



*WHAT IS HAPPENING TO  
FINANCIAL MARKET  
VOLATILITY AND WHY?*

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SIEPR February 26, 2009

# *RISK*

- A Risk is a bad future event that might happen.
- Some risks can be avoided completely.
- But some risks are worth taking because the possible benefit exceeds the possible costs.
- Finance investigates which risks are worth taking.

## *NOBEL ANSWERS*

- Markowitz (1952) and Sharpe(1964) and Tobin (1958) received Nobel awards in 1990 and 1981 for associating risk with the variance of financial returns.
- Capital Asset Pricing Model or CAPM  
answer: Only variances that could not be diversified would be rewarded.

# *BLACK-SCHOLES AND MERTON*

- Options can be used as insurance policies. For a fee we can eliminate financial risk for a period.
- What is the right fee?
- Black and Scholes(1972) and Merton(1973) developed an option pricing formula from a dynamic hedging argument. Their answer also satisfies the CAPM.
- They received the Nobel prize in 1997

## *IMPLEMENTING THESE MODELS*

- Practitioners required estimates of variances and covariances or equivalently volatilities and correlations.

## *ESTIMATES DIFFER FOR DIFFERENT TIME PERIODS*

- Volatility is apparently varying over time
- What is the volatility now?
- What is it likely to be in the future?
- How can we forecast something we never observe?

# *ARCH MODEL*

- The ARCH model predicts the variance of returns on the next day.
- It relies on two features of returns
  - Volatility Clustering
  - Mean Reversion of Volatility
- Econometric Methods fit this model to data



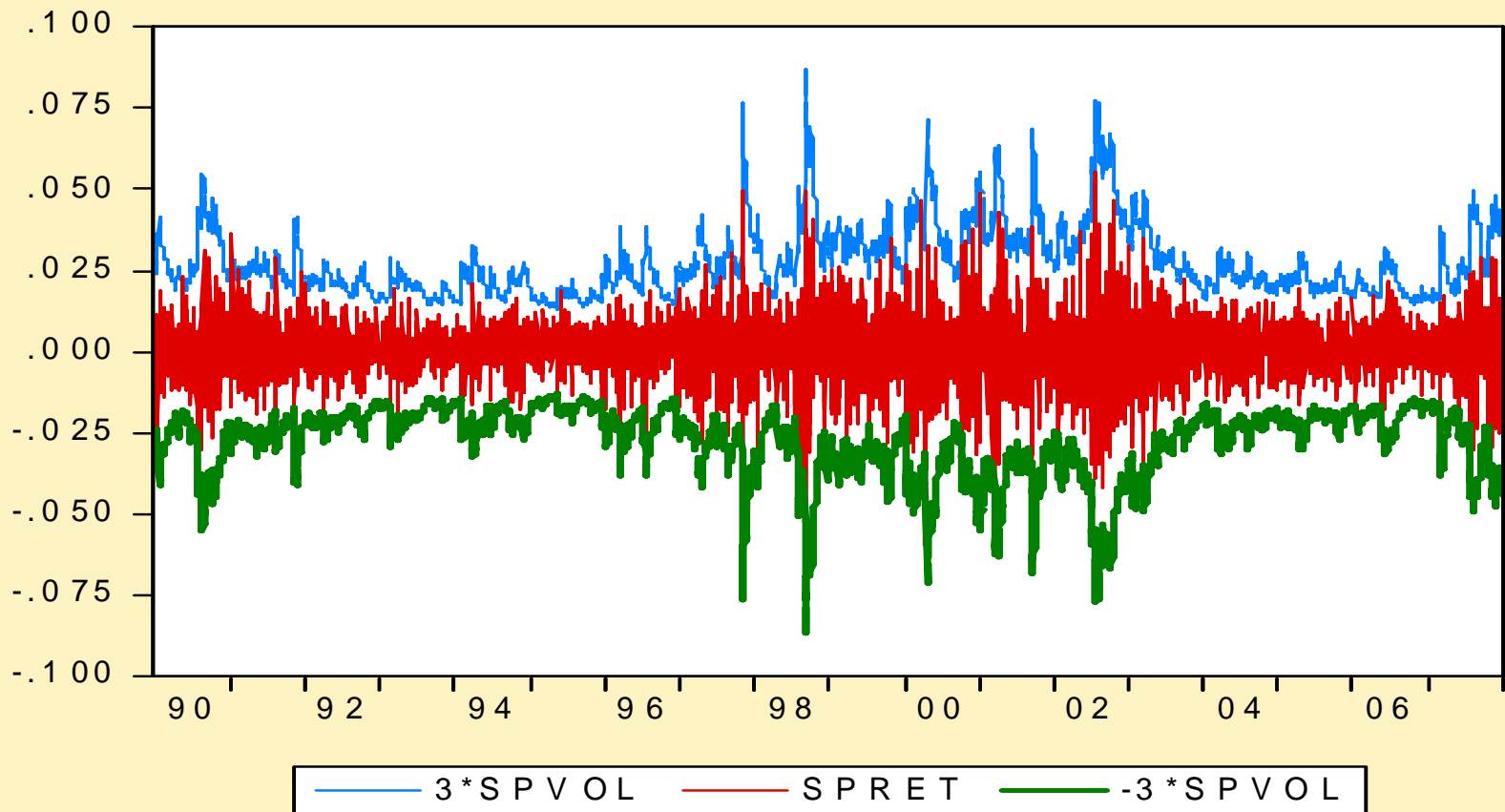








# *Plus and Minus three Sigma*



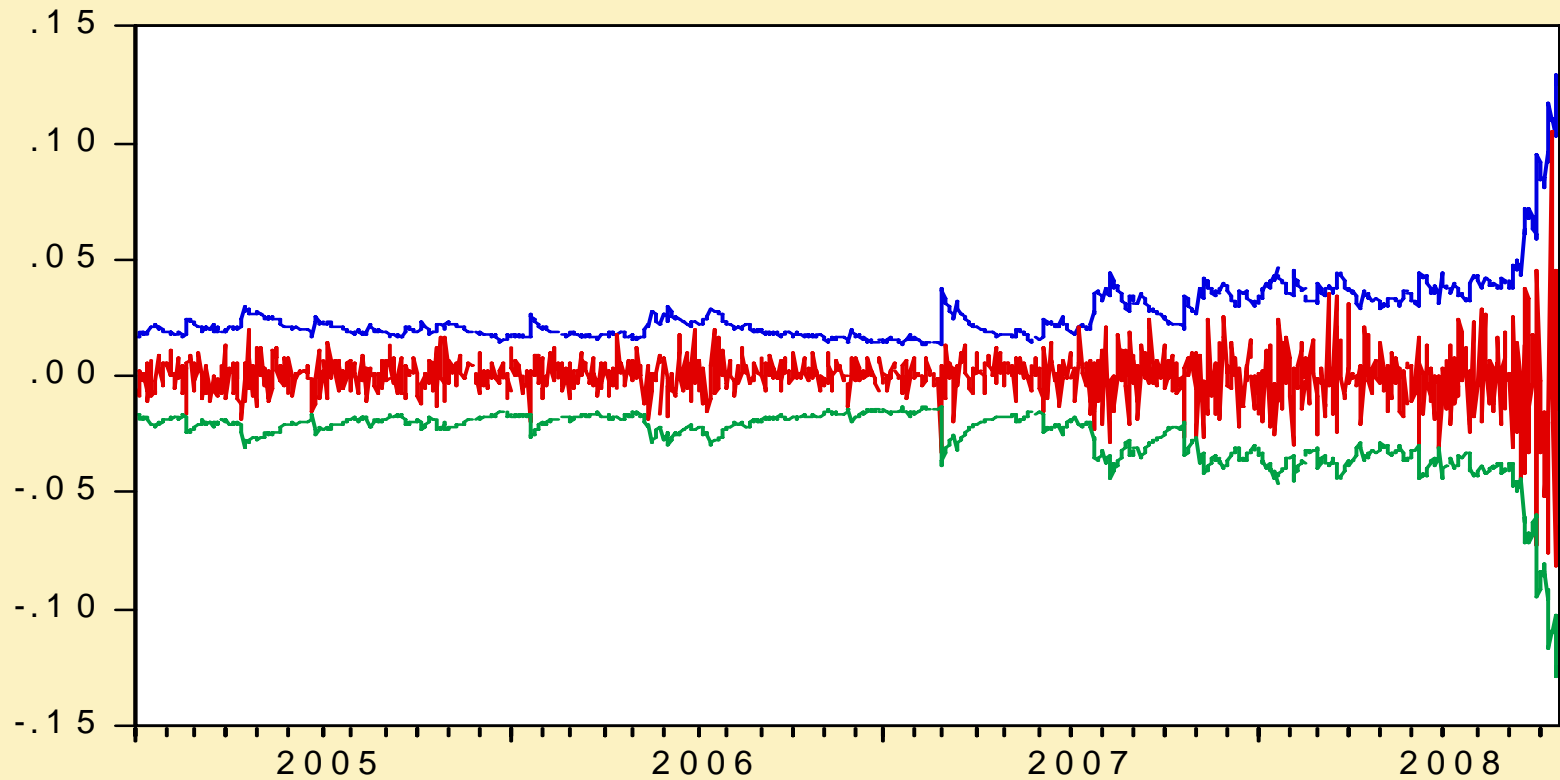
# *OBSERVATIONS*

- CONFIDENCE INTERVAL IS CHANGING
- GREEN CURVE IS APPROXIMATELY VAR
- .6% RETURNS EXCEED INTERVAL
- LARGEST IS -6.8 SIGMA! (oct 27 1997)
- MORE EXTREMES THAN EXPECTED FOR A NORMAL BUT NOT FOR A STUDENT-T

