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Understanding Volatility

Rational and Behavioral Models

Academic Presentation
The Royal Institution of Great Britain
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Swiss Finance Institute

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Agenda

1. Is Volatility an Asset Class?
2. Properties of Volatility
3. Understanding Volatility with Economic Models
4. Rational and Behavioral Explanations
5. Predicting Volatility
6. References

1. Is Volatility an Asset Class?

Markets

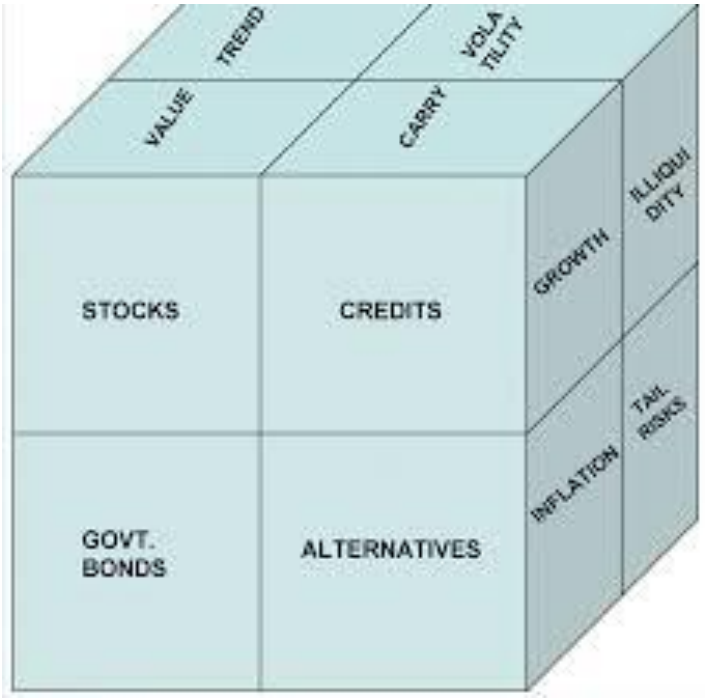
- Volatility
- Derivatives
- Shares
- **Consumption**
- **Production**

Features

- Some regularities
- Pricing well known
- Efficient Market Hypothesis
- **Preferences**
- **Technology**

Nelken (2007): «Volatility as an Asset Class»

1. Is Volatility as an Asset Class?



Ilmanen (2011) «Expected Returns»

1. Is Volatility as an Asset Class?

Pension Funds are Starving for Returns!

