Trading Frenzies and Their Impact on Real Investment

Itay Goldstein
University of Pennsylvania
Wharton School of Business

Emre Ozdenoren
London Business School and CEPR

Kathy Yuan
London School of Economics and CEPR

April 2010

Trading Frenzies and Real Economic Activity

- Trading Frenzies arise when speculators rush to trade in the same direction causing large price flactuations.
  - Recent episodes with Bear Stearns or Lehman Brothers?

- **What causes trading frenzies?**
  - Financial markets usually generate strategic substitutes. What is the source of strategic complementarities?

- **What is their real effect?**
  - Feedback effect from financial market to firms' cash flows: Source of complementarities.
  - Are trading frenzies necessarily bad?

Feedback Effects in Financial Markets

- We address these questions in a model where financial-market prices affect real investments via the information they convey to decision makers.
  - Note: there is no 'automatic' effect of market prices on the real economy.
  - These are secondary markets, and if prices are deemed uninformative they ought to be ignored.

- In the model:
  - A capital provider decides how much capital to provide for a new real investment.
  - The decision of the capital provider depends on his assessment of the productivity of the proposed investment. He relies on private information and information in asset price.

Strategic Interactions

- Speculators have access to correlated and uncorrelated information.
- The following strategic interactions emerge.
- **Strategic substitutes:** speculators prefer not to buy (sell) when many others buy (sell) due to the **traditional price mechanism**.
  - Low weight on correlated information.
- **Strategic complementarities:** speculators prefer to buy (sell) when many others buy (sell) because of the **feedback effect**.
  - A coordinated sale by many speculators transmits negative information to the capital provider leading to a reduction in the amount of capital provided and in the value of the security, and increases the profit from selling.
  - Large weight on correlated information: **frenzies**.

Trading Frenzies and Investment Efficiency

- Frenzies might disrupt investment efficiency by generating too much weight on noise in correlated information, but may also promote efficiency by overcoming noise in trading process (liquidity trading).

- Interestingly, speculators always do the opposite from what is desirable for investment efficiency. Their incentive to coordinate is high (low) exactly when coordination is undesirable (desirable).

- Room for policy to change trading patterns and improve price informativeness and investment efficiency.

Related Literature

Growing feedback literature:

- **Empirical:** Baker, Stein, and Wurgler (2003), Luo (2005), Chen, Goldstein, and Jiang (2007), and others.

- **Theoretical:** Fishman and Hagerty (1992), Leland (1992), Khanna, Slezak, and Bradley (1994), Boot and Thakor (1997), Dow and Gorton (1999), Subrahmanyam and Titman (1999), Fulghieri and Lukin (2007), Dow, Goldstein, and Guembel (2007), and others.

- **Most related:**
  - Ozdenoren and Yuan (2008): Exogenous feedback from asset prices to the real value of a firm generates excess volatility. **No learning.**
  - Goldstein and Guembel (2008): Learning by a decision maker leads to manipulation of the price by a single trader. **No coordination**.

- Goldstein, Ozdenoren, and Yuan (2007): Strategic complementarities in currency trading due to learning by central bank. **No price mechanism**.
  - Angeletos, Lorenzoni, and Pavan (2007) study a related mechanism in a model where traders learn from the real economy.

Complementarities in Financial Markets: Froot, Scharfstein, and Stein (1992), Veldkamp (2006), and others.

Model Setup

- A firm has access to an investment technology that needs to be financed by a capital provider.

- A financial asset whose payoff is tied to the technology's cash flow is traded in the financial market.

- Timeline
  - $t = 0$: Speculators trade and the asset is priced.
  - $t = 1$: Capital provider decides how much capital to provide.
  - $t = 2$: Cash flow is realized; all agents receive their payoffs.

Capital Provider's Problem

- The payoff from the investment is $\tilde{F}I$, where I is the amount of investment financed by the capital provider, and $\tilde{F} \geq 0$ is the level of productivity.
- Capital provider must incur a cost when choosing I,

$$C(I) = \frac{1}{2}cI^2.$$

  - $C(I)$: cost of raising capital or effort incurred in monitoring the investment.
- Optimization problem conditional on his information set, $\mathcal{F}_l$, at $t = 1$:

$$I = \arg\max_I E[\tilde{F}I - C(I)|\mathcal{F}_l].$$

- The solution:

$$I = \frac{E[\tilde{F}|\mathcal{F}_l]}{c}.$$

Speculators' Problem

- A continuum of risk neutral speculators indexed by $i \in [0, 1]$ trade a security (derivative), whose payoff is the cash flow from the investment $\tilde{F}I$.

