Predatory Trading

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Motivation

- Forced liquidation of large position:
  - is often associated with low liquidity
  - can be very costly
  - cross-correlation structure goes wild
  - is a key concern in risk management
- This paper: predatory trading,
  - trading that induces and/or exploits other traders’ need to reduce their positions
- Wall Street conventional wisdom:
  - “They’ll let you in, but they won’t let you out.”
Examples

- Amaranth

- Long-Term Capital Management (LTCM)
  
  "If lenders know that a hedge fund needs to sell something quickly, they will sell the same asset - driving the price down even faster. Goldman Sachs and counterparties to LTCM did exactly that in 1998. Goldman admits it was a seller but says it acted honorably and had no confidential information."
Examples

- Amaranth
- Long-Term Capital Management (LTCM)
- UBS Warburg and Enron

“UBS Warburg’s proposal to take over Enron’s traders without taking over the trading book was opposed on the ground that “it would present a ‘predatory trading risk’, as Enron traders effectively know the contents of the trading book.”
• Amaranth
• Long-Term Capital Management (LTCM)
• UBS Warburg and Enron
• 1987 Crash, Brady Report:
  “several ‘triggers’ ... ignited mechanical, price-insensitive selling by a number of institution following portfolio insurance strategies ... The selling by these investors, and the prospect of further selling by them, encouraged a number of aggressive trading-oriented institutions to sell in anticipation of further declines. ”
Examples

- Amaranth
- Long-Term Capital Management (LTCM)
- UBS Warburg and Enron
- 1987 Crash
- Askin/ Granite vs. Merrill Lynch
- Metallgesellschaft (MG)
Results

- Under which circumstances occurs predatory trading
- Price overshooting
- Systemic risk
- Time-varying liquidity - dries up when it is needed the most
- “Distress” value < orderly liquidation value < paper value
- Contagion
- Risk management, disclosure
Timeline

Investment Phase

Predation
- exogenous default
- single predator
- multiple predator

endogenous default
systemic risk
Model

• Time is continuous \( t \in [0, T] \)

• Large strategic traders — “big players” \( i \in \{1, 2, \ldots, I\} \):
  • trading intensity/speed: \( a^i(t) \)
  • aggregate speed constraint: \( \sum_i a^i \leq A \)

• position at time \( t \):
  \[ x^i(t) = x^i(0) + \int_0^t a^i(\tau) d\tau \]

• aggregate holding
  \[ X(t) = \sum_{j=1}^{I} x^j(t) \]

• Long-term traders — many small investors:
  • aggregate demand: \( Y(p) = \frac{1}{\lambda}(\mu - p) \)

• Price:
  \[ p(t) = \mu - \lambda(S - X(t)) \]
• **Price**

\[ p(t) = \mu - \lambda (S - X(t)) \]

where supply \( S \geq l\bar{x} \), hence, \( p(t) \leq \mu \).

• **Price impact of order flow**

  • “permanent”: \( \lambda \sum_i a^i \)
  • “temporary”: \( \gamma (|\sum_i a^i| - A) \) if \( |\sum_i a^i| > A \)

  equal order priority:

  • no temporary price impact for first \( \bar{a} \) buy- (\( a \) sell-) orders
  • trader \( i \)’s temporary price impact cost:

\[
G := \gamma \max \left\{ 0, a^i - \bar{a}, a - a^i \right\}
\]
Equilibrium Price at $t_0$
Long-Run Price Shift

\[ S \]

\[ p \]

\[ \mu \]

\[ \text{lx}(t_0) \]

\[ (l-1)x \]
A trader in crisis/default must liquidate: \( \Rightarrow \) forced to sell at a \textit{minimum speed} of \( A/I \)

What triggers default?
- Part 1: bad luck: \( i \) is in crisis at time \( t_0 \)
- Part 2: wealth fall below critical level: \( W^i(t) \leq W \)
Objective Function and Equilibrium

Strategic trader $i$’s objective is to maximize his expected wealth

$$
\max_{a^i(\cdot) \in A^i} E \left( x^i(T) \mu - \int_0^T [a^i(t)p(t) + G(a^i(t), a^{-i}(t))] dt \right) \quad (*)
$$

Definition
An equilibrium is a set of processes $(a^1, \ldots, a^I)$ such that, for each $i$, $a^i$ solves $(*)$, taking $a^{-i} = (a^1, \ldots, a^{i-1}, a^{i+1}, \ldots, a^I)$ as given.
Preliminary Analysis

Agent minimizes trading costs as if his own trades do not affect the price.

