Fear, Greed, and Financial Crises: A Cognitive Neurosciences Perspective

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The complexity of price discovery in an efficient market: the stock market reaction to the Challenger crash

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Received 15 November 2001; received in revised form 8 February 2002; accepted 12 July 2002
January 28, 1986, 11:39am

- 11:47am: “Space Shuttle Explodes”
- 12:17pm: “Lockheed Has No Immediate Comment”
- 12:52pm: “Rockwell Intl Has No Comment”
Reagan Establishes Presidential Commission To Investigate
Rogers Commission Report Published June 9, 1986

- Concluded that Morton Thiokol was at fault
The Stock Market Reflected This Information Within Minutes

Table 2
Intraday stock market behavior around the Challenger crash

<table>
<thead>
<tr>
<th>Time</th>
<th>Morton Thiokol</th>
<th>Lockheed</th>
<th>Martin Marietta</th>
<th>Rockwell International</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30 a.m.</td>
<td>US$37.25</td>
<td>US$47.25</td>
<td>US$35.38</td>
<td>US$34.75</td>
</tr>
<tr>
<td>Noon</td>
<td><strong>Halt</strong></td>
<td>US$44.50</td>
<td>US$34.25</td>
<td>US$32.75</td>
</tr>
<tr>
<td>12:36 p.m.</td>
<td>US$25.00</td>
<td>US$45.00</td>
<td>US$32.50</td>
<td>US$34.13</td>
</tr>
<tr>
<td>1:00 p.m.</td>
<td>US$34.38</td>
<td>US$45.00</td>
<td>US$33.00</td>
<td>US$33.25</td>
</tr>
</tbody>
</table>

Panel A. Stock price movements

Panel B. Stock returns

This table reports the price movements and stock returns of the four major space-shuttle firms in the period immediately surrounding the 11:39 a.m. crash of the space shuttle Challenger on January 28, 1986. There is no reported price for Morton Thiokol at noon because of an NYSE trading halt in that stock from 11:52 a.m. to 12:44 p.m. The first post-crash trade in Morton Thiokol occurred at 12:36 p.m. on NASDAQ. Data are taken from the price sheets of Francis Emory Fitch.
Fig. 1. Intraday stock price movements following the challenger disaster.
The Wisdom of Crowds

\[ x_i = x + \epsilon_i \]

\[ \overline{x} = \frac{1}{n} \sum_{i=1}^{n} x_i \]

\[ = x + \frac{1}{n} \sum_{i=1}^{n} \epsilon_i \approx x \]
The Madness of Mobs!

3 June 2013

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Behavioral Critique of Efficient Markets

- Rationality is not supported by the data
- Cognitive and behavioral biases
  - Loss aversion, anchoring, framing
  - Probability matching
  - Randomization
  - Overconfidence
  - Overreaction
  - Herding
  - Mental accounting
Loss Aversion

- A: $240,000
- B: $1,000,000  With 25% Probability
  $0  With 75% Probability

Which Would You Prefer?
Loss Aversion

- C: $-750,000
- D: $-1,000,000 With 75% Probability
  $0 With 25% Probability

Which Would You Prefer?
Loss Aversion

- A+D: $240,000 With 25% Probability
  - $760,000 With 75% Probability

- B+C: $250,000 With 25% Probability
  - $750,000 With 75% Probability

Now Which Would You Prefer?
Loss Aversion

- This is the underlying mechanism of “rogue” traders:

<table>
<thead>
<tr>
<th>Trader</th>
<th>Year</th>
<th>Company</th>
<th>Currency</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nick Leeson</td>
<td>1995</td>
<td>Barings</td>
<td>£</td>
<td>827,000,000</td>
</tr>
<tr>
<td>Yasuo Hamanaka</td>
<td>1996</td>
<td>Sumitomo</td>
<td>$</td>
<td>2,600,000,000</td>
</tr>
<tr>
<td>John Rusnak</td>
<td>2002</td>
<td>Allied Irish Banks</td>
<td>$</td>
<td>691,000,000</td>
</tr>
<tr>
<td>Jiulin Chen</td>
<td>2005</td>
<td>China Aviation Oil</td>
<td>$</td>
<td>550,000,000</td>
</tr>
<tr>
<td>Jerome Kerviel</td>
<td>2006-2008</td>
<td>Societe Generale</td>
<td>€</td>
<td>4,900,000,000</td>
</tr>
<tr>
<td>Boris Picano-Nacci</td>
<td>2008</td>
<td>Caisse d'Epargne</td>
<td>€</td>
<td>751,000,000</td>
</tr>
<tr>
<td>Kweku Adoboli</td>
<td>2011</td>
<td>UBS</td>
<td>$</td>
<td>2,300,000,000</td>
</tr>
</tbody>
</table>