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Some Greeks

Some Greeks

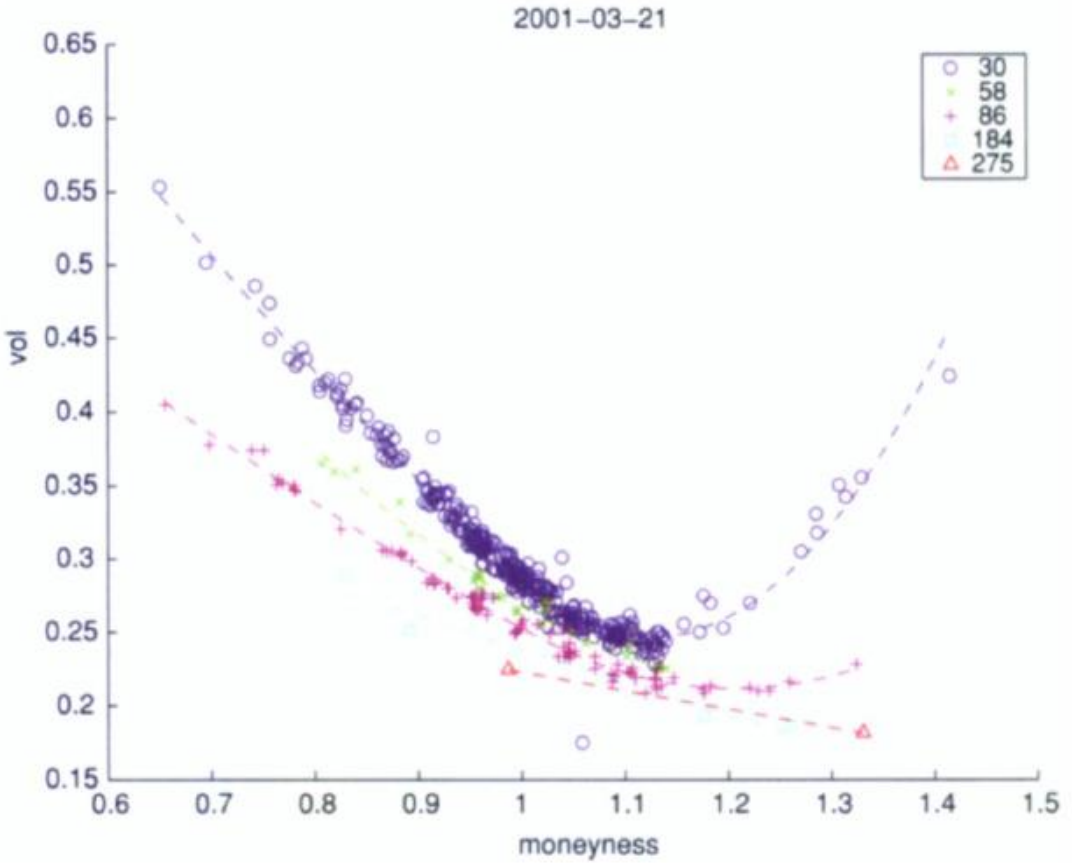
Some Greeks

Tyche drawn by Tatjana Heinz

2. Properties of Volatility

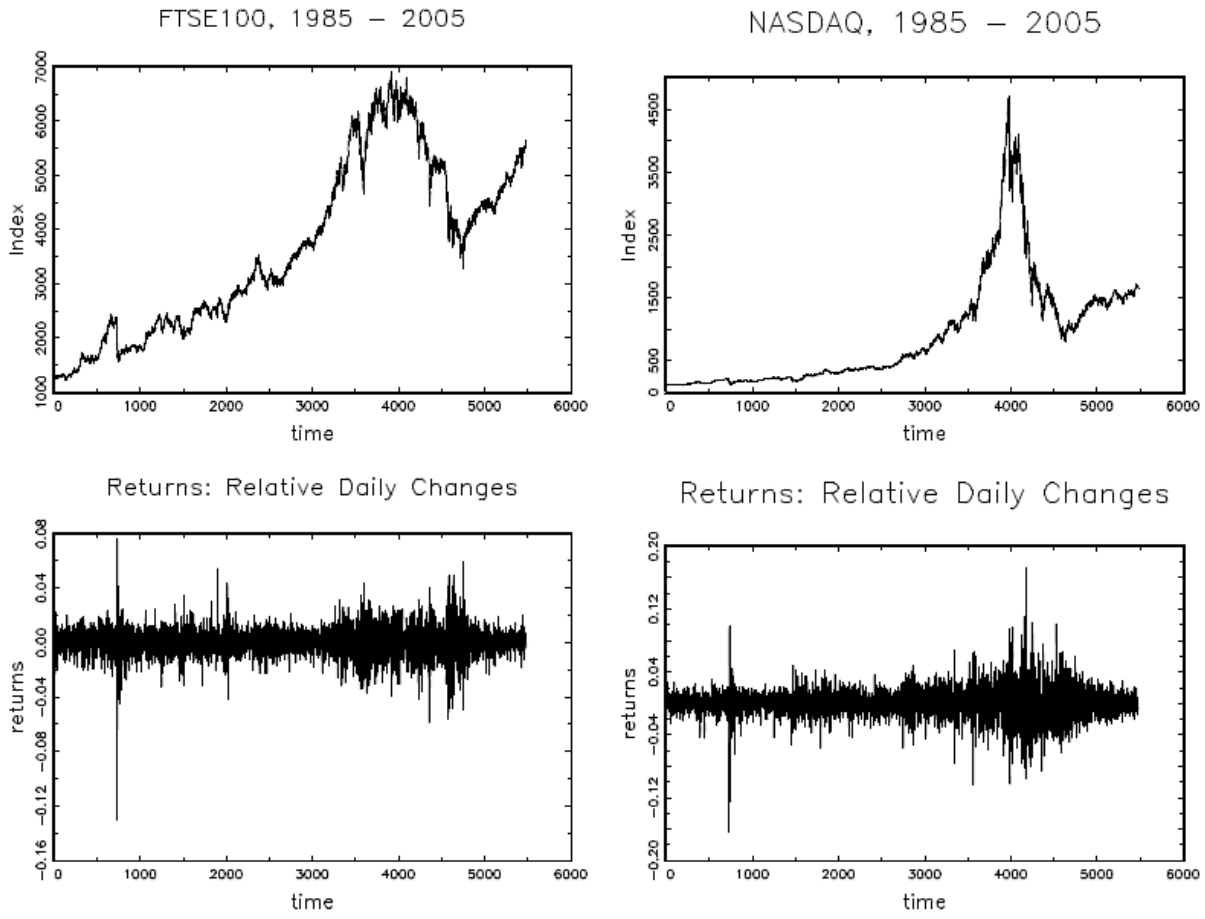
a. Volatility Smiles
b. Volatility is stochastic
c. Volatility is mean reverting
d. Volatility is higher in market crashes
e. Implied Volatility is higher than realized volatility