- Speculator i is restricted to buy or short up to a unit of the asset: $x(i) \in [-1, 1]$.

- Based on information set $\mathcal{F}_i$, speculator i solves the following problem:

$$\max_{x_i \in [-1,1]} x(i) E\left[\tilde{F}I - P|\mathcal{F}_i\right],$$

  - P is the price of the security in the financial market (unknown to speculators when submitting trades).

- Because of risk neutrality: $x(i) = -1$ or 1.

Information Structure

- Prior: $\tilde{f} = ln(\tilde{F})$ is normal with mean $\bar{f}$ and variance σ_f^2 (or $1/\tau_f$).
  - Log-normal distribution is key for linear closed-form solution.

- Each speculator observes two signals:
  - A private signal: $\tilde{s}_i = \tilde{f} + \sigma_s \tilde{\epsilon}_i$, where ϵ_i is standard normal. Signal precision: τ_s,
  - A common signal: $\tilde{s}_c = \tilde{f} + \sigma_c \tilde{\epsilon}_c$, where ϵ_c is standard normal. Signal precision: τ_c.

- Capital provider has two pieces of information:
  - A private signal: $\tilde{s}_l = \tilde{f} + \sigma_l \tilde{\epsilon}_l$, where ϵ_l is standard normal. Signal precision: τ_l.
  - The price of the traded security: P.

Market Clearing

- Market price is set so that demand from informed speculators equals noisy supply of the risky asset: $Q(\tilde{\xi}, P)$.
  - Supply shock $\tilde{\xi} \sim N(0, \sigma_\xi^2)$. $\sigma_\xi^2 = 1/\tau_\xi$.
  - Supply curve is upward-sloping in price.

- To solve the model in closed form, we assume:

$$Q(\tilde{\xi}, P) = 1 - 2\Phi\left(\frac{\tilde{\xi} - \ln(\delta P)}{\sigma_s}\right),$$

where $\Phi(\cdot)$ denotes the cumulative standard normal distribution function.

Equilibrium

- $I\left(\tilde{s}_l, P\right)$ solves the capital provider's problem.
- $x(\tilde{s}_i, \tilde{s}_c)$ solves speculator i's problem.
- The market clearing condition is satisfied:

$$Q(\tilde{\xi}, P) = X(\tilde{f}, \tilde{\epsilon}_c) = \int x(\tilde{f} + \sigma_s \tilde{\epsilon}_i, \tilde{f} + \sigma_c \tilde{\epsilon}_c) d\Phi\left(\tilde{\epsilon}_i\right).$$

- A *linear monotone equilibrium* is an equilibrium where $x(\tilde{s}_i, \tilde{s}_c) = 1$ if $\tilde{s}_i + k\tilde{s}_c \geq g$ for constants k and g, and $x(\tilde{s}_i, \tilde{s}_c) = -1$ otherwise.
  - Speculator buys the asset if and only if a linear combination of her signals is above a cutoff g, and sells it otherwise.

Strategic Substitutes and Complementarities

- Recall that speculator solves:

$$\max_{x_i \in [-1,1]} x(i) E\left[\tilde{F} I - P | \mathcal{F}_i\right]$$

- **Strategic substitutes: price mechanism.**
  - When speculators trade in one direction, price moves against them, and incentive to trade that way is reduced: **less weight on correlated signal**.

- **Strategic complementarities: feedback effect.**
  - When speculators trade in one direction, real investment moves to make the trade more profitable, and incentive to trade that way is increased: **more weight on correlated signal**.

- The equilibrium k^* reflects both (on top of precisions of two signals).

Benchmark: Capital Provider Doesn't Learn from Price

- When the capital provider does not learn from the price, speculators put weight $k_{BM} < \tau_c/\tau_s$ on the common signal.
  - Obviously, strategic substitutes among speculators reduce the weight they put on the common signal below τ_c/τ_s.
- We find that $k_{BM} < k^*$.
- When we shut down the feedback effect from the price to real investment, speculators rely less on the common signal.

Impact of Information Structure and Noise Trading

- k^* increases when:
  - The prior, the capital provider's signal, or the speculators' private signals are less precise (τ_f, τ_l, or τ_s decrease).
  - The speculators' common signal is more precise (τ_c increases).