- Asymmetric weighting of gains vs. losses
- Magnitudes matter; small stakes don’t have this effect
Finite Cognitive Load

www.viscog.com
Rationality and the Cognitive Neurosciences

Patient Elliot Had Frontal Lobe Damage:

- No Impact on IQ or Logical Functions
  - Perceptual Ability
  - Past Memory
  - Short-Term Memory
  - Learning
  - Language
  - Arithmetic

- But Behavior Was Quite **Irrational**!
Damasio (1994, p. 36):

When the job called for interrupting an activity and turning to another, he might persist nonetheless, seemingly losing sight of his main goal. Or he might interrupt the activity he had engaged, to turn to something he found more captivating at that particular moment... The flow of work was stopped. One might say that the particular step of the task at which Elliot balked was actually being carried out too well, and at the expense of the overall purpose. One might say that Elliot had become irrational concerning the larger frame of behavior...
No Reaction to Emotional Stimuli:

- “to know, but not to feel.”
- Impaired emotional response $\Rightarrow$ irrationality
- Serious implications for decisionmaking
- What do we mean by rational?
- Left brain/right brain distinction
An Example of Conflict In The Brain

Say the colors of the following word:

- RED
- GREEN
- BLUE
- YELLOW
- ORANGE
- BLUE
- BROWN
- RED
- GREEN
- PURPLE
- PINK
- BLACK
- BLUE
- YELLOW
- GREEN
An Example of Conflict In The Brain

Say the colors of the following word:

RED      GREEN      BLUE      YELLOW      ORANGE
BLUE      BROWN      RED       GREEN      PURPLE
PINK      BLACK      BLUE      YELLOW      GREEN
Other Examples

Distinction Between Function and Mechanism

- Forced smile vs. natural smile
- Social rejection vs. physical pain

Emotional Stimulus Can Hinder The Neocortex

- Too flustered to speak
- “The Gift of Fear”
- Road rage
Road Rage

4 × 286 = _____

3 × 727 = _____

2 × 516 = _____

5 × 679 = _____

7 × 124 = _____

2 × 129 = _____

8 × 328 = _____

6 × 457 = _____

2 × 697 = _____

8 × 342 = _____

9 × 713 = _____

7 × 643 = _____

6 × 833 = _____

4 × 179 = _____

4 × 427 = _____

9 × 234 = _____
Road Rage
### Road Rage

<table>
<thead>
<tr>
<th>Equation</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2 \times 627$</td>
<td>_____</td>
</tr>
<tr>
<td>$9 \times 154$</td>
<td>_____</td>
</tr>
<tr>
<td>$3 \times 214$</td>
<td>_____</td>
</tr>
<tr>
<td>$2 \times 724$</td>
<td>_____</td>
</tr>
<tr>
<td>$7 \times 729$</td>
<td>_____</td>
</tr>
<tr>
<td>$5 \times 313$</td>
<td>_____</td>
</tr>
<tr>
<td>$9 \times 118$</td>
<td>_____</td>
</tr>
<tr>
<td>$3 \times 143$</td>
<td>_____</td>
</tr>
<tr>
<td>$4 \times 534$</td>
<td>_____</td>
</tr>
<tr>
<td>$7 \times 964$</td>
<td>_____</td>
</tr>
<tr>
<td>$5 \times 388$</td>
<td>_____</td>
</tr>
<tr>
<td>$6 \times 234$</td>
<td>_____</td>
</tr>
<tr>
<td>$8 \times 312$</td>
<td>_____</td>
</tr>
<tr>
<td>$2 \times 363$</td>
<td>_____</td>
</tr>
<tr>
<td>$3 \times 377$</td>
<td>_____</td>
</tr>
<tr>
<td>$8 \times 125$</td>
<td>_____</td>
</tr>
</tbody>
</table>
“Fight or flight” response is immediate
- Increased breathing, heart rate, blood pressure
- Constriction of blood vessels to certain body parts
- Dilation of blood vessels to muscles, dilation of pupils
- Release of nutrients (fat, glucose); slowed digestion
- Inhibited hunger and sex drive
- Reduced hearing, tunnel vision, accelerated reflexes

Response occurs before we realize it

Important evolutionary adaptation

Is this the optimal response for today’s contexts?
Risk Perception and Adaptive Behavior

- But Homo Sapiens has unique new machinery
  - Prefrontal cortex enables symbolic thought
  - Appeared 60,000 years ago, and spread rapidly
  - Allows for more complex behaviors

- We can overrule “fight-or-flight”
- But should we?
- What are our goals?
- How can we best achieve them?
The Effects of Automobile Safety Regulation

Sam Peltzman
University of Chicago

Technological studies imply that annual highway deaths would be 20 percent greater without legally mandated installation of various safety devices on automobiles. However, this literature ignores offsetting effects of nonregulatory demand for safety and driver response to the devices. This article indicates that these offsets are virtually complete, so that regulation has not decreased highway deaths. Time-series (but not cross-section) data imply some saving of auto occupants’ lives at the expense of more pedestrian deaths and more nonfatal accidents, a pattern consistent with optimal driver response to regulation.