a. Volatility Smiles



Source: Broadie, Chernov and Johannes (2001)

b. Volatility is Stochastic

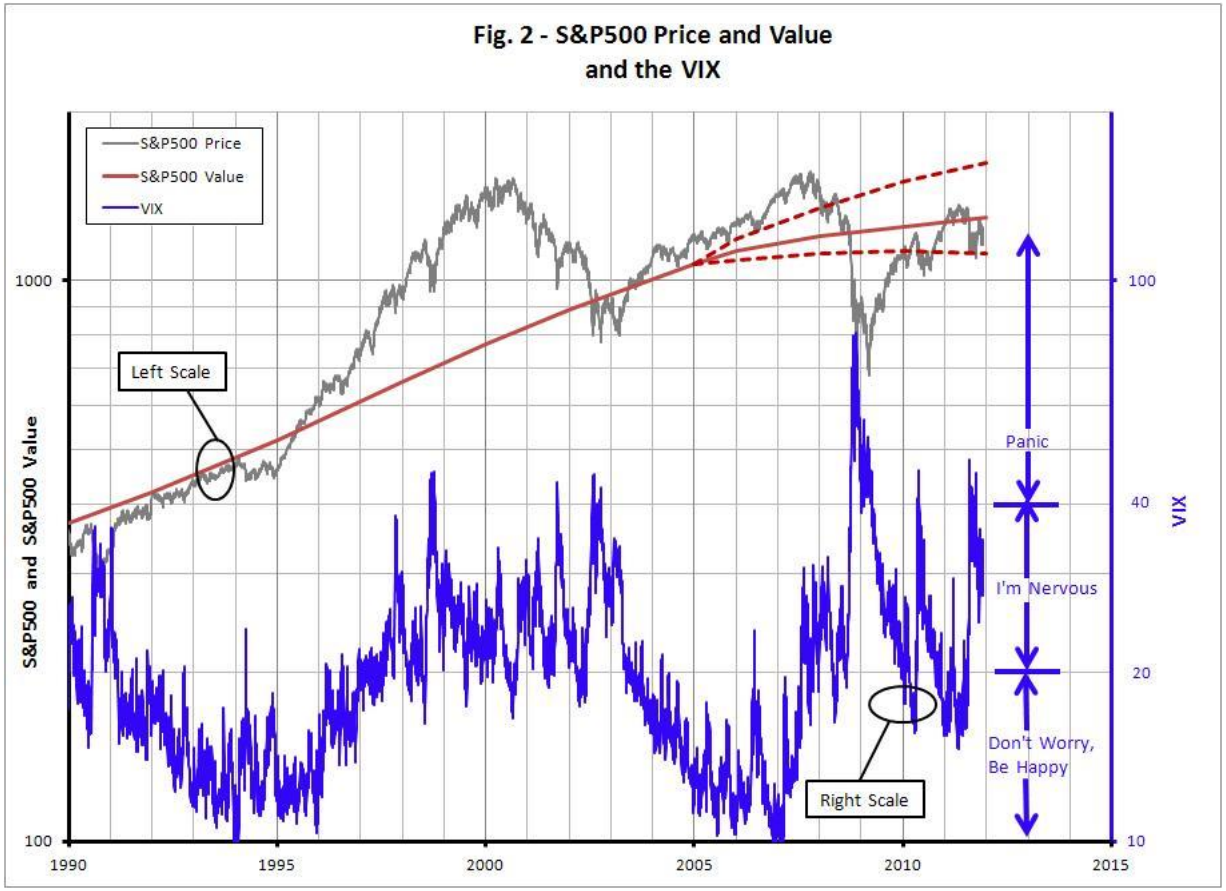


Source: Lux (2009) «Stochastic Behavioral Asset Pricing»

c. Volatility is Mean Reverting

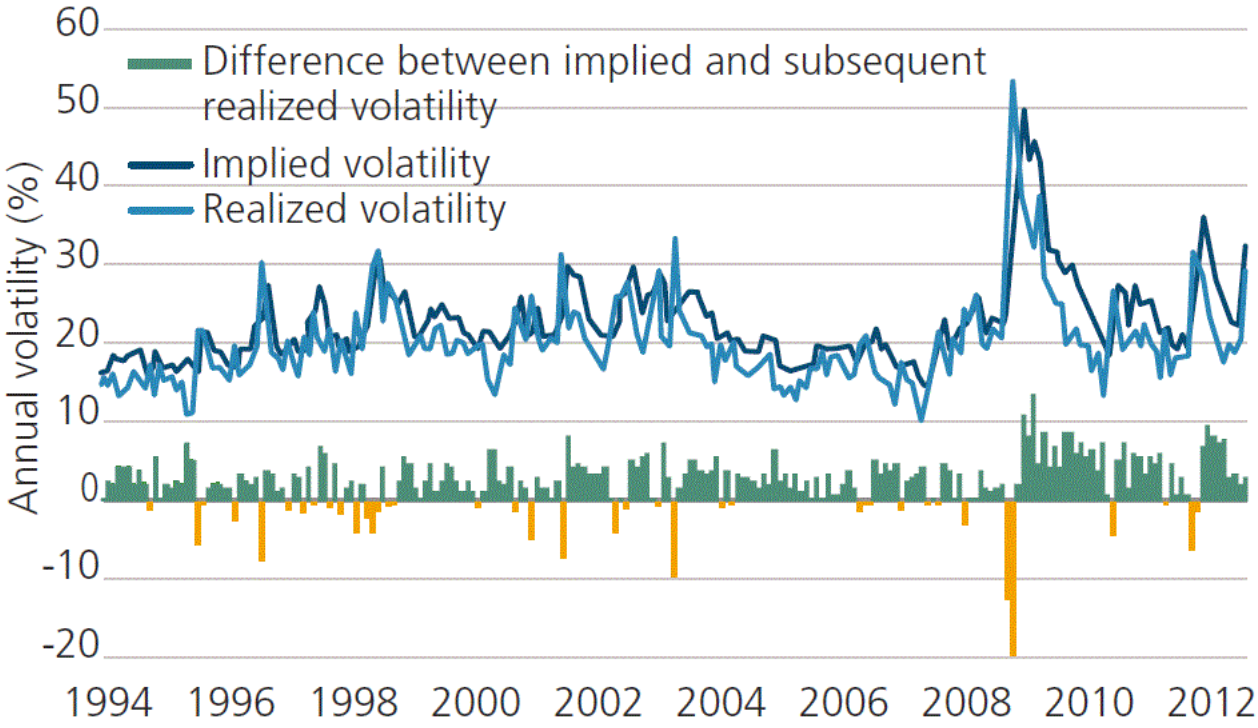
http://www.macroption.com/is-volatility-mean-reverting/

d. Volatility is Higher in Market Crashes



http://quant.stackexchange.com/questions/1177/why-is-volatility-mean-reverting

e. Implied is higher than Realized Volatility



Rennison and Pedersen (2012) «The Volatility Risk Premium»

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3. Understanding Volatility with Economic Models (1)

Is important

… to give your investors an intuition (consitent investment story) on which economic principles your returns are based!