## *DOES THIS WORK IN TURBULENT TIMES?*

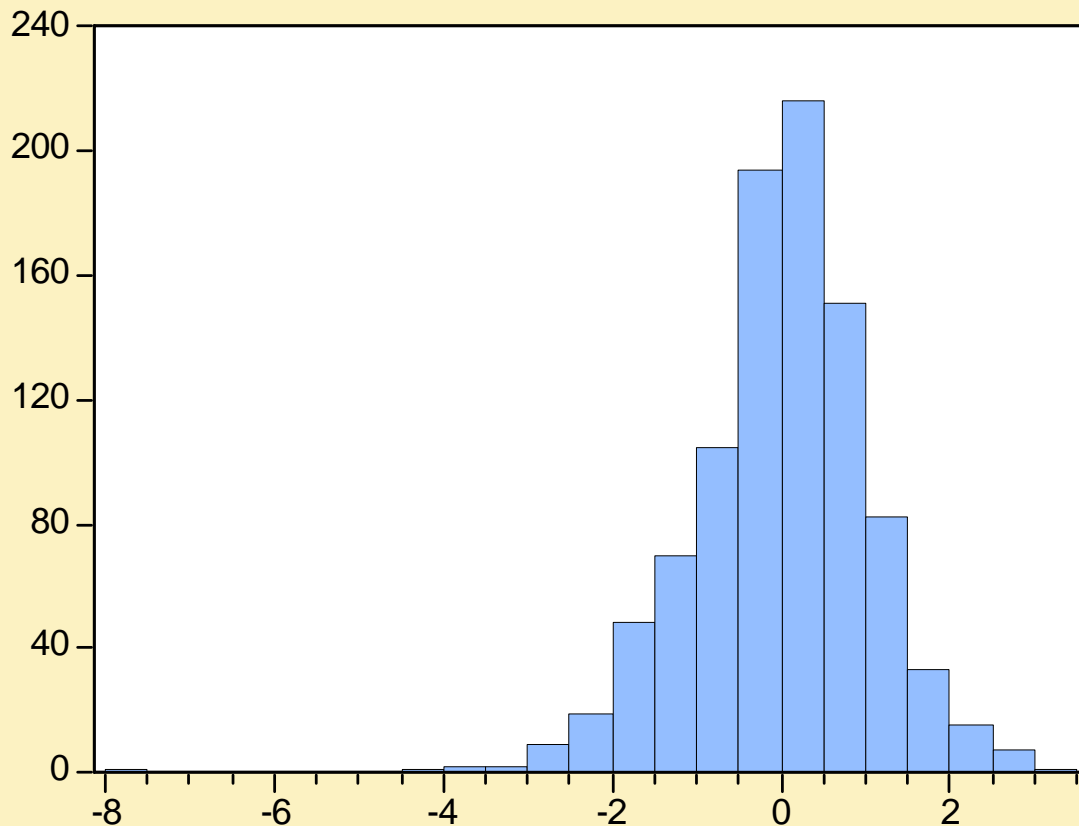
- ESTIMATE THROUGH 2004
- KEEPING SAME PARAMETERS, FORECAST TO END OF SAMPLE ONE DAY AT A TIME.
- DO WE SEE MULTI-SIGMA MOVES?

# *Plus and Minus 3 x sigma using 2004 model*



—  $3 * DJSD 04$  — DJRET —  $-3 * DJSD 04$

# STANDARDIZED RETURNS SINCE 2004 USING 2004 ESTIMATED MODEL



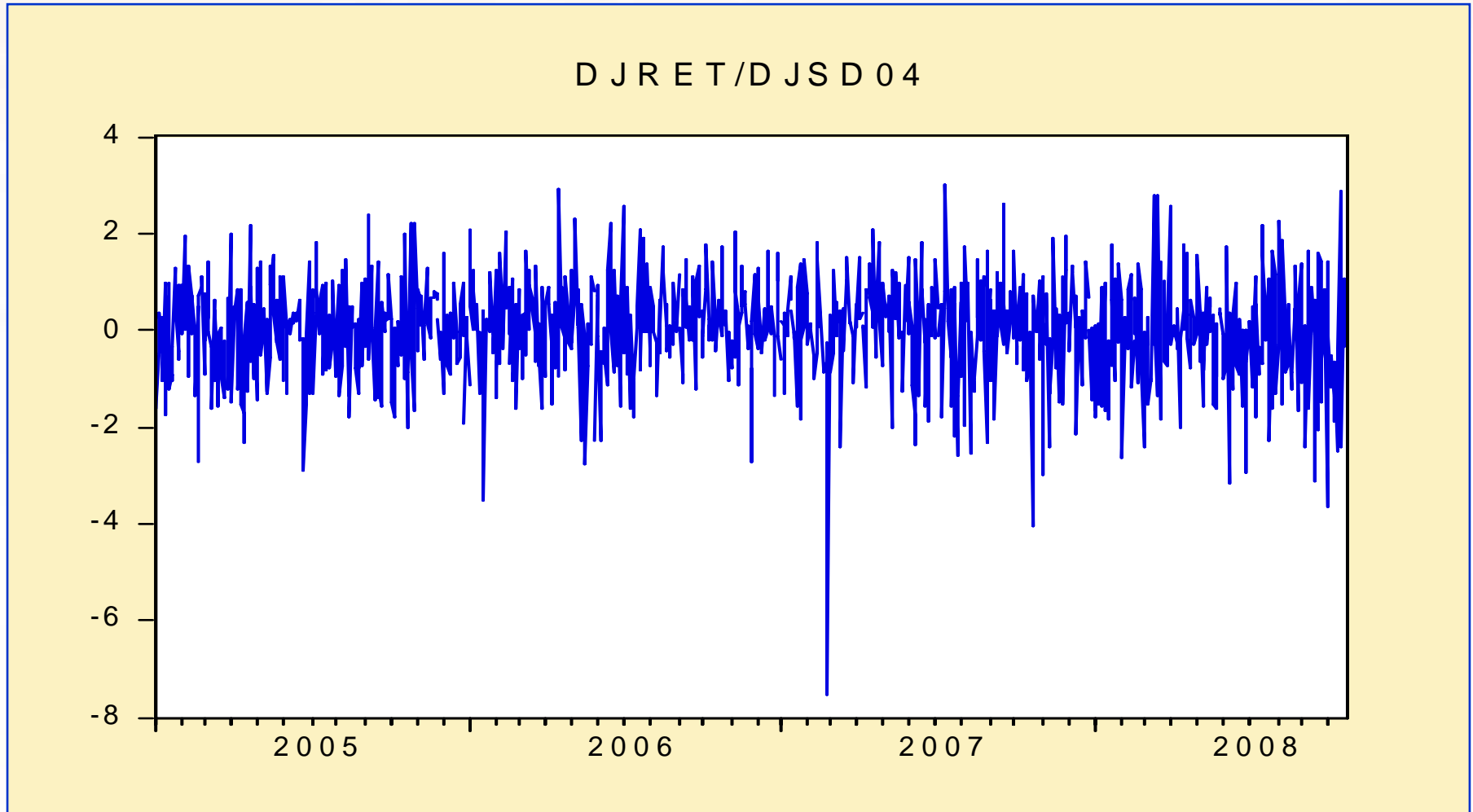
Series: DJRET/DJSD04  
Sample 1/03/2005 10/20/2008  
Observations 956

Mean	-0.001066
Median	0.063605
Maximum	3.004820
Minimum	-7.536694
Std. Dev.	1.053278
Skewness	-0.665960
Kurtosis	5.993653

Jarque-Bera	427.6494
Probability	0.000000

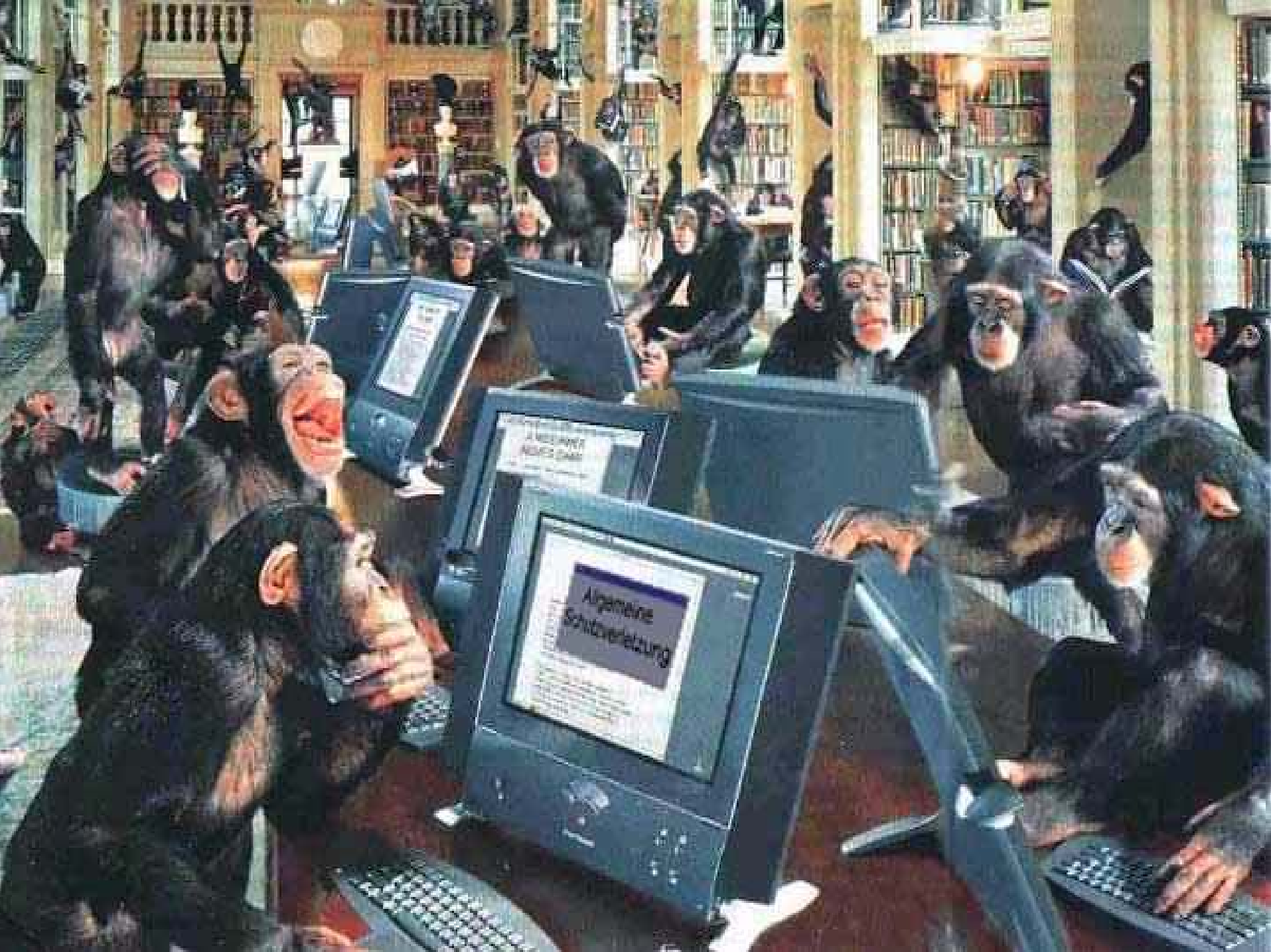


# *WHAT WAS -7 SIGMA EVENT?*



# *SURPRISING SUCCESS*

- Although the original application of ARCH was macroeconomic, the big success was for financial data.
- Why does it work?
- What makes volatility high?