Automobile Safety Regulation and the Incentive to Drive Recklessly: Evidence from NASCAR

Russell S. Sobel* and Todd M. Nesbit†

When safety regulation makes automobiles safer, drivers may drive more recklessly, partially or completely offsetting effects on the overall level of safety. Evidence of these offsetting effects has been hard to find, however, primarily because of the aggregate nature of accident data. In this paper we explore how changes in the safety of automobiles used in the National Association for Stock Car Auto Racing (NASCAR) has altered the incentive of drivers to drive recklessly. This unique data set allows more accurate and objective measurement of the necessary variables to test for these effects at a microlevel. Our results strongly support the presence of these offsetting behavioral effects.

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Risk Perception and Adaptive Behavior

- Life is filled with risk/reward trade-offs
- Suppose risk declines but reward is the same
  \[\Rightarrow\] Take more risk! (same risk level as before will now yield greater reward)
- But what if risk **perception** differs from reality?
  - Path-dependent, subjective, and variable
- After a **sequence** of gains, risk seems lower
- After a **single** bad loss, risk seems greater
Implications for Finance

Preferences Are Produced By The Three Brains

- Logical reasoning produced by hominid brain
- Emotional stimulus can override hominid brain
- Lack of emotion can also lead to irrationality
- Preferences may not be stable over time
- Preferences may not be stable over situations
- Individuals do not always behave “rationally”
- Neuroscientific and evolutionary foundations of financial crises
Lessons From The Financial Crisis?

- Pension Funds
- Mutual Funds
- Sovereign Wealth Funds
- Foundations & Endowments
- Hedge Funds

Rating Agencies

- Commercial Banks
- Investment Banks
- Mortgage Companies
- Fannie Mae
- Freddie Mac

Politicians

In the insurance & CDS market, the following were involved:

- Pension Funds
- Mutual Funds
- Sovereign Wealth Funds
- Foundations & Endowments
- Hedge Funds

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Lessons From The Financial Crisis?

U.S. Real Home Price Index, 1890 –2012

Home Prices

Population

Source: Robert J. Shiller
Lessons From The Financial Crisis?

“Hall of Shame”? 
- Homeowners 
- Commercial banks 
- Investment banks and other issuers of MBSs, CDOs, and CDSs 
- Mortgage lenders, brokers, servicers, trustees 
- Credit rating agencies (S&P, Moody, Fitch) 
- Insurance companies (multiline, monoline) 
- Investors (hedge funds, pension funds, mutual funds, others) 
- Regulators (SEC, OCC, CFTC, Fed, etc.) 
- Government sponsored enterprises 
- Politicians

Is Human Behavior The Culprit?
Has This Happened Before?

Yes, Many Times (see Reinhart and Rogoff, 2008):

- 18 times since 1974
- 5 **big** bank-related crises:
  - 1977: Spain
  - 1987: Norway
  - 1991: Finland
  - 1991: Sweden
  - 1992: Japan
- Common themes:
  - Rising housing and stock markets
  - Capital inflows
  - Large public debt
  - Financial liberalization
Crisis Preparation vs. Crisis Prevention

- Break up banks and broker/dealers that are “too big to fail”
- Create exchanges for CDSs and other large OTC contracts
- Create financial NTSB for analyzing all blow-ups
- Require confidential disclosure regarding “network” exposures
- Implement counter-cyclical leverage constraints for bank-like entities
- Enforce “suitability” requirements for mortgage-broker advice
- Require certification for mgmt. and boards of complex financial institutions
- Impose more mark-to-market accounting and risk controls
- Impose capital adequacy requirements for all bank-like entities
- Create new discipline of “risk accounting”
- Impose small derivatives tax to fund financial engineering programs
- Revise laws to allow “pre-packaged” bankruptcies for finance companies
- Change corporate governance structure (compensation, CRO role, etc.)
- Teach economics, finance, and risk management in high school
Conclusion

- Fear and greed do drive Wall Street
- That may not be a bad thing
- Possible explanation for “intuition”
- Irrational behavior ↔ emotions gone wild!
- Modeling rationality may involve multiple minds
- Implies new perspective on market efficiency: the Adaptive Markets Hypothesis
- Financial regulation must take this into account
  - Regulators also suffer from loss aversion
  ⇒ A complete theory of human behavior
Thank You!


