

Contagious Adverse Selection

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Credit Crisis of 2007-2009

A key element: some liquid markets shut down

Market Confidence

- ▶ We had it
- ▶ We lost it
- ▶ We got it back

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 - ▶ unexpected losses (in housing and some related financial instruments)

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- ▶ an interpretation:
 - ▶ "opaqueness": inevitable and also creates informational rents for financial intermediaries
 - ▶ informational rents imply uninformed traders faced adverse selection (broadly interpreted)

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- ▶ an interpretation:
 - ▶ "opaqueness": inevitable and also creates informational rents for financial intermediaries
 - ▶ informational rents imply uninformed traders faced adverse selection
 - ▶ but markets operated OK with adverse selection in good times

A Contagious Adverse Selection Propagation Channel

- ▶ Shock to system shows that common understanding of background adverse selection is wrong in asset market A
- ▶ A few (pessimistic) uninformed traders drop out of market A
- ▶ A few other traders - thinking that uninformed traders on the other side of the market are dropping out - also drop out
- ▶ and so on
- ▶ A few (pessimistic) uninformed traders drop out of market B, which they think may be correlated with market A
- ▶ and so on...

Contagious Adverse Selection

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 - ▶ and so on...
- ▶ understand a contagious adverse selection channel in a clean simple theoretical model

Higher Order Adverse Selection

- ▶ Uninformed are unsure if others in market are "informed"
- ▶ "Adverse selection" is selection of informed market partners
 - ▶ In Akerlof (1970), all sellers are informed: "Adverse Selection" is selection of informed sellers with bad cars.
- ▶ Leads to **coordination** problem between uninformed agents (uninformed agents want to trade only if other uninformed agents trade)

Contagious Miscoordination (driven by Adverse Selection)

- ▶ Coordination on risky outcomes possible if and only if approximate common knowledge of gains from coordination
- ▶ Lack of common knowledge of gains from coordination implies contagious spreading of inefficient outcomes
- ▶ Thus **market confidence** = approximate common knowledge of bound on expected losses of uninformed agents

Akerlof (1970) meets Rubinstein (1989)

George Akerlof, QJE 1970, "The Market for 'Lemons'"

Ariel Rubinstein, AER 1989, "The Electronic Mail Game"

and

ariel



Accounting Standards / Credit Ratings

- ▶ How to provide sufficient common understanding of "value" of asset /asset class to allow impersonal transactions (Morris and Shin 2007 "Optimal Communication")
- ▶ Or create "market confidence" i.e., approximate common knowledge of bound on expected losses
- ▶ This was our original motivation for understanding contagious adverse selection: identifying model-based social value of widely available and focal information sources

This Talk

- ▶ Present "minimal" model of higher order adverse selection leading to contagious miscoordination
- ▶ Discussing accounting agenda and implications (if any) for modelling the crisis

Related Literature

- ▶ Akerlof (1970): equally informed agents
- ▶ Bhattacharya-Spiegel (1991), Pagano (1989), Dow (2004): multiple equilibria with noise traders in or out
- ▶ Rubinstein (1989), Monderer and Samet (1989), Carlsson and van Damme (1993), our own earlier work: coordination and approximate common knowledge
- ▶ Dang-Gorton-Holmstrom (2010): informationally insensitive debt

Bilateral Trade Environment

- ▶ N potential risk neutral sellers of an object value it at $v - c$
- ▶ N potential risk neutral buyers of an object value it at $v + c$
- ▶ $c > 0$ is common knowledge; there are gains from trade $2c$
- ▶ $v = \bar{v} + \varepsilon$, where ε takes values $(-M, 0, M)$ with probabilities $(\delta, 1 - 2\delta, \delta)$
- ▶ Efficient (and fair) for each buyer to pay the expectation of v (\bar{v}) for the object.

