



# 15.401 Finance Theory

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*MIT Sloan MBA Program*

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***Lecture 21: Efficient Markets***

# Critical Concepts

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15.401

- Motivation
- Powers of Observation
- Behavioral vs. Rational
- The Triune Model of the Brain
- The Adaptive Markets Hypothesis
- Conclusion

## Readings

- Lo (2005, 2007)

## Theory of Market Efficiency:

- No Free Lunch, No Arbitrage
- Prices Fully Reflect All Available Information
- Prices Follow Random Walks
- Trade-Off Between Risk and Expected Return
- “Active” Management Does Not Add Value



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## The complexity of price discovery in an efficient market: the stock market reaction to the Challenger crash<sup>☆</sup>

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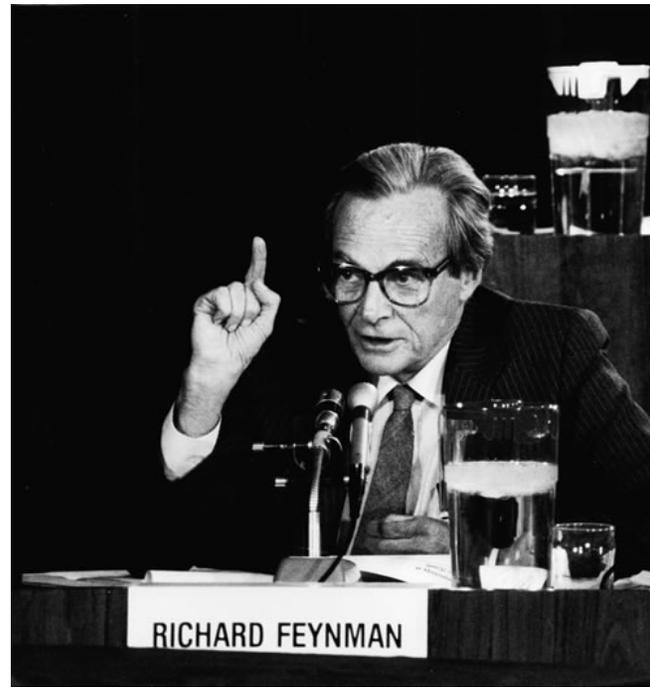
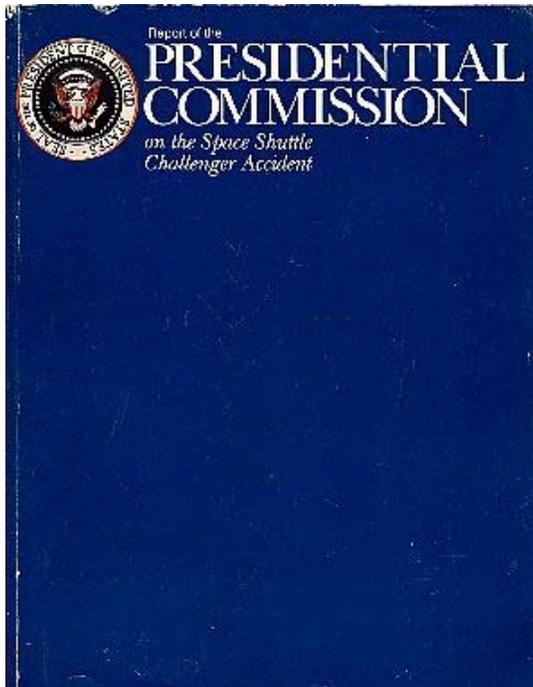
January 28, 1986, 11:39am

- 11:47am: “Space Shuttle Explodes”
- 12:17pm: “Lockheed Has No Immediate Comment”
- 12:52pm: “Rockwell Intl Has No Comment”



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- Reagan Establishes Presidential Commission To Investigate



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Rogers Commission Report Published June 9, 1986