**Lemma**

A trader’s problem can be written as

\[
\min_{a^i(t) \in \mathcal{A}^i} \mathbb{E} \int_0^T a^i(t) X^{-i}(t) \, dt
\]

s.t.

\[
x^i(T) = x^i(0) + \int_0^T a^i(t) \, dt = \bar{x} \quad \text{if } i \in \mathcal{I}^p
\]

\[
a^i(t) \in \left[ a \left( a^{-i}(t) \right), \bar{a} \left( a^{-i}(t) \right) \right].
\]
Predatory Phase I: Exogenous default

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>$I$</td>
<td>$I^p$</td>
<td>$\lambda$</td>
<td>$\mu$</td>
<td>$S$</td>
<td>$A$</td>
<td>$x(t_0)$</td>
<td>$\bar{x}$</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>140</td>
<td>40</td>
<td>20</td>
<td>8</td>
<td>10</td>
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Distressed trader

Single Predator
Price Overshooting

- Exogenous Default
- Single Predator
- Multiple Predators
- Endogenous Default
- Systemic Risk
- Risk Management
- Valuation

Initial Positions
- Necessary Predation

Literature

The diagram illustrates the Price Overshooting model with Friedman predator buys. The graph shows the price over time, with the predator buying at a certain point, leading to a sharp decrease in price. The model is based on the work of Predatory Trading by Brunnermeier & Pedersen.
Price Overshooting

Sell one more share
Price Overshooting

Sell two more shares
Why does the predator keep selling?
Competing Predators Spoil the Prey!

Three examples: $I = 3$, 9, and 27.

<table>
<thead>
<tr>
<th>$I^d/I$</th>
<th>$\lambda$</th>
<th>$\mu$</th>
<th>$S$</th>
<th>$A$</th>
<th>$x(t_0) \cdot I$</th>
<th>$\bar{x} \cdot I$</th>
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<tbody>
<tr>
<td>$\frac{1}{3}$</td>
<td>1</td>
<td>140</td>
<td>40</td>
<td>20</td>
<td>16</td>
<td>20</td>
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![Graph 1](image1.png)

![Graph 2](image2.png)
Price Overshooting

Summary

1. If "money on the sideline", $\bar{x} - x(t_0)$, is small, then
   $\Rightarrow$ Predatory Trading and
   $\Rightarrow$ Price overshooting

2. Competition among predators reduces price overshooting.

3. If "money on the sideline" is large, there is no predatory trading or price overshooting.
Predatory Phase II: Endogenous Default

- trader defaults if his marked-to-market wealth drops below $W$
- Others’ selling lowers price and erodes trader’s wealth even further
  $\Rightarrow$ trader’s wealth can drop below $W$ after $t_0$
- survival hurdle, $W(\cdot)$, is even higher
  $\Rightarrow$ better to start selling now if wealth is lower than survival hurdle
- the more traders are expected to default, the higher is the survival hurdle $W(I^d)$ since
  - predation is more fierce
  - more traders have to fully liquidate their position
Endogenous Default
Predatory Trading
Brunnermeier & Pedersen

Model
Predation
Exogenous Default
Single Predator
Multiple Predators
Endogenous Default
Systemic Risk
Risk Management Valuation

Systemic Risk

\[ W(I) \]
\[ W(4) \]
\[ W(3) \]
\[ W(2) \]
\[ W(1) \]
\[ W \]

Initial Positions
Necessary Predation

Literature
In testimony to the House of Representatives, 10/1/98:

“...the act of unwinding LTCM’s portfolio in a forced liquidation would not only have a significant distorting impact on market prices but also in the process could produce large losses, or worse, for a number of creditors and counterparties, and for other market participants who were not directly involved with LTCM.”
Risk Management

- Risk management should take into account that in times of crisis
  - predatory trading lowers liquidity
  - predatory trading affects correlation structure of assets
  - other large traders’ positions matter: “dealer exit stress test” (Risk Magazine Nov. 2003)
  - rigid risk management strategies can be exploited by predators
- These effects are more severe because $W(I^d)$ is higher
  - in markets that are typically less liquid (higher $\lambda$)
  - for open-end funds which may suffer fund outflows
Valuation with Endogenous Liquidity

Three levels of valuation:

1. “paper value”:
2. “orderly liquidation value”:
3. “distressed liquidation value”:

\[ V_{\text{paper}} > V_{\text{orderly}} > V_{\text{distressed}} \]
Predatory Trading HAS TO Occur in Equilibrium

“little” money on the sideline ⇒ Predatory Trading

\[ \bar{x} - x(t_0) \text{ is low} \]

Nobody defaults

\[ t_0 \leq t \]

Someone defaults

Investment phase  predatory phase
Predatory Trading HAS TO Occur in Equilibrium

"lots of" money on the sideline ⇒ No Equilibrium
$ar{x} - x(t_0)$ is large

Nobody defaults
Someone defaults

Investment phase

$p(t)$

$p(t_0)$
Further Implications of Predatory Trading

- Front-running
  - predators sell first and buy when distressed traders sell
- Batch Auctions, Trading Halts, Circuit Breakers
  - uniform price execution lowers price overshooting
- Bear Raids and the Uptick Rule
- Contagion
- Collusion
Collusion

• Predators have an incentive to collude:
  • to trigger many defaults
  • to exploit fully the defaults

• Collusive and non-collusive outcomes qualitatively different
Related Literature

- Cai (2002)
- Friedman (1953); DeLong, Shleifer, Summers, and Waldmann (1990a)
- Attari, Mello, and Ruckes (2002);
- Bernardo and Welch (2002)
Conclusion

- Predatory trading important
  - for large traders
  - in illiquid markets
- Predatory trading can lead to
  - price overshooting
  - low distressed liquidation values (time-varying liquidity)
  - systemic risk
  - different cross-correlation across assets
  - contagion