Ingredients of Economic Models

- Cash Flows
- Expectations
- Risk Aversion
- Market Interaction

3. Understanding Volatility with Economic Models (2)

Two Religions in Economics

Rationalists

- Fama
- Cochrane, Campbell
- Barro, Grossman
- Prescott, Kydland
- Dumas, Veronesi, Buraschi, …
- ..

Behavioralists

- Shiller
- Kahnemann and Tversky
- Lakonishok, Shleifer, Vishny
- Brock and Hommes
- Lux, Levy, …
- Evstigneev, Hens, Schenk-Hoppe.
- …

3. Understanding Volatility with Economic Models (3)

Two Religions in Economics

Rationalists

- Expectations are rational
- Risk Aversion is stable
- Markets are in equilibrium

→

- Representative Agent
- Exogeneous shocks

Behavioralists

- Biased expectations
- Changing risk aversion
- Disequilibria possible

→

- Heterogeneous Agents
- Endogenous fluctuations

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a. Volatility Smiles

Rational Explanation

- Smile originates from Black Scholes Merton Model which assumes constant vola
- But vola is stochastic and jumps

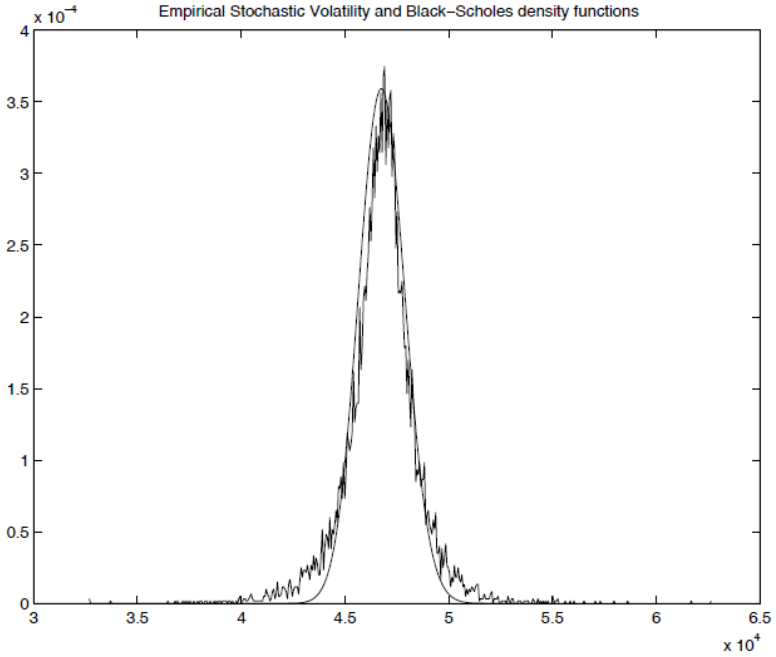
Behavioral Explanation

- Probabilty to be OTM is smaller than ATM.
- Small Probabilites are exaggerated

«Favorite Long-Shot Bias»

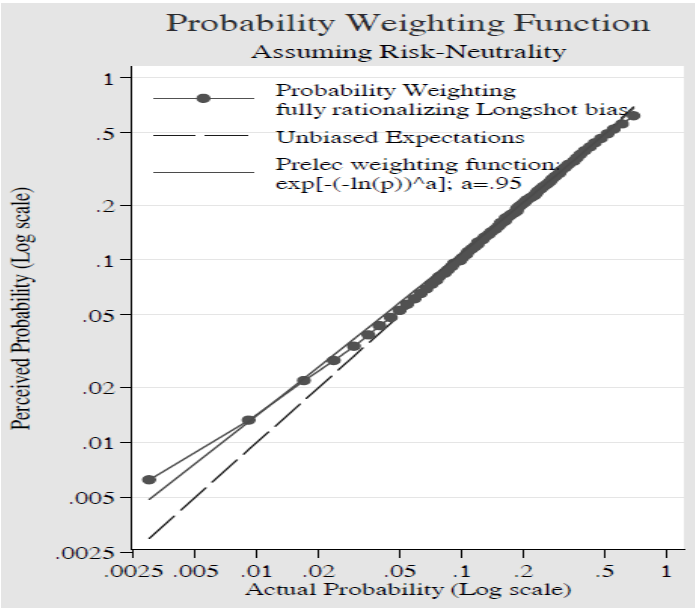
a. Volatility Smiles

Rational Explanation



«Deviations from BSM»
Fouque, Papanicolaouy, and Sircarz (2000)