- Concluded that **Morton Thiokol** was at fault

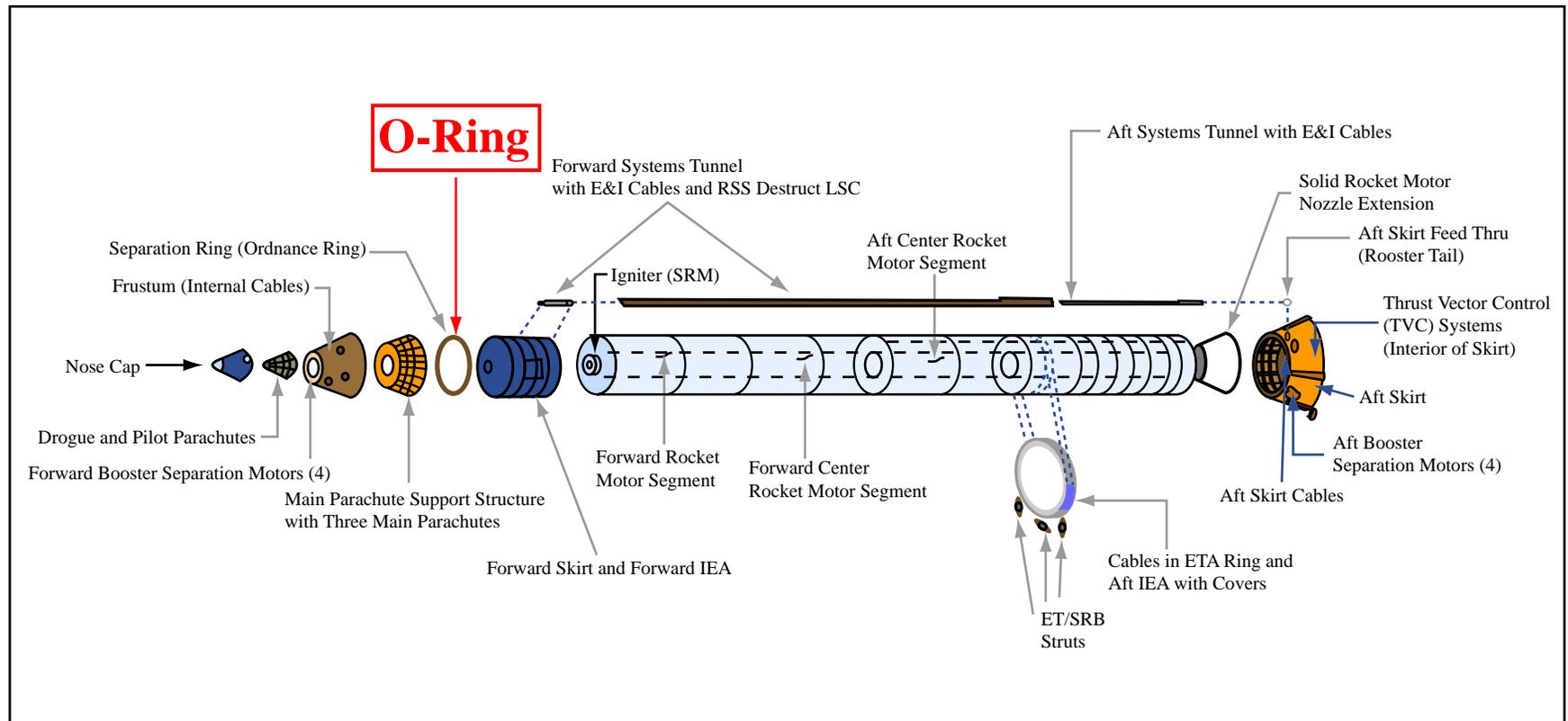


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- The Stock Market Reflected This Information Within **Minutes**

Table 2  
Intraday stock market behavior around the Challenger crash

Time	Morton Thiokol	Lockheed	Martin Marietta	Rockwell International
<i>Panel A. Stock price movements</i>				
11:30 a.m.	US\$37.25	US\$47.25	US\$35.38	US\$34.75
Noon	Halt	US\$44.50	US\$34.25	US\$32.75
12:36 p.m.	US\$35.00	US\$45.00	US\$32.50	US\$34.13
1:00 p.m.	US\$34.38	US\$45.00	US\$33.00	US\$33.25
<i>Panel B. Stock returns</i>				
11:30–Noon	Halt	– 5.82%	– 3.18%	– 5.76%
Noon–12:36	– 6.04%	1.12%	– 5.11%	4.20%
12:36–1:00	– 1.79%	0.00%	1.54%	– 2.56%

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.

