}$. $d = i$ is investment, $d = n$ is no investment / abandonment / correction
The Model (cont’d)

- $t = 2$: $v = R^d_\theta$ is realized. Assumptions:
  - $R^i_H > R^n_H, R^n_L > R^i_L$: continuation (abandonment) is optimal in state $H (L)$. Implies $R^i_H - R^i_L > R^n_H - R^n_L$. 2 sub-cases
    * Case 1: $R^n_H > R^n_L$ so $v$ is monotonic in the state
    * Case 2: $R^n_H < R^n_L$ so $v$ is non-monotonic in the state (e.g. Aghion and Stein (2008))
  
- $R^i_H > R^n_L$: highest possible value is attainable in state $H$

- $\gamma$ is posterior on state $H$ s.t. manager is indifferent between continuation and abandonment:
  
  $$\gamma R^i_H + (1 - \gamma) R^i_L = \gamma R^n_H + (1 - \gamma) R^n_L.$$ 2 sub-cases:
  - $\gamma < \frac{1}{2}$ so continuation is ex-ante optimal
  - $\gamma > \frac{1}{2}$ so abandonment is ex-ante optimal

- Will focus on $R^n_H < R^n_L$ and $\gamma < \frac{1}{2}$; paper also analyzes the three other combinations and shows the key intuition still holds
An Asymmetric Trade Equilibrium

- First consider $\frac{1-\lambda}{2-\lambda} < \gamma$, so $X = -1$ induces $d = n$.
- BNS (buy, not sell) equilibrium: buy if $\theta = H$, no trade if $\theta = L$

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<thead>
<tr>
<th>$X$</th>
<th>$-2$</th>
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<tr>
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- If positively-informed speculator buys, she is fully revealed if $X = 2$, and makes a profit if $X = 0$ or $X = 1$
  - Expected profit is $\frac{1}{3} (R_H^i - R_L^i)$
Negatively-Informed Speculator

- If \( X = -2 \), fully revealed; if \( X = 0 \), standard profit
- If \( X = -1 \), she receives \( \frac{1-\lambda}{2-\lambda} R_H^n + \frac{1}{2-\lambda} R_L^n \) for a share which is worth \( R_L^n \). Profit of \( \frac{1-\lambda}{2-\lambda} (R_H^n - R_L^n) < 0 \)
  - Even though MM takes into account \( d = n \), speculator loses. Reason: MM knows that manager will abandon, but not that abandonment is optimal. Speculator knows that \( d = n \) and abandonment is optimal
  - Value of the asset being arbitraged is endogenous to the act of arbitrage.

- BNS equilibrium is sustainable if

\[
\frac{1}{3} (R_H^i - R_L^i) > \kappa > \frac{1}{3} \left[ \frac{1}{2} (R_H^i - R_L^i) + \frac{1-\lambda}{2-\lambda} (R_H^n - R_L^n) \right]
\]

(plus technical conditions to rule out selling on positive information)
Other Equilibria

- **$T$ (trade) equilibrium**: buy if $\theta = H$, sell if $\theta = L$. Sustainable if low $\kappa$
- **$NT$ (no trade) equilibrium**: no trade if $\theta = H$, no trade if $\theta = L$. Sustainable if high $\kappa$
  - Standard LTA of transaction cost
- **$SNB$ (sell, not buy)**: no trade if $\theta = H$, sell if $\theta = L$. Sustainable if
  \[ \frac{1}{3} \left( R_H^i - R_L^i \right) > \kappa > \frac{1}{3} \left( \frac{1}{2} + \frac{1-\lambda}{2-\lambda} \right) \left( R_H^i - R_L^i \right) \]
  - Standard LTA of price impact. High for buying as $X > 0$ is informative
- **$BNS$** is the only sustainable equilibrium if
  \[ \frac{1}{3} \left[ \frac{1}{2} \left( R_H^i - R_L^i \right) + \frac{1-\lambda}{2-\lambda} \left( R_H^n - R_L^n \right) \right] < \kappa < \frac{1}{3} \left( \frac{1}{2} + \frac{1-\lambda}{2-\lambda} \right) \left( R_H^i - R_L^i \right) \]
  - Range is strictly positive since $R_H^i - R_L^i > R_H^n - R_L^n$
  - New LTA of feedback effect
- No $\kappa$ for which $SNB$ is sustainable but $BNS$ is not
  - Feedback effect is asymmetric. Trading on information in either direction improves fundamental value, which hurts a short position but helps a long position
The No-Feedback Case