Behavioral Explanation



«Favorite Long-Shot Bias»
Snowberg and Wolfers (2010)

Prospect Theory Probability Weighting Function

- Film Coke Zero The Mechanic
- https://www.youtube.com/watch?v=ITU_gdal1SY
- Shows: Not probabilities matter – but possibilities!

b. Volatility is Stochastic

Rational Explanation

- Exogenous shocks are clustured, stochastic and have jumps

Behavioral Explanation

- Expectations switch between bull and bear markets
- Endogeneous fluctuations generated by interaction of heterogenous agents
- T. Lux (2009)

«Endogenous Uncertainty»

c. Volatility is Mean-Reverting

Rational Explanation

- Exogenous shocks are mean-reverting

Behavioral Explanation

- People get used to bad news when they come regularly

«Habit Formation»

d. Volatility is Higher in Market Crashes

Rational Explanation

- For stock markets:
- When stock prices drop
- The Debt/Equity ratio increases thus stocks are more risky and stock prices fluctuate more
- Merton (1973)

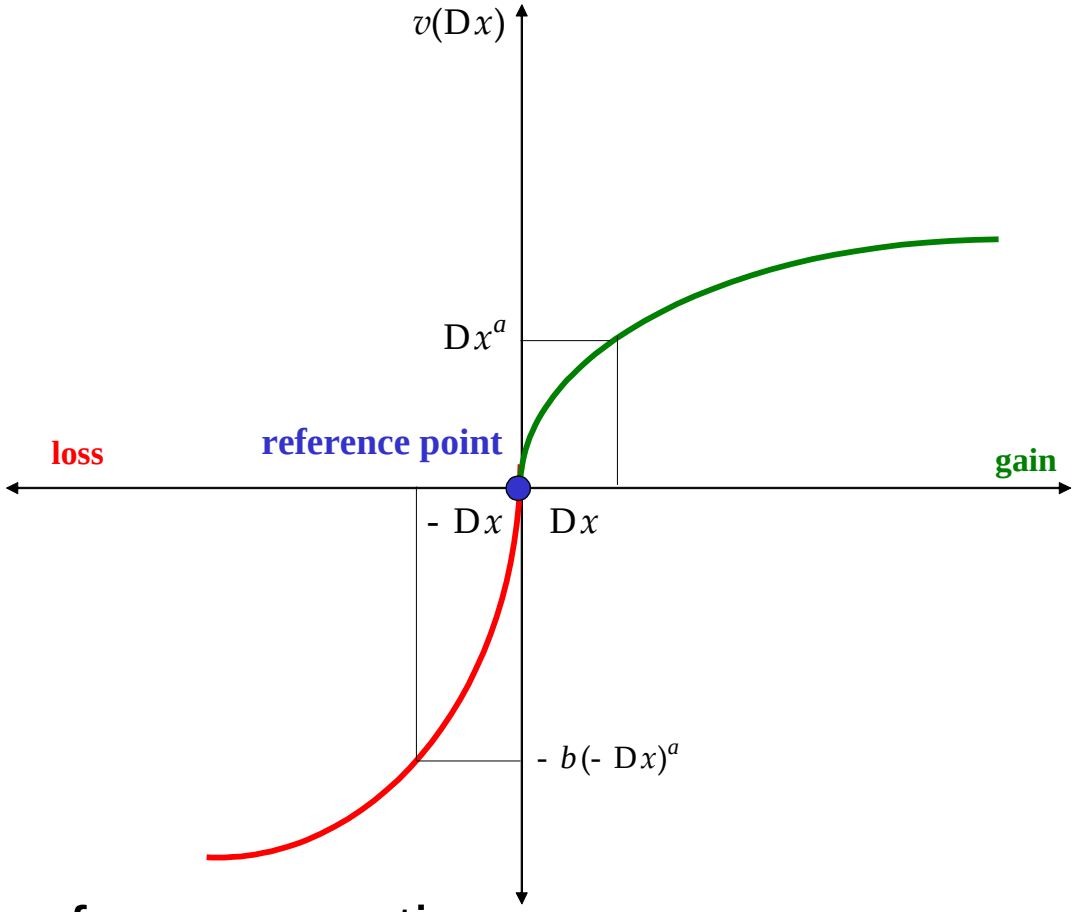
«Leverage Effect»

Behavioral Explanation

- Usually lower returns coincide with lower risk because people are risk averse
- But people take more risk to avoid sure losses
- Thus negative returns coincide with higher risk.