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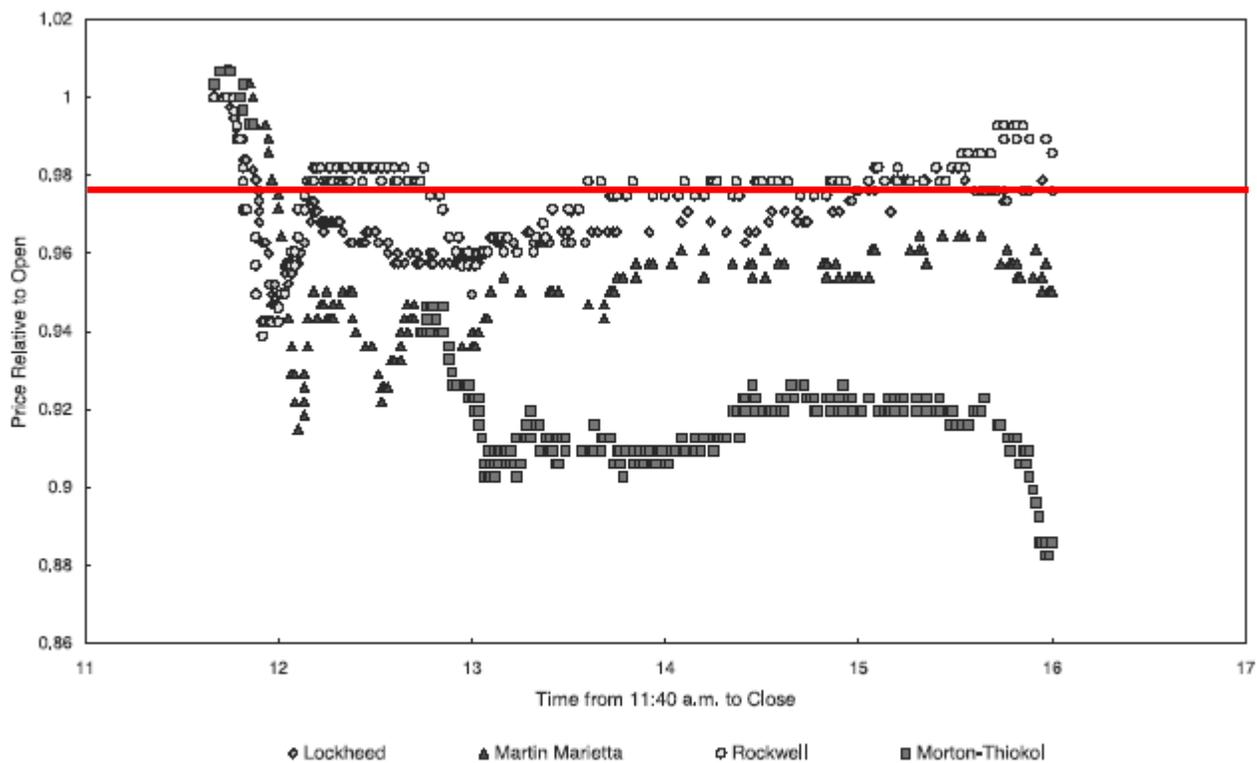


Fig. 1. Intraday stock price movements following the challenger disaster.

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## Behavioral Finance:

- Market Participants Are Irrational
- Cognitive and Behavioral Biases
  - Loss Aversion, Anchoring, Framing
  - Overconfidence
  - Overreaction
  - Herding
  - Mental Accounting

Still image removed due to copyright restrictions. See the video here: profsimons. "Selective Attention Test." March 10, 2010. YouTube. Accessed October 15, 2010. <http://www.youtube.com/watch?v=vJG698U2Mvo>.

## 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!

Book cover image removed due to copyright restrictions:  
Damasio, Antonio. *Descartes' Error: Emotion, Reason, and the Human Brain.* New York, NY: Harper Perennial, 1995. ISBN: 9780380726479.

**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...

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## 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