- k^* decreases in variance of noise trading σ_ξ^2.
  - A higher variance of noise trading implies a lower ability of speculators to affect the capital provider's decisions.
  - Hence, speculators have lower incentive to coordinate, and this reduces k^*.

Efficient Coordination

- Denote the optimal level of coordination by k_{OP}, and choose it to maximize expected value of investment:

$$E_0\left[\max_I E\left[\tilde{F}I - \frac{1}{2}cI^2 \,|\tilde{s}_l = s_l, P\right]\right]$$

  - The information in the price is generated as before:
    - A speculator purchases the asset if $\tilde{s}_i + k_{OP}\tilde{s}_c \geq g$ and shorts it otherwise.

- **Result:** The optimal level of coordination is $k_{OP} = \tau_c/\tau_\xi$, which maximizes τ_p, the precision of price.
  - Ex ante efficiency increases in k for $k < k_{OP}$ and decreases for $k > k_{OP}$.

- **Intuition**:
  - Price is a noisy signal affected by noise in common signal and noise trading:
$$z(P) = \tilde{f} + \frac{k}{1+k}\sigma_c\tilde{\epsilon}_c + \frac{1}{1+k}\tilde{\xi}$$
  - Coordination increases the effect of noise in the common signal and decreases the effect of noise trading.
  - Optimal coordination is high when noise in common signal is less harmful (τ_c is high) and when noise trading is more harmful (τ_ξ is low).

- There is a conflict between the profit incentive of speculators and the efficiency of investment.
  - Speculators **wish to coordinate** when noise trading is less volatile (**low liquidity**) because then they can affect the decision of the capital provider.

- But their **coordination is desirable** when noise trading is more volatile (**high liquidity**) because this is when coordinated informed trading is needed to guide investments.

▶ Equilibrium coordination is lower than optimal when τ_ξ is low, and higher than optimal when τ_ξ is high.

Excess Volatility in Asset Price and Real Investment

- Deviations from the optimal level of coordination are manifested in higher levels of excess (or non-fundamental) volatility.

- Excess volatility of asset price and excess volatility of investment are minimized when $k = k_{OP}$.
  - Above k_{OP}, there is excessive volatility coming from the noise in the common signal,
  - Below it, there is excessive volatility coming from the noisy supply.

Policies: Influencing Cost of Investment

- Consider reducing or increasing the cost of capital to influence speculators' behavior.
- For example let $C(I, \tilde{F}) = \frac{1}{2} c \tilde{F}^{\beta} I^2$.
- Counter-cyclical funding policies ($\beta > 0$) make the payoff less sensitive to the fundamental, and hence reduce the coordination payoff. The opposite is true for pro-cyclical funding policies.
- Recall that there exists $\bar{\tau}_\xi$ such that there is too little coordination for τ_ξ less than $\bar{\tau}_\xi$ and too much coordination for τ_ξ larger than $\bar{\tau}_\xi$.

Corollary 1 *There exists $\bar{\tau}_\xi$ such that following a counter-cyclical policy ($\beta > 0$) when τ_ξ is larger than $\bar{\tau}_\xi$ and a pro-cyclical policy ($\beta < 0$) when τ_ξ is less than $\bar{\tau}_\xi$ improves efficiency and reduces excess volatility.*

Intervention in Security Trading

- Government may directly control noise trading.

Corollary 2 *The equilibrium k^* is closer to k_{OP} if government increases τ_ξ when $\tau_\xi < \bar{\tau}_\xi$ and decreases τ_ξ when $\tau_\xi > \bar{\tau}_\xi$.*

- Government can buy and sell market indices.
  - When the market liquidity is high, focusing on absorbing the liquidity.
  - When the market liquidity is low, providing liquidity.

Public Information

Corollary 3 *By releasing public news, $\tilde{s}_n = \tilde{f} + \sigma_n \tilde{\epsilon}_n$, to all market participants, the government can reduce the equilibrium level of coordination.*

- Contrast with existing results on transparency and coordination.
- Commonly shared information is informative of the final payoff.
- Capital providers can filter out if speculators coordinate on this piece of public information.

Conclusion

- Decision-makers such as capital providers use information revealed in aggregate trading through prices to make investment decisions.
- This generates coordination incentives among speculators, making prices overly exposed to the noise in the correlated information.
- There is also a benefit to coordination: overcomes the effect of liquidity trading on price.
- Typically coordination in equilibrium goes in opposite direction to optimal coordination.
- Hence, room for policy to change trading patterns, increase informativeness and efficiency.