Bilateral Trade Environment

	probability	value to sellers	value to buyers
lemon	δ	$\bar{v} - M - c$	$\bar{v} - M + c$
normal	$1 - 2\delta$	$\bar{v} - c$	$\bar{v} + c$
peach	δ	$\bar{v} + M - c$	$\bar{v} + M + c$

Efficiency

Ex ante gains from trade = $2c \times$ Probability of Trade

Adding Adverse Selection

- ▶ Now suppose that k out of N buyers and sellers observe v perfectly
- ▶ Other $N - k$ buyers and sellers observe nothing
- ▶ Write $q = \frac{k}{N}$ for measure of adverse selection

Simply Trading Mechanism

- ▶ Buyers and Sellers randomly matched
- ▶ Price \bar{v}
- ▶ Matched buyer and seller say "yes" or "no" to trade
- ▶ Trade occurs only if both say yes

Common Knowledge Assumptions

- ▶ First analyze benchmark where environment is common knowledge (but background adverse selection parameterized by q)
- ▶ Then analyze what happens when common knowledge (e.g., of M) is relaxed

Key Parameter: Loss Ratio

- ▶ Suppose you are a uninformed seller matched with a random buyer who will buy UNLESS (1) he is informed; AND (2) the object is a lemon
- ▶ When faced with an informed buyer (a probability q event), expected losses are: $\delta (M + c) - c$
- ▶ When faced with an uninformed buyer (a probability $1 - q$ event), expected gains are: c
- ▶ The "Loss Ratio" is

$$\psi = \frac{q (\delta (M + c) - c)}{(1 - q) c}$$

- ▶ If δM is large compared with c , then

$$\psi \approx \frac{q \delta M}{(1 - q) c}$$

- ▶ Symmetric calculations apply to buyers....

Common Knowledge of Loss Ratio

- ▶ Suppose common knowledge of parameters and thus ψ
- ▶ If $\psi < 1$, there is a unique equilibrium where no one trades
- ▶ If $\psi \geq 1$, there is also an equilibrium where everyone trades

Best Responses without Common Knowledge

- ▶ Suppose a seller is uncertain about the proportion π of uninformed buyers who will sell and is uncertain of M
- ▶ When will he accept trade?
- ▶ Expected gain to trade of uninformed seller conditional on π and M is

$$\begin{aligned}
 & \left\{ \begin{array}{l} \delta (q + (1 - q) \pi) (c - M) \\ + (1 - 2\delta) (q + (1 - q) \pi) c \\ + \delta (1 - q) \pi (c + M) \end{array} \right\} \\
 = & (1 - q) \pi c - q (\delta (M + c) - c) \\
 = & (1 - q) c (\pi - \psi)
 \end{aligned}$$

Best Responses without Common Knowledge

- ▶ Expected gain to trade of uninformed seller conditional on π and M is

$$(1 - q) c (\pi - \psi)$$

- ▶ Thus optimal to trade if

$$E(\pi) \geq E(\psi)$$

- ▶ Symmetric analysis for buyer

Necessary Conditions for Trade

1. An agent's expectation of the loss ratio is less than 1...
2. (1) is true and his expectation of the proportion of agents on other side of market for whom (1) is true is greater than his expectation of the loss ratio...
3. (2) is true and his expectation of the proportion of agents on other side of market for whom (2) is true is greater than his expectation of the loss ratio...
4. etc....

DEFINITION. There is market confidence for agent i if and only if all the above statements are true.

We will show that this is also a sufficient condition for trade.

An Electronic Mail Game Example

- ▶ Rubinstein (1989)
- ▶ States $\Omega = \{1, 2, \dots, 2K\}$
- ▶ At state 1, the loss ratio is high, $\psi_H > \frac{3}{2}$
- ▶ At all other states, the loss ratio is low but not too low, $1 > \psi_L > \frac{1}{2}$
- ▶ All sellers observe information partition $(\{1\}, \{2, 3\}, \{3, 4\}, \dots)$
- ▶ All buyers observe information partition $(\{1, 2\}, \{3, 4\}, \{5, 6\}, \dots)$

Trade

- ▶ Uninformed seller observing $\{1\}$ will not trade (expected loss ratio exceeds 1)
- ▶ Uninformed buyer observing $\{1, 2\}$ will not trade (expected proportion of uninformed traders trading less than $\frac{1}{2}$ which is less than expected loss ratio....)
- ▶
- ▶ Uninformed agents never trade no matter how high K is

Intuition

- ▶ Fix any event $E = \{k, k + 1, k + 2, \dots\}$
- ▶ There is an agent who thinks that no more than half of uninformed traders on other side of the market are trading.