# The Triune Model of the Brain

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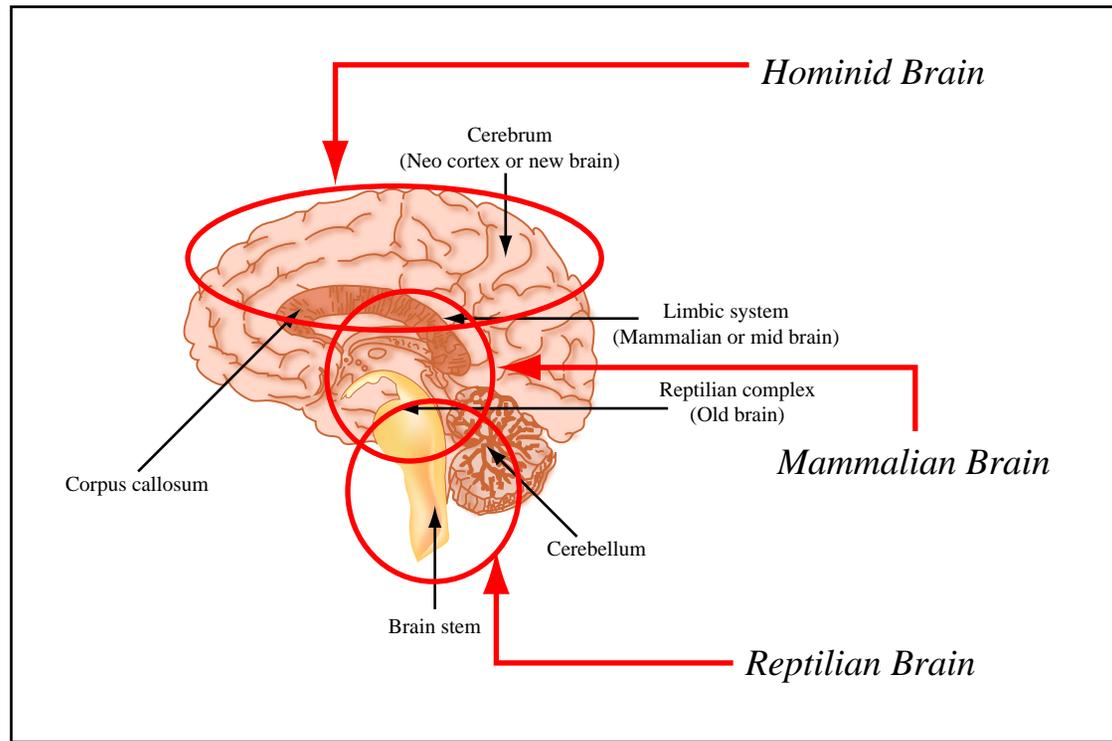


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## Examples of Applications:

- Forced Smile vs. Natural Smile
- Social Rejection vs. Physical Pain

## Emotional Stimulus Can Short-Circuit Hominid Brain

- “The Gift of Fear”, G. de Becker
- Too Flustered To Speak

# The Triune Model of the Brain

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Say the colors of the following word:

RED GREEN BLUE YELLOW ORANGE

BLUE BROWN RED GREEN PURPLE

PINK BLACK BLUE YELLOW GREEN

# The Triune Model of the Brain

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Say the colors of the following word:

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## Preferences Are Produced By The Three Brains

- Logical Reasoning Produced by Hominid Brain
- Emotional Stimulus Overrides Hominid Brain
- Preferences May Not Be Stable Over Time
- Preferences May Not Be Stable Over Circumstances
- What Are Your Ultimate Objectives?
- Will Your Actions Help Or Hinder You?

# The Adaptive Markets Hypothesis

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## **Biological, Not Physical, View of Markets:**

1. Individuals Act In Self-Interest
2. Individuals Make Mistakes
3. Individuals Learn and Adapt
4. Competition Drives Adaptation and Innovation
5. Natural Selection Shapes Market Ecology
6. Evolution Determines Market Dynamics

## Simon's Notion of "Satisficing":

- Heuristics, Not Optimization
- Develop Mental Models To Simplify Decisions
- Learning Is A Key Evolutionary Adaptation
- Cost: Leads To Certain Biases And Regularities
- How Do We Know Where To Stop Optimizing?

**Answer** ⇒ **Evolutionary Forces**

## Where Do Heuristics Come From?

- Consider the Problem of Getting Dressed
- Wardrobe: 5 Jackets, 10 Pants, 20 Ties, 10 Shirts, 10 Pairs of Socks, 4 Pairs of Shoes, 5 Belts
- 2,000,000 Possible Outfits!
- Suppose It Takes 1 Second To Evaluate Each Outfit
- How Long Will It Take To Get Dressed?
- 23.1 Days!

How Do We Get Dressed So Quickly?