## *BETTER ANSWER*

- Economic news on future values and risks moves prices
- Volatility is the natural response of a financial market to new information.
- News arrives in clusters.
- *High volatility means a cluster of important news!*



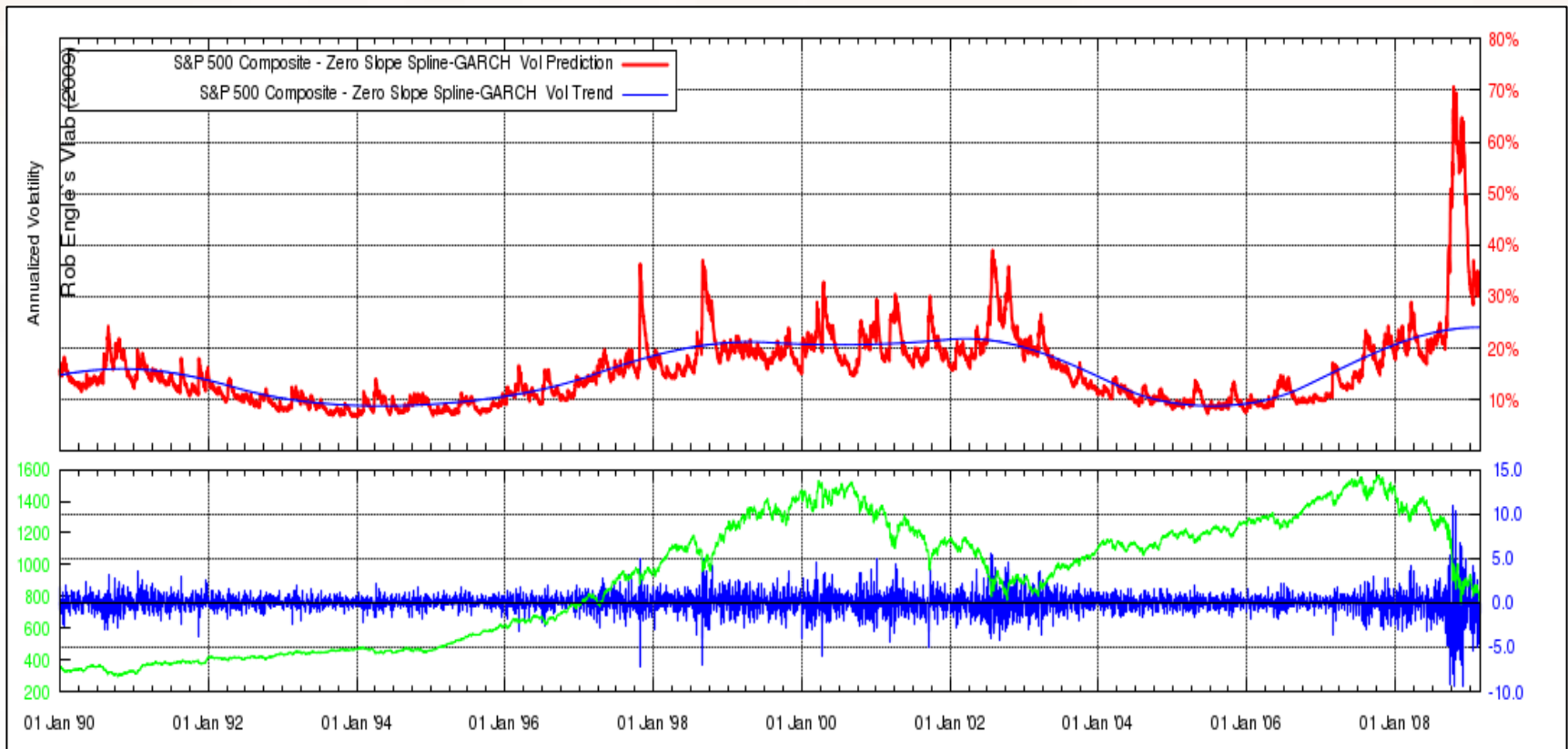
# *VOLATILITY*

Through February 20, 2009

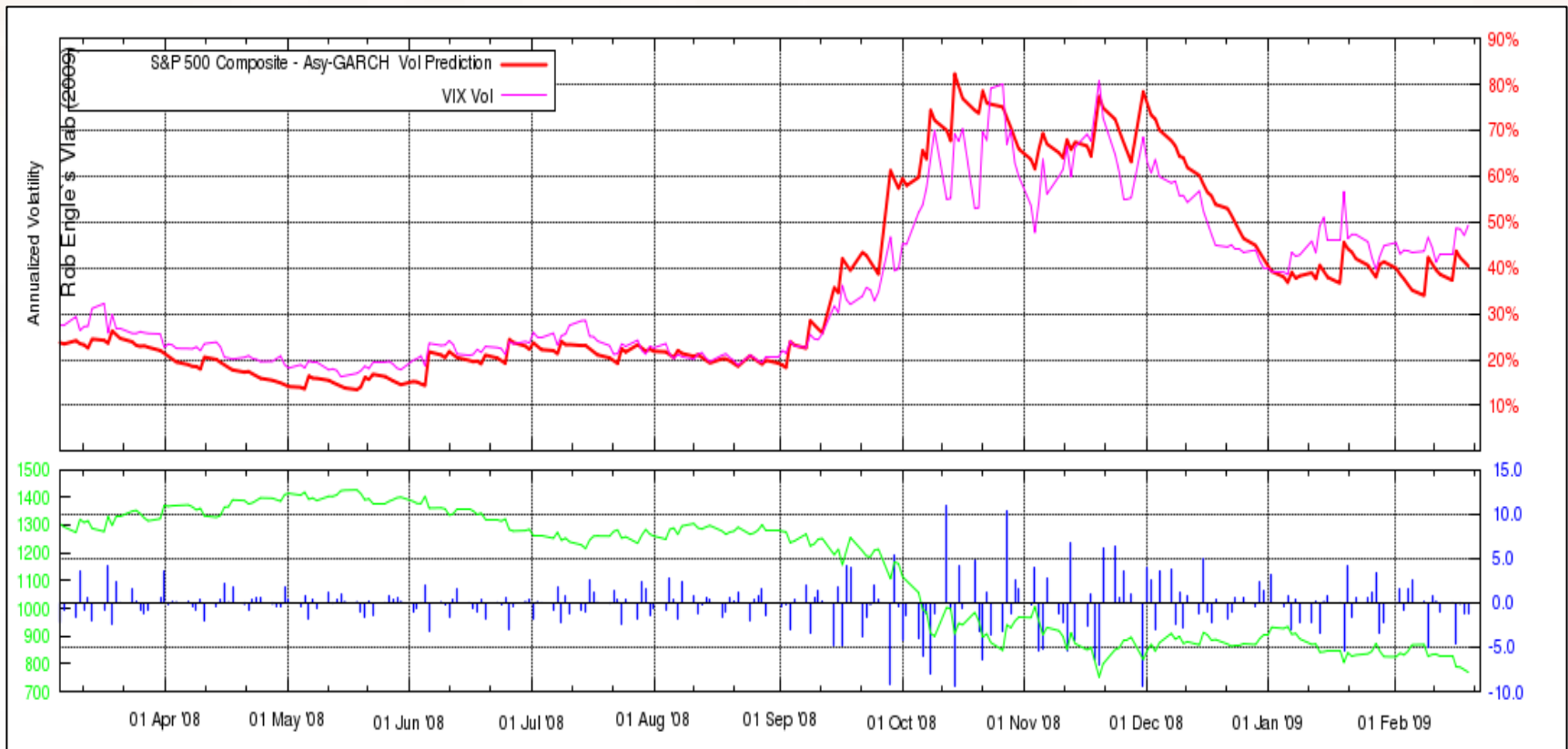
VLAB

<http://vlab.stern.nyu.edu>

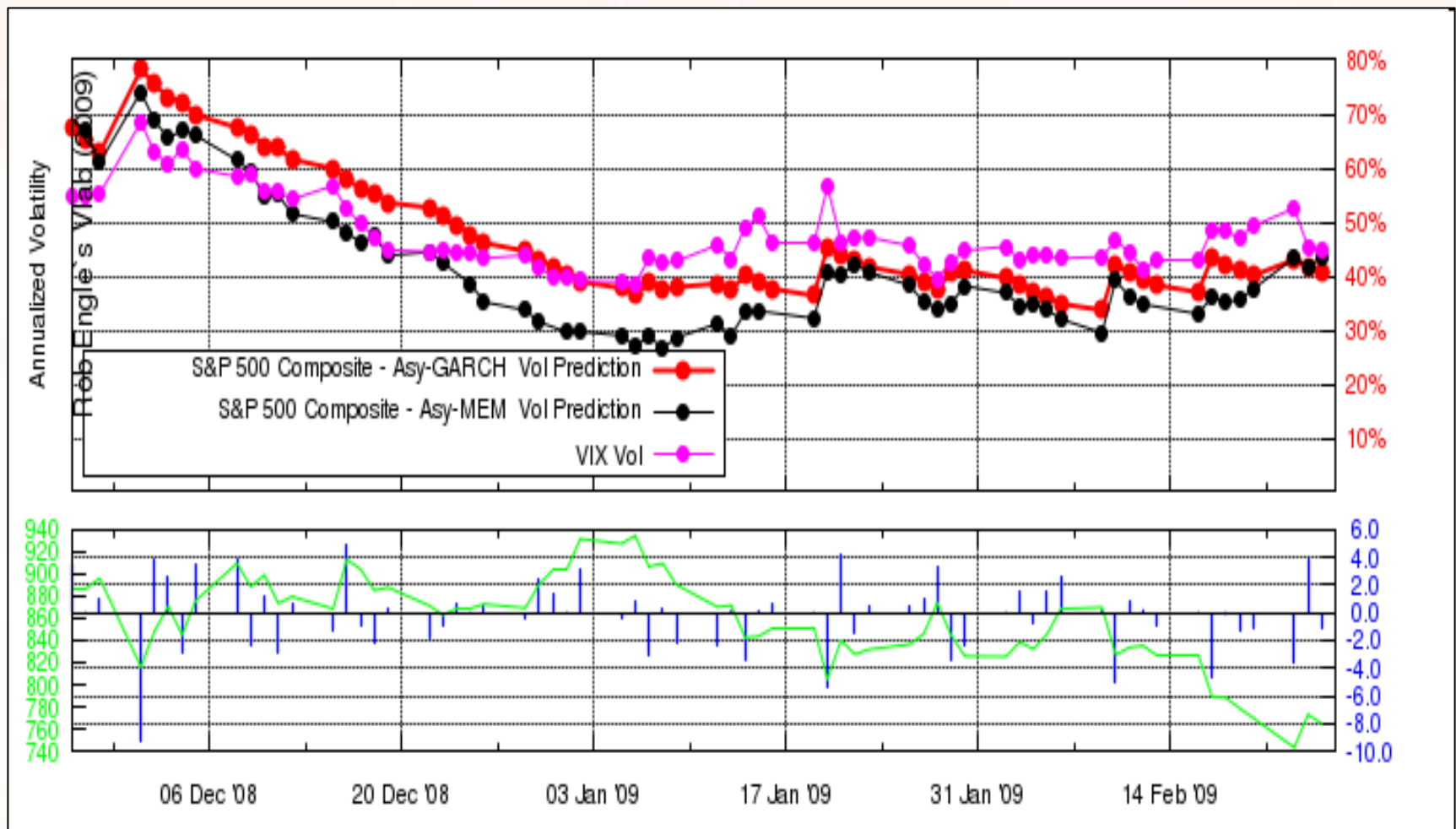