Global Game Example

- ▶ Carlsson and van Damme (1993), Morris and Shin (1998, 2003)
- ▶ Suppose a parameter θ is drawn from density $g(\cdot)$
- ▶ Each buyer and each seller observes a signal $x_i = \theta + \sigma\varepsilon_i$, where ε_i is drawn according to $f(\cdot)$
- ▶ Suppose loss ratio $\tilde{\psi} : \mathbb{R} \rightarrow \mathbb{R}_+$ with $\tilde{\psi}$ decreasing, $\tilde{\psi}(\theta) > 1$ for sufficiently small θ , $\tilde{\psi}(\theta) > \frac{1}{2}$ for all θ

Global Game Example

- ▶ For small $\sigma > 0$, for every x_i will think that about half of people on other side of the market have observed lower signals
- ▶ The unique equilibrium will have nobody trading.

Losing Market Confidence

- ▶ Suppose $\frac{1}{2} < \psi < 1$
- ▶ Initially, ψ is common knowledge.(i.e., $\sigma = 0$)
- ▶ All uniformed agents trade and ex ante utility is maximized
- ▶ Shock does NOT change ψ but adds noise $\sigma > 0$

Formal(ish) Definition of Market Confidence

- ▶ Each agent i is one of a set of "types" T_i
- ▶ Each agent has beliefs $\pi_i : T_i \rightarrow \Delta(T_{-i} \times \mathbb{R})$, $\pi_i(t_{-i}, \psi | t_i)$
- ▶ Write $\tilde{\psi}_i(t_i)$ for type t_i 's expectation of ψ
- ▶ For each i , fix a $E_i \subseteq T_i$

DEFINITION. $(E_i)_{i=1}^{2N}$ embodies market confidence if each $t_i \in E_i$ believes that the proportion of traders on the other side of the market with $t_j \in E_j$ is at least $\tilde{\psi}_i(t_i)$

THEOREM. Agent i has market confidence if and only if there exists $(E_i)_{i=1}^{2N}$ embodying market confidence with $t_i \in E_i$

- ▶ Compare Aumann (1976), Monderer and Samet (1989)
- ▶ Implies sufficiency of market confidence for trade

Asset Returns

- ▶ Let $v = \bar{v} + \eta$, where η is distribution according to f_θ
- ▶ Tail probability:

$$\begin{aligned}\delta(\theta) &= \text{Prob}_\theta(\eta \geq c) \\ &= \int_{\eta=c}^{\infty} f_\theta(\eta) d\eta \\ &= 1 - F_\theta(c)\end{aligned}$$

Asset Returns

- ▶ Another key parameter will be the expected deviation of the common value of the asset from its mean if returns are in one of the tails:

$$\begin{aligned} M(\theta) &= E_{\theta}(\eta | \eta \geq c) \\ &= \frac{1}{\delta(\theta)} \int_{\eta=c}^{\infty} \eta f_{\theta}(\eta) d\eta \end{aligned}$$

- ▶ These will be the only parameters of returns that will matter in our trading game. In particular, for each distribution θ , there is a corresponding loss ratio defined as above:

$$\psi(\theta) = \frac{\text{expected losses}}{\text{expected gains}} = \frac{q(\delta(\theta)(M(\theta) + c) - c)}{(1 - q)c}.$$

General Trading Mechanism

- ▶ Double Auction supports equilibrium of simple trading game as approximate equilibria proportional to the ex ante probability that there is ψ -confidence i.e. approximate common knowledge of low expected losses

Recognition versus Disclosure

- ▶ Recognition: in financial bottom line
- ▶ Disclosure: in the footnote
- ▶ Makes a difference [Barth, Clinch and Shibano (2003), Espahbodi et al. (2002)]

Accounting Standards

- ▶ Finding the balance between
 - ▶ accurate measurement
 - ▶ common understanding
- ▶ Attempting to convey more information may lead to less focussed attention and less common understanding
- ▶ One purpose of accounting standards is to signal to audience what numbers others will simultaneously be focussing on

Conclusion

- ▶ "Market Confidence" well interpreted as approximate common knowledge that expected losses from participation are bounded
- ▶ Benchmark model of adverse selection driven coordination problems
- ▶ Framework to analyze role of information