# The Adaptive Markets Hypothesis

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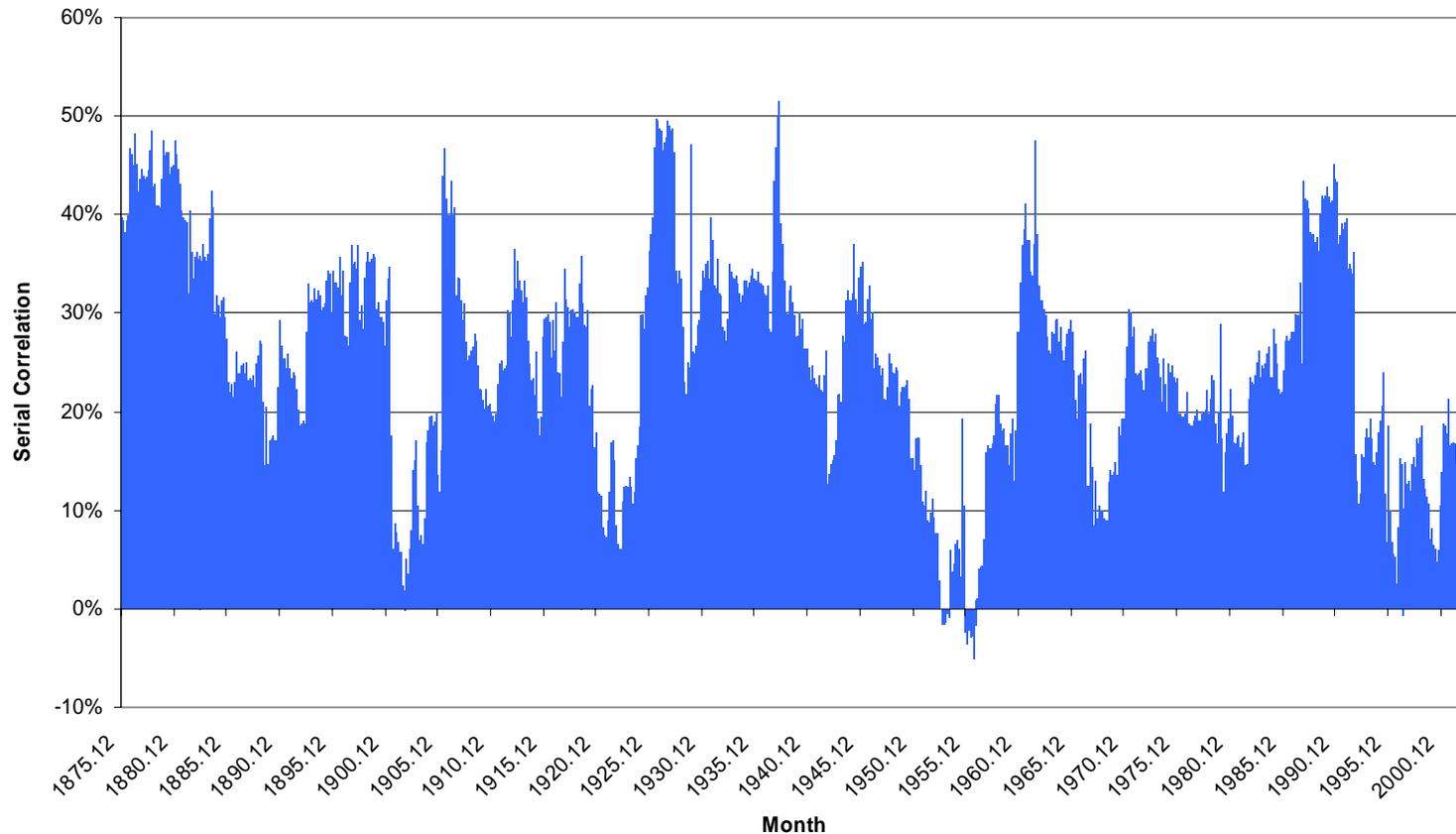
## Practical Implications:

- Risk/Reward Relation Not Stable (Nonlinear)
- Risk Premia Are Time-Varying
- Limited Arbitrage Exists From Time To Time
- Strategies Wax And Wane
- Adaptation and Innovation Are Keys To Survival
- Survival Is All That Matters!

# The Adaptive Markets Hypothesis

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Rolling 5-Year Serial Correlation Coefficient of S&P Composite Index  
January 1871 to April 2003 (Data Source: R. Shiller)



## Unifying Behavioral and Rational Finance

- An Evolutionary Perspective
- Sociobiology (Wilson)
- Ecology of Markets (Niederhoffer and Zeckhauser)
- Neuroeconomics

## Are You The Fittest?

# Additional References

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