«Gambling for Resurrection»

Prospect Theory Utility Function



«gambling for resurrection»

e. Implied is higher than Realized Volatility

Rational Explanation

- This is true for index options but not for individual options
- Thus selling index options hedged by basket of individual options is profitable – except in crashes

«Correlation Risk Premium»

Behavioral Explanation

- Worries matter more than they should as experience sampling shows.

«Crash-o-Phobia»

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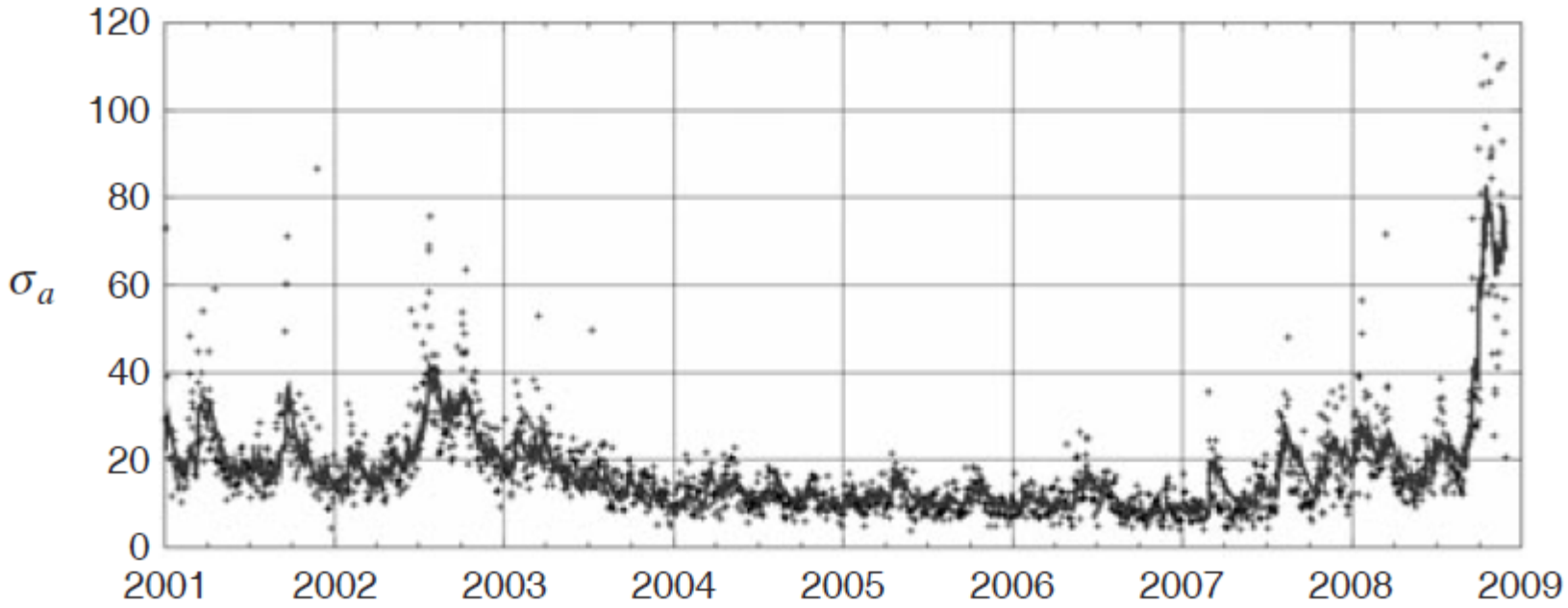
Predicting Volatility

FIGURE 1 S&P 500 TARCH one-step-ahead volatility forecasts (solid line) and realized volatility (crosses).



Source: Brownlees, R. Engle, B. Kelly (2011)

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