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- If $\frac{1-\lambda}{2-\lambda} > \gamma$, $d = i$ even if $X = -1$. No feedback
  - If $X = -1$, she makes the standard profit of $\frac{1-\lambda}{2-\lambda} \left( R_H^i - R_L^i \right) > 0$
  - No set of parameters for which $BNS$ is sustainable but not $SNB$, nor vice-versa
Other Sub-cases

- $R^n_H > R^n_L$ and $\gamma < \frac{1}{2}$:
  - Similar to main case analyzed, although speculator no longer makes a loss when selling on negative information (instead, makes a smaller gross profit)
  - Issues of manipulation disappear

- $R^n_H > R^n_L$ and $\gamma > \frac{1}{2}$:
  - Without information, manager abandons the investment
  - Buying reveals positive information, inducing investment, increasing firm value. Selling does not change the decision
  - Asymmetry remains. Feedback effect (weakly) increases the profitability of buying and (weakly) reduces the profitability of selling

- $R^n_H < R^n_L$ and $\gamma > \frac{1}{2}$:
  - Mirror image of case analyzed
Discussion of Assumptions for Asymmetric LTA

- Sufficient information in the market to affect decision: $\frac{1-\lambda}{2-\lambda} < \gamma$
  - $\gamma$ is close to $\frac{1}{2}$: desirability of project is uncertain
  - $\lambda$ is high: order flow is informative

- Uncertainty on whether the speculator is present: $\lambda < 1$
  - Otherwise, the price at $X = -1$ is fully revealing
  - Market maker fully anticipates abandonment, but does not know that abandonment is optimal

- Speculator’s initial position is zero
  - Loses from increasing firm value only if she ends with a short position
  - Assumption can be relaxed if speculator cares about relative, rather than absolute performance

- Corrective action vs. amplifying action
  - Intuition no longer holds as bad news leads to action that reduces firm value further (e.g., capital provision, credit ratings)
  - Corrective actions are natural when decision maker maximizes firm value (e.g. manager, board, blockholder)
Speculator’s trading strategy is asymmetric, but not obvious that price impact will be asymmetric

MM takes into account asymmetry when forming pricing function

- Positive order flow can be consistent with a negatively-informed speculator. Thus, \( p(X = 1) = p(X = 0) \)
- Although negative information does not lead to a negative order flow, it can have a negative price impact since pricing function adjusts

Stock price increase if \( \theta = H \) equals stock price decrease if \( \theta = L \): required by market efficiency

What is the stock price impact of the state realization conditional on speculator being present?
The Model

Stock Returns (cont’d)

- Bad news travels slowly:

\[
\text{abs} \left( p_{1,\text{spec}}^{H} - p_{0} \right) - \text{abs} \left( p_{1,\text{spec}}^{L} - p_{0} \right) \\
= \frac{1}{3} \left( 1 - \lambda \right) \left( p(2) - p(-1) \right) > 0.
\]

- Intuition: MM cannot distinguish a negatively-informed speculator from an absent speculator (i.e. no information). Key is \( \lambda < 1 \)

- Returns to a good investment manifest more rapidly (i.e. to a greater degree at \( t = 1 \) than \( t = 2 \)) than returns to a bad investment
**Implications**

- LTA will persist as markets evolve and investors become more sophisticated
  - Other theories rely on SSCs, irrational over-extrapolation, or IA between arbitrageurs and their investors (Shleifer and Vishny (1997))
  - Here, essence of LTA is manager learning from investors. Likely to increase with investor sophistication

- LTA is asymmetric, so good news has a greater price impact than bad news. Consistent with Hong, Lim, and Stein (2000)
  - Hong and Stein’s (1999) behavioral model does not predict asymmetry; ours is a rational model
  - HLS explanation: manager has information, and disseminates good news more readily by news releases. Here, investors have information, and “disseminate” good news more readily by trading
Real implications: if bad news is not impounded in prices, manager does not learn it and does not abandon bad investment

- Overinvestment, but not due to PBs (as in Jensen (1986), Stulz (1990), Zwiebel (1996)). Manager is fully aligned with firm value and wishes to learn from prices to maximize value; is also aware of the asymmetry
- Widespread value destruction in M&A (Andrade, Mitchell and Stafford (2001))
Conclusion

- LTA arising from fact that value of asset being arbitrag ed is endogenous to act of arbitrage
  - Effect leads to asymmetric trading and asymmetric price impact, even though market maker is rational
  - Bad news travels slowly, leading to overinvestment even in the absence of agency problems
  - Returns to a good investment are more front-loaded than the returns to a bad investment

- Paper is linked to a broader literature on the real effects of financial markets: see Bond, Edmans, and Goldstein (2012) for a survey