# S&P 500 GARCH



# ONE YEAR TARCH and VIX

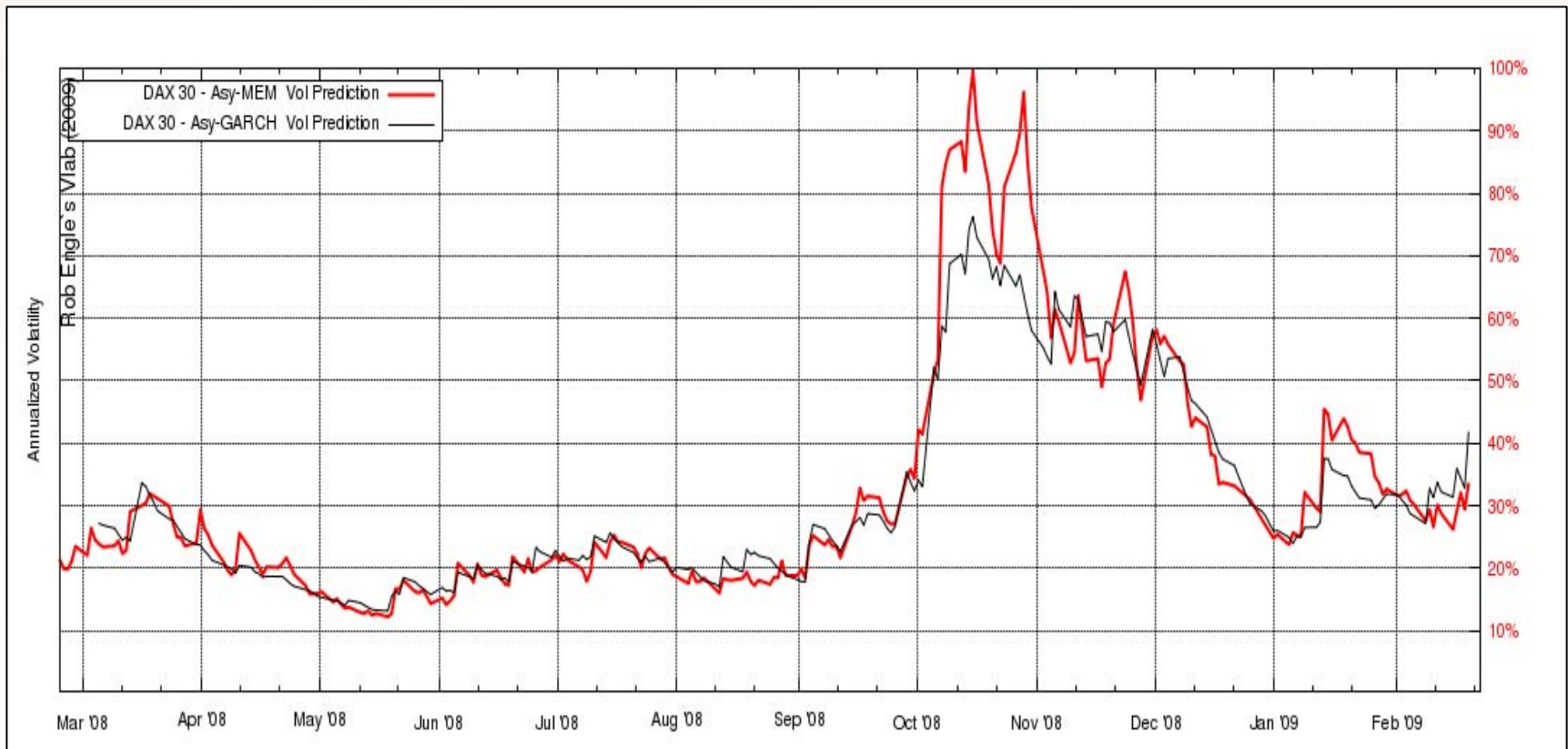


# ADDING YESTERDAY

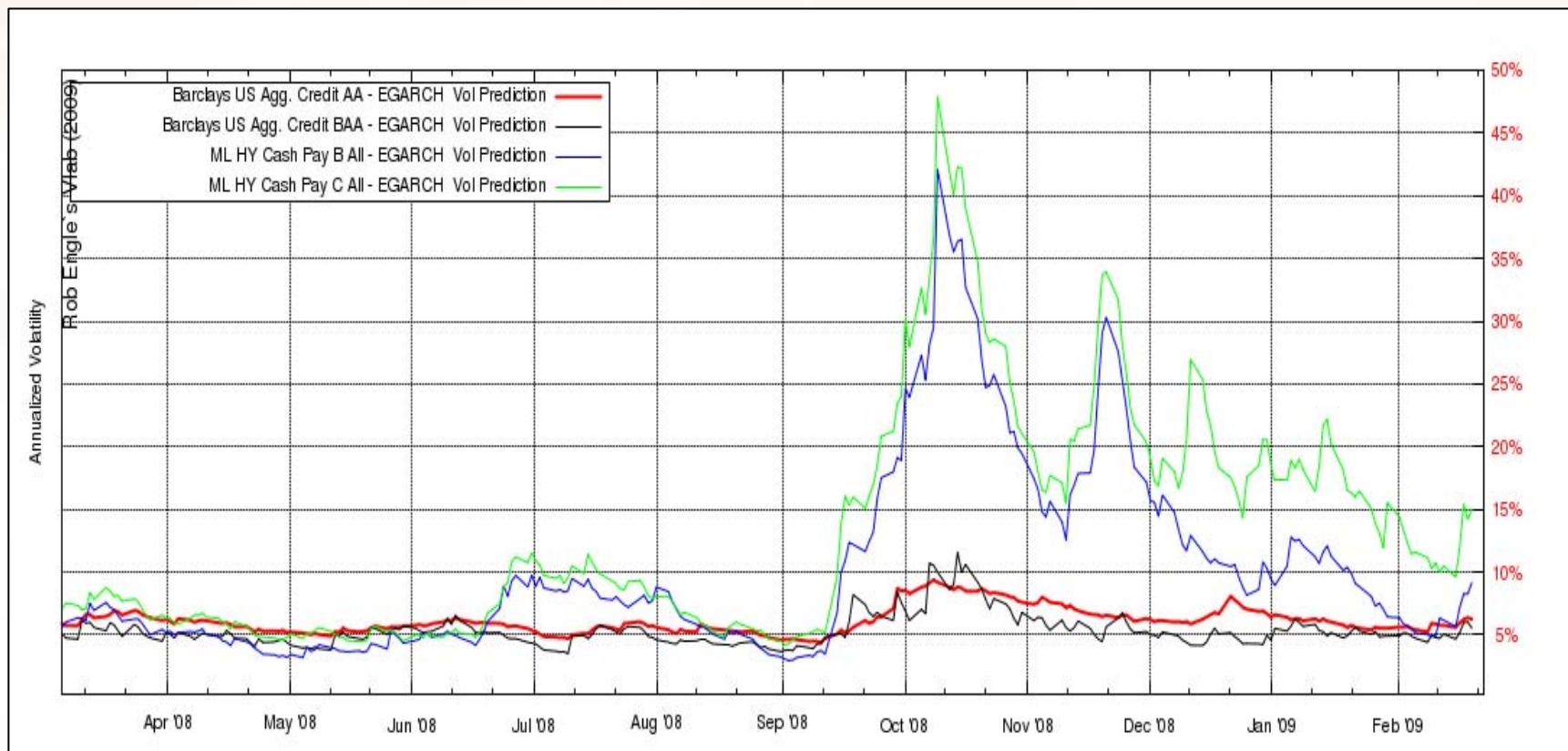




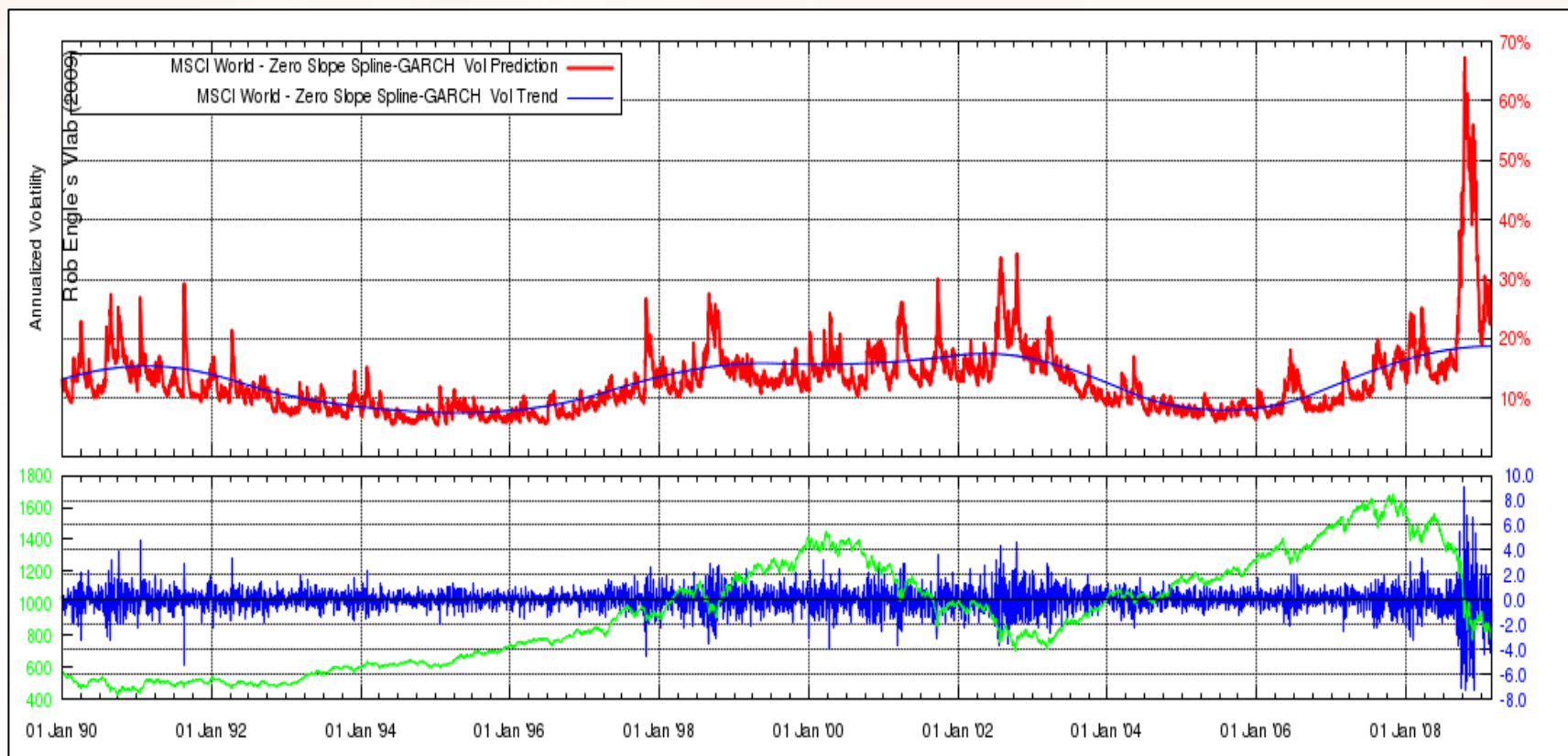
# RANGE BASED GARCH USING ASYMMETRIC MEM FOR DAX



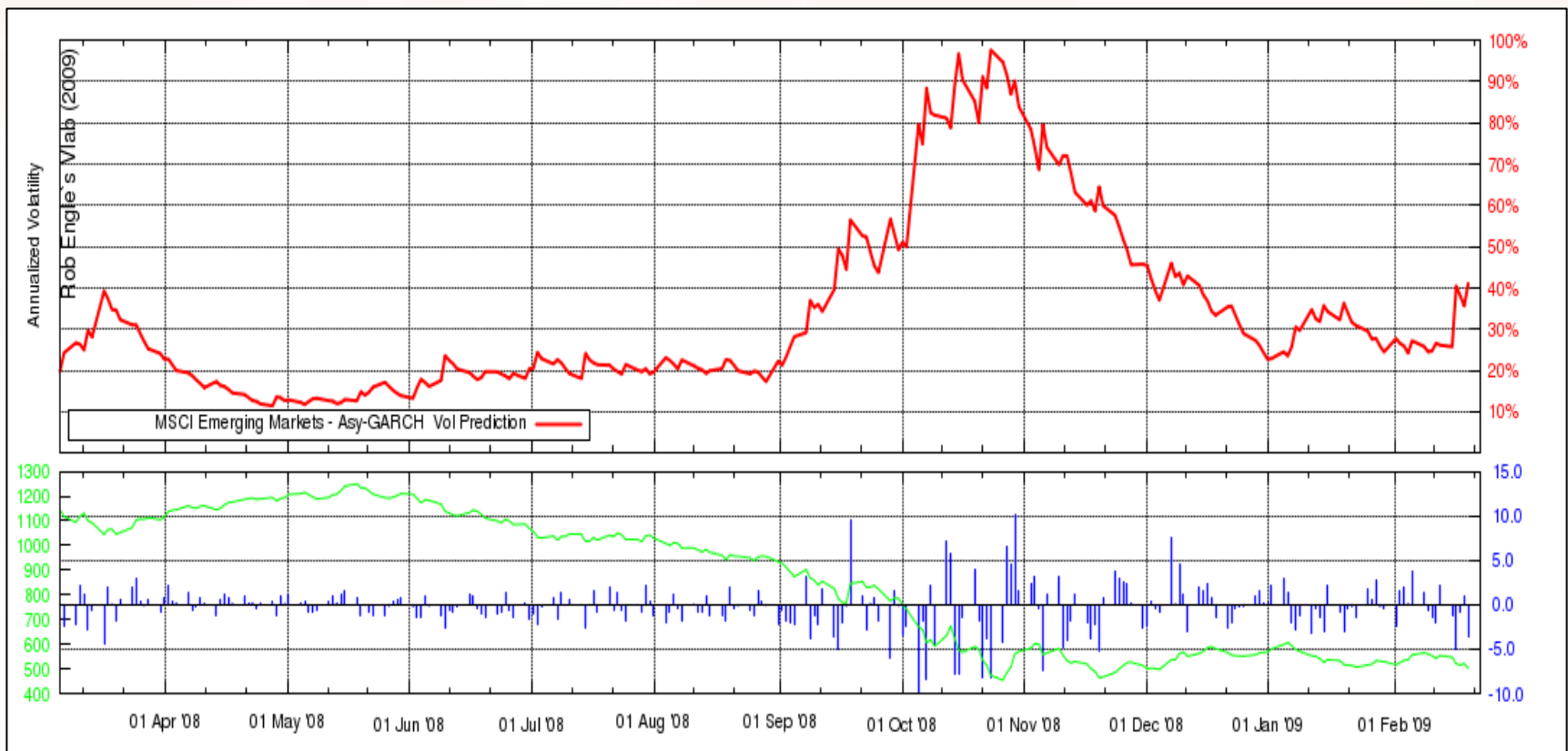
# CORPORATE BONDS



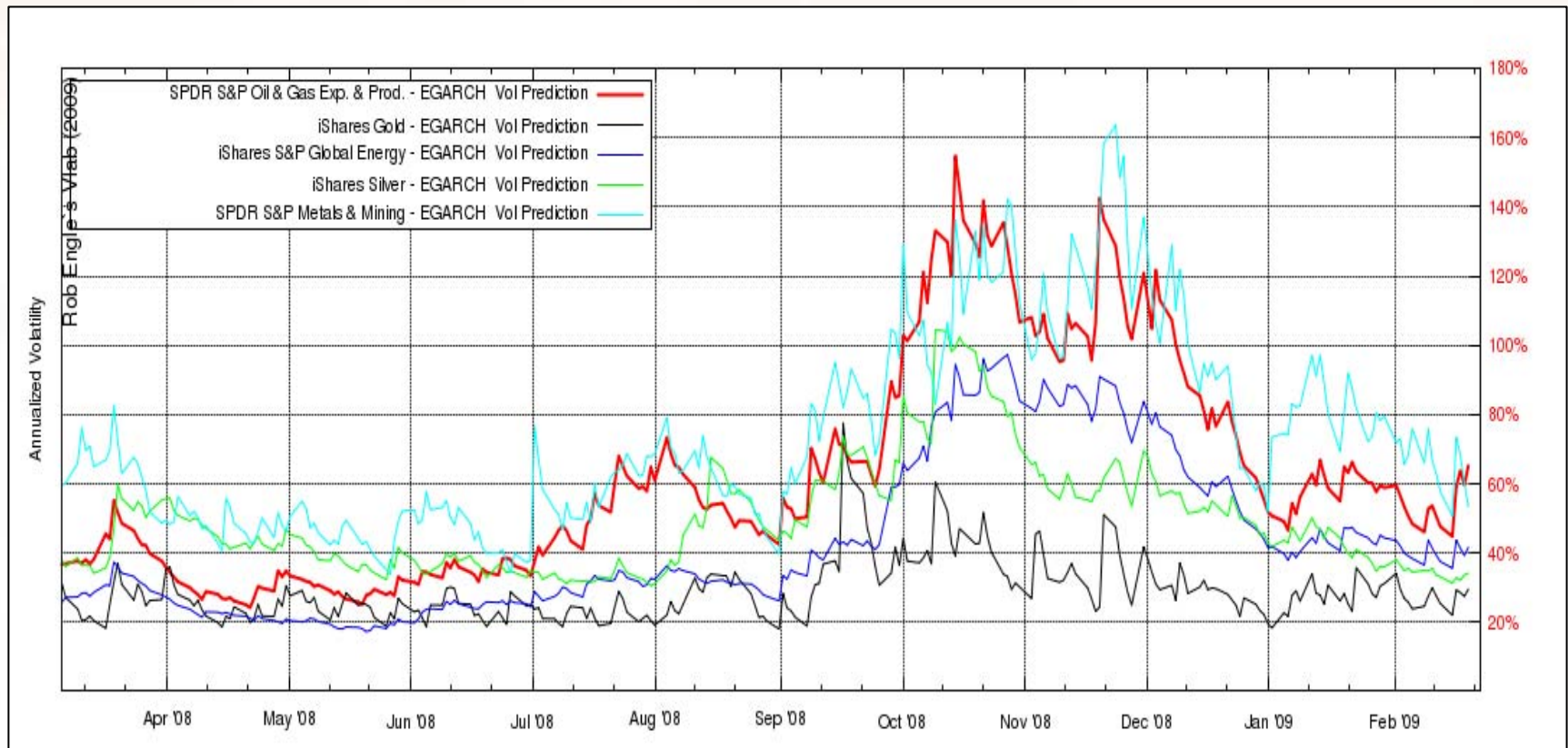
# MSCI WORLD INDEX



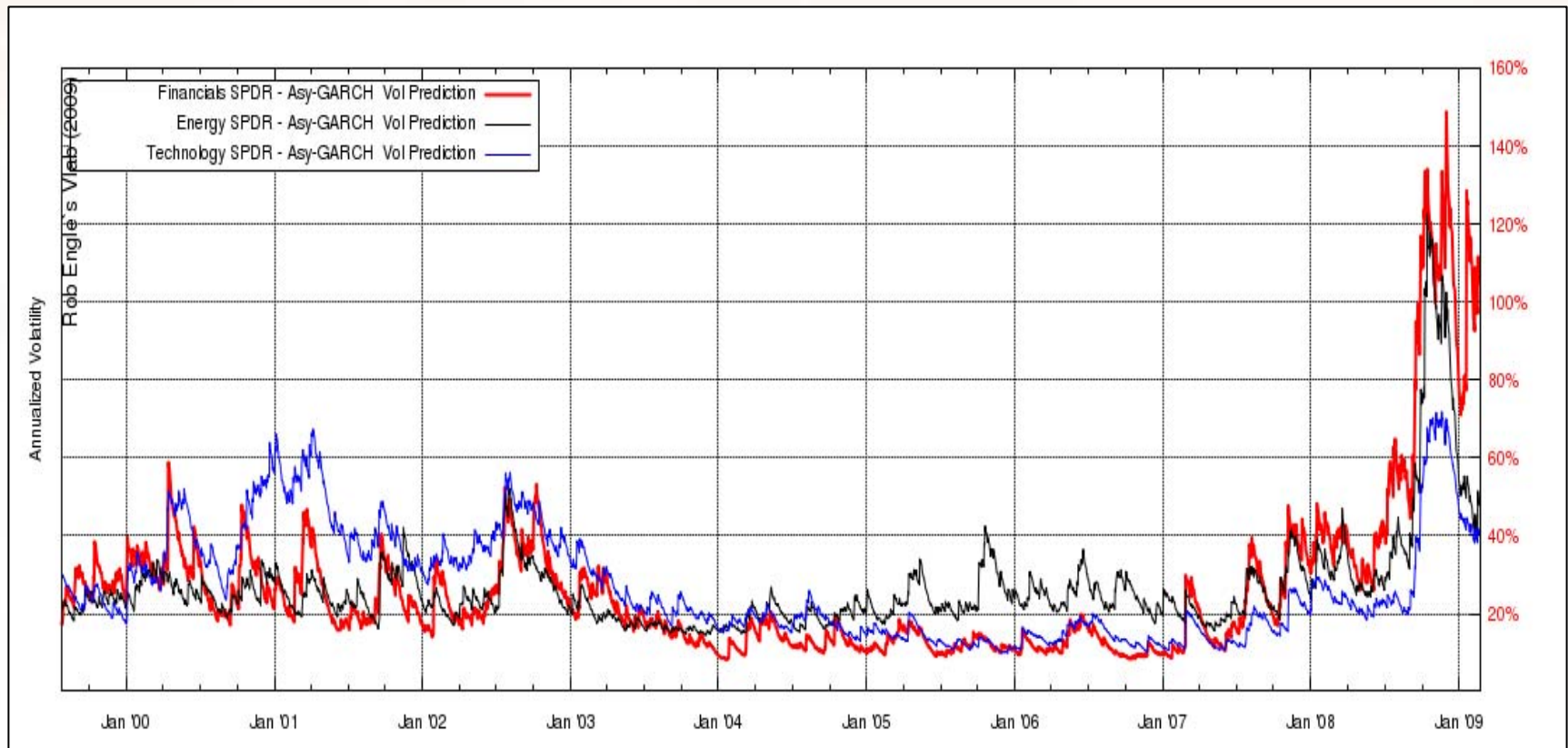
# MSCI EMERGING MARKET INDEX



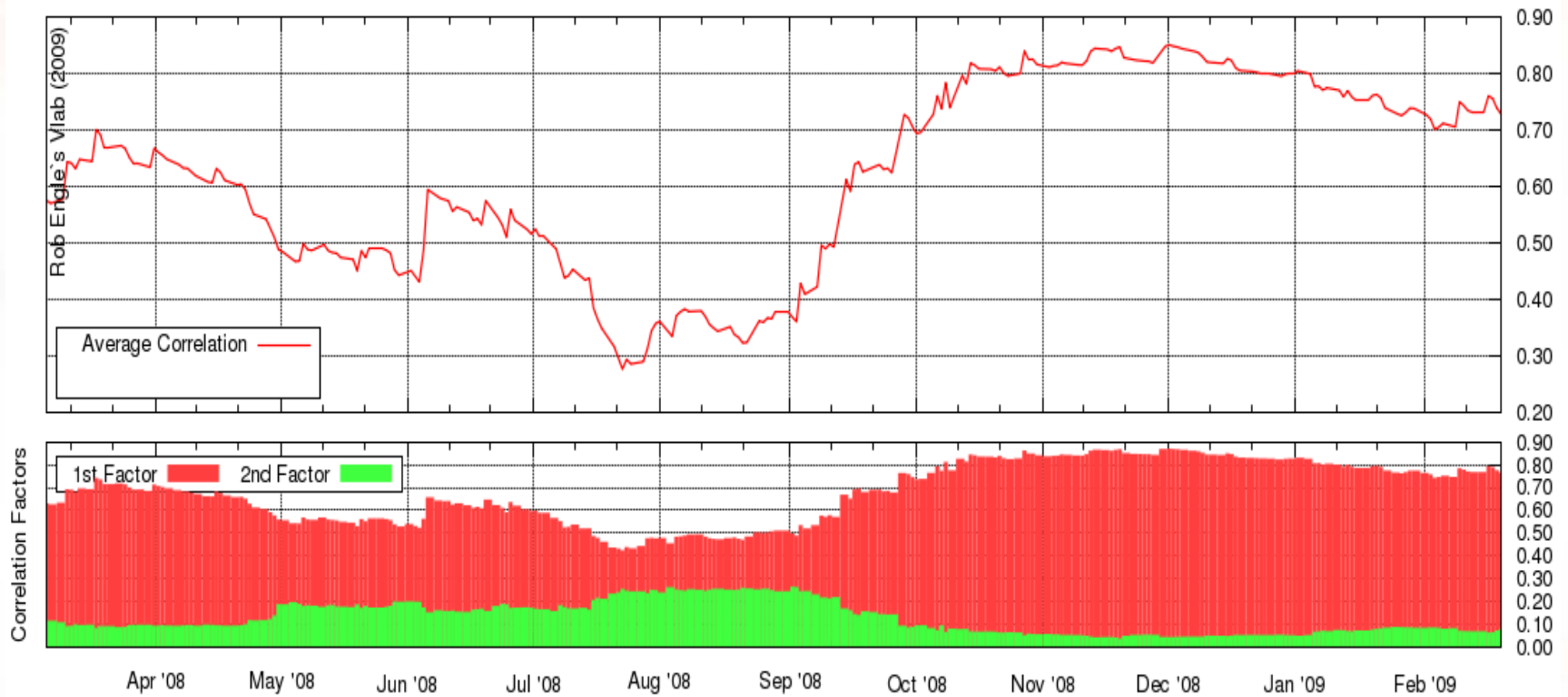
# COMMODITIES



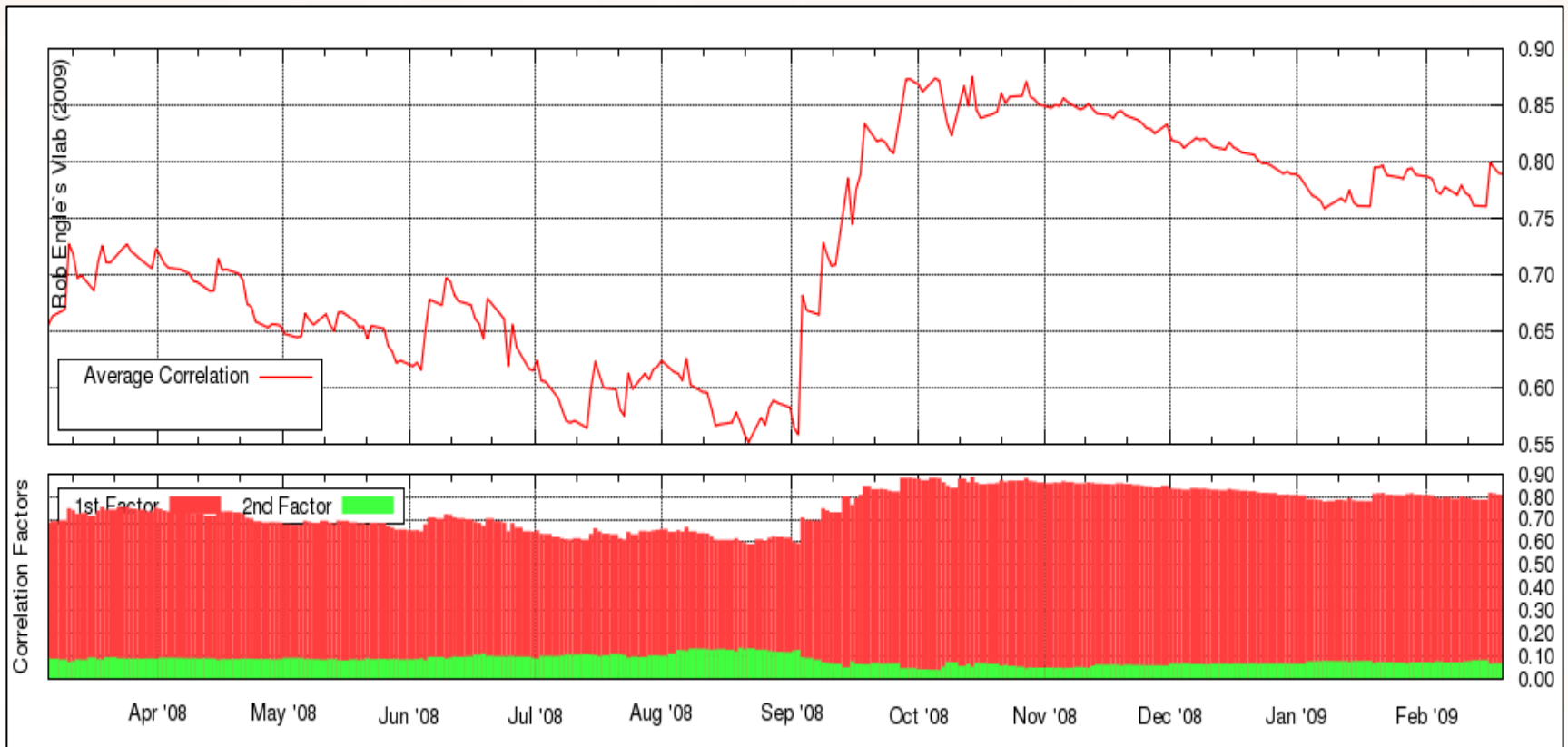
# ENERGY, FINANCE, TECHNOLOGY



# SECTOR CORRELATIONS



# INTERNATIONAL CORRELATIONS





## *WHERE IS VOLATILITY TODAY?*

- For most assets, volatility last fall was dramatically above levels since 1990 but is now somewhat lower.
- In the US, I think this is due
  - A) Macroeconomic uncertainty
  - B) Credit problems particularly associated with securitized debt.

RESTORING  
FINANCIAL  
STABILITY

How to Repair a Failed System

VIRAL ACHARYA  
MATTHEW RICHARDSON  
EDITORS

NEW YORK UNIVERSITY  
**NYU**  
**STERN**  
LEONARD N. STERN  
SCHOOL OF BUSINESS



*THE SPLINE GARCH MODEL OF  
LOW FREQUENCY VOLATILITY  
AND ITS MACROECONOMIC  
CAUSES*

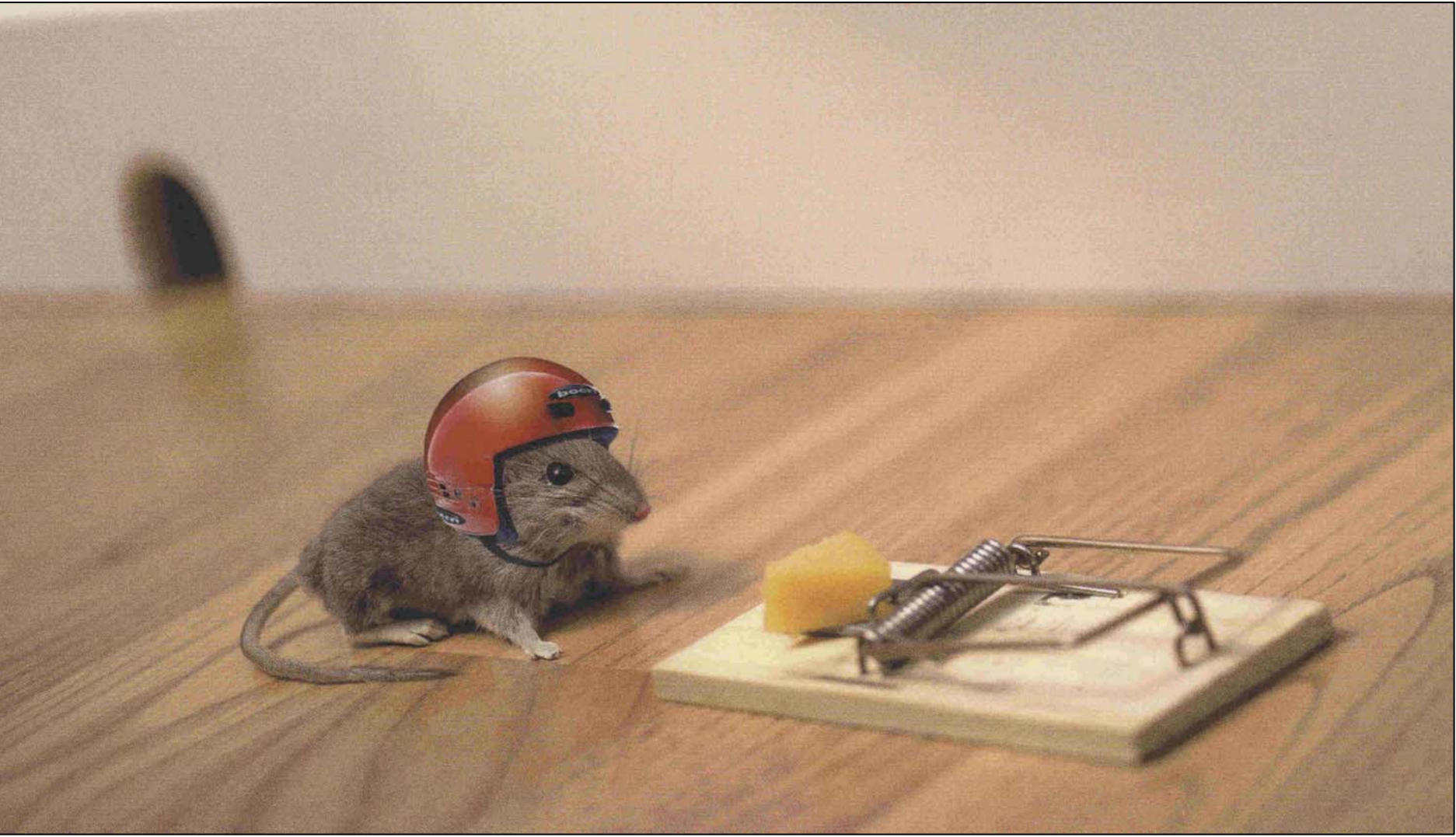
Robert Engle and Jose Gonzalo Rangel  
Review of Financial Studies 2008

## *MODEL LOW FREQUENCY VOLATILITY*

- For what countries is this greatest?
- For what time periods is it greatest?
- What macroeconomic variables are associated with volatility?

# *WHAT MAKES FINANCIAL MARKET VOLATILITY HIGH?*

- High Inflation
  - Slow output growth and recession
  - High volatility of short term interest rates
  - High volatility of output growth
  - High volatility of inflation
- 
- Small or undeveloped financial markets
  - Large countries

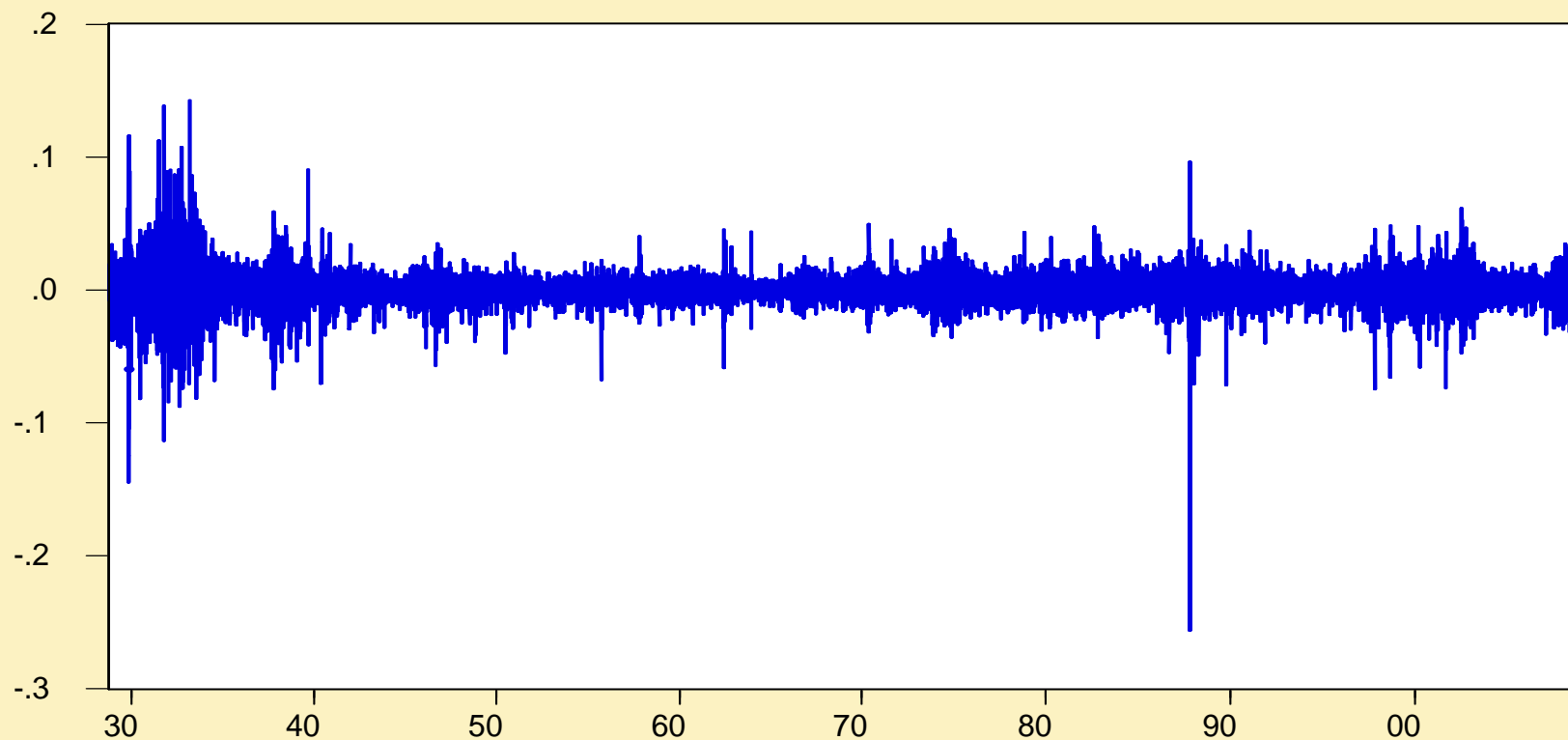




*THREE VOLATILITY  
EPISODES*

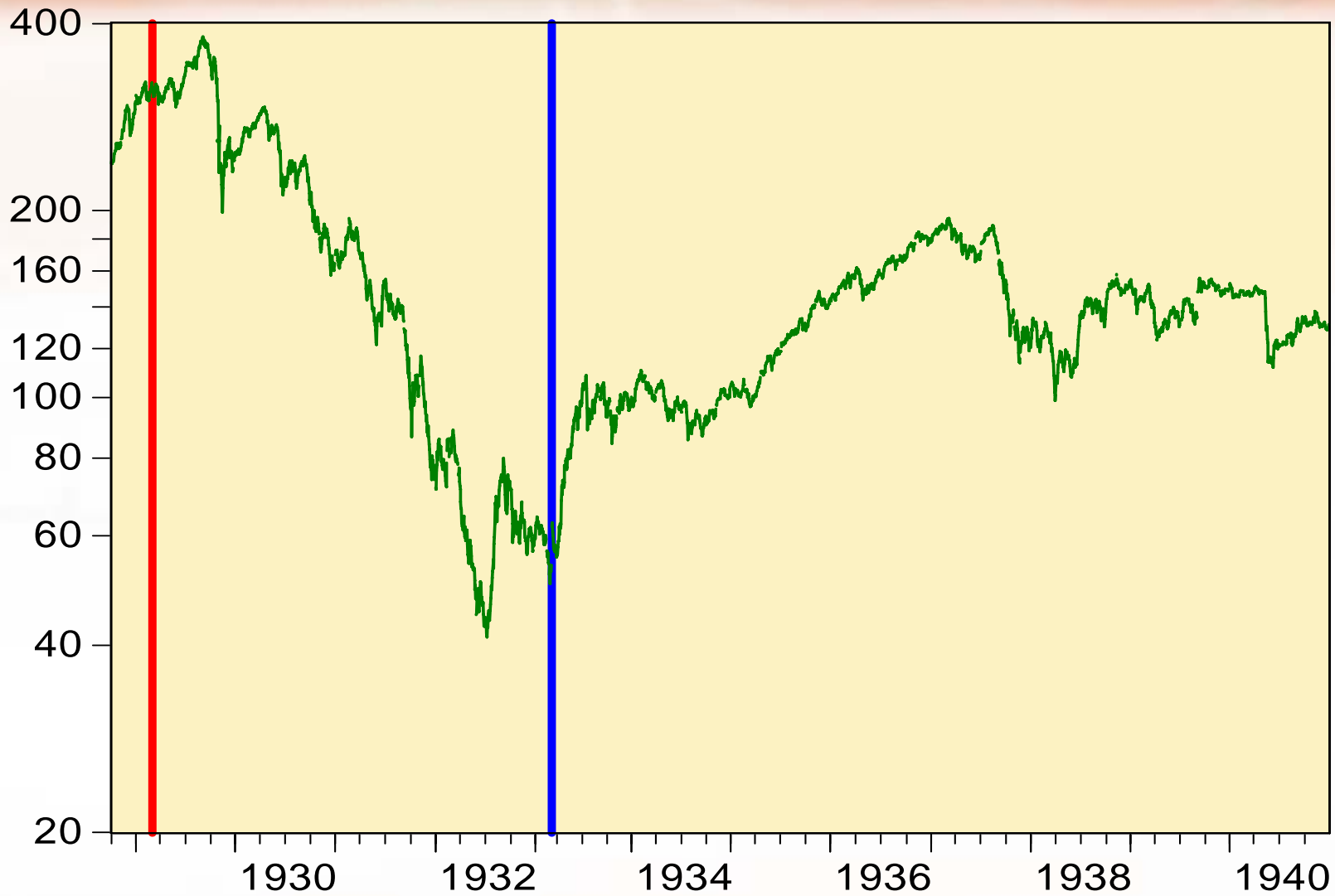
# *DOW JONES 1928-2008*

D J R E T

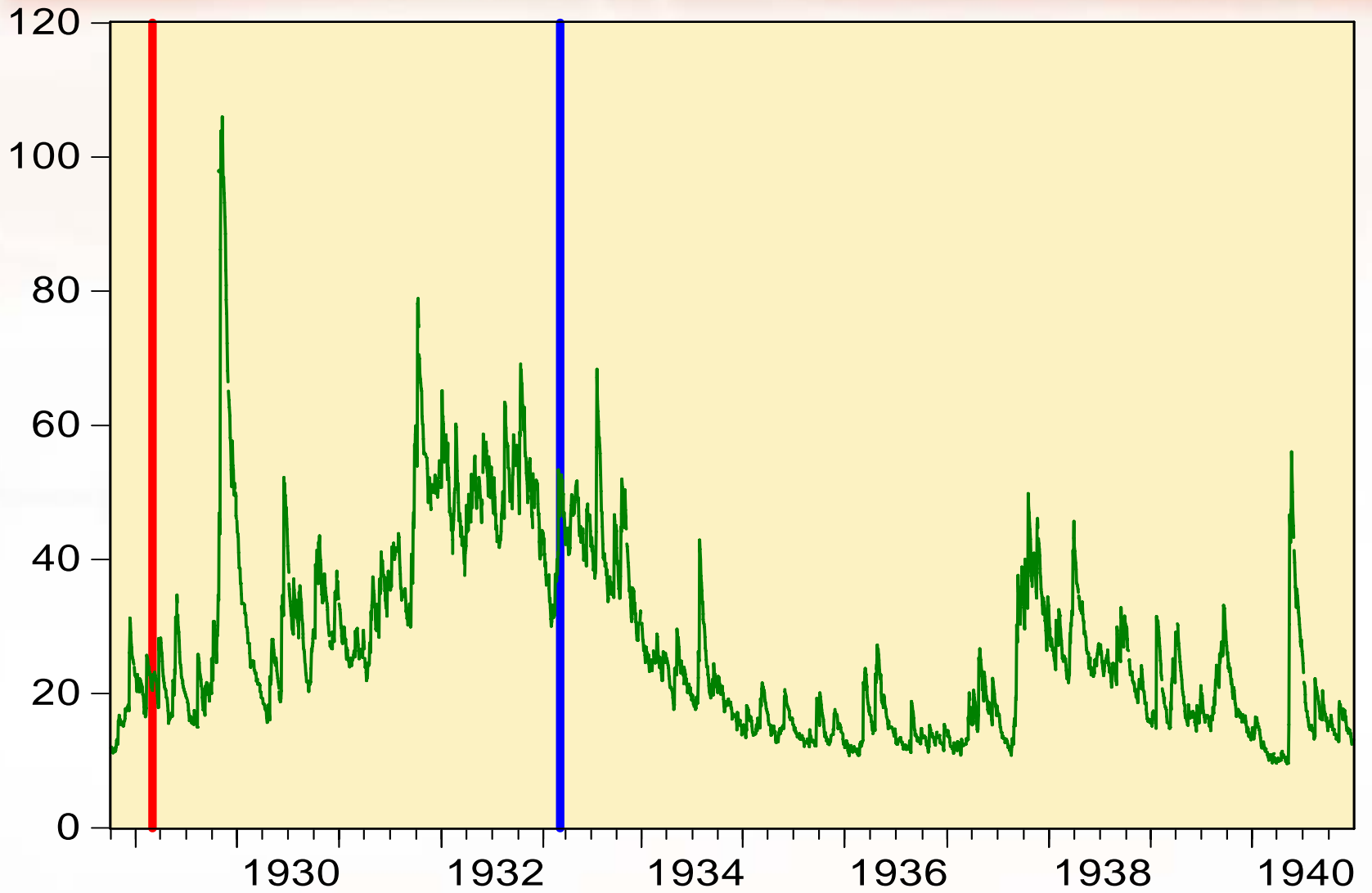




# DJCLOSE

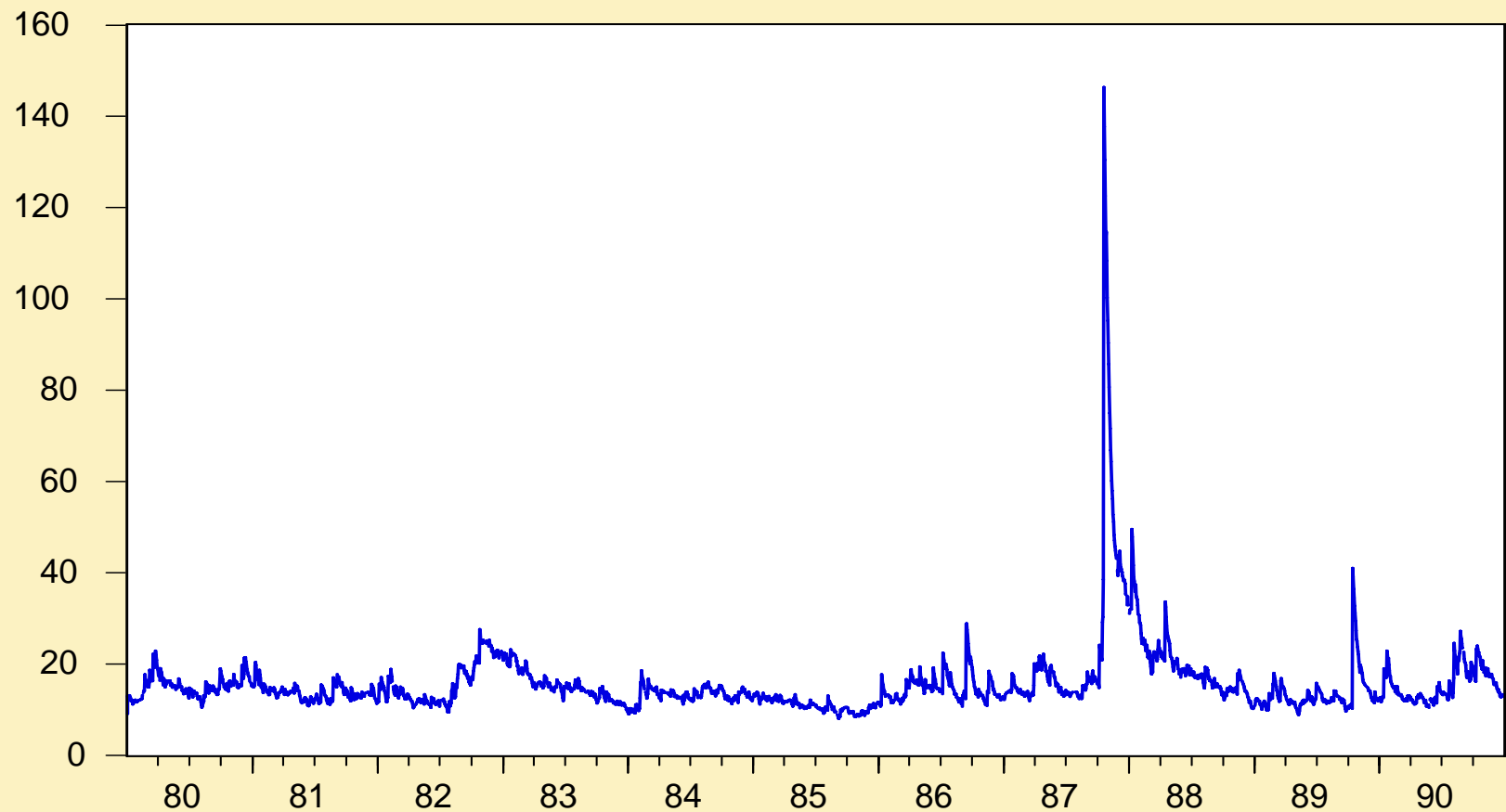


# VOLCOMP



# *DJ VOLATILITY 1980-1990*

DJVOL\_COMP



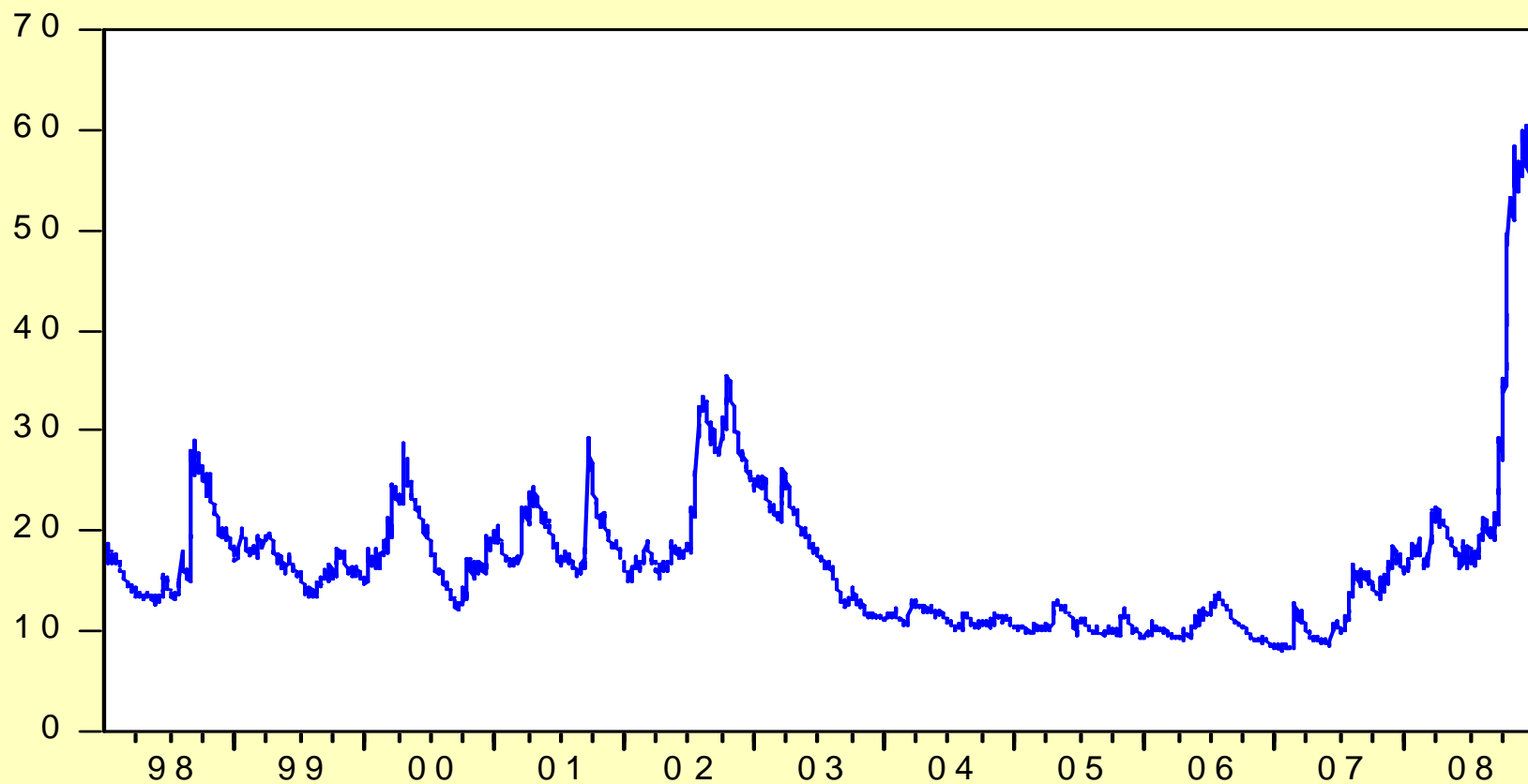
*AND FOR 1998-2008?  
WHAT CAN WE EXPECT?*





# *DJ VOLATILITY 1998-2008*

VOLCOMP PERM





*THE RISK OF WAR and  
TERRORISM*



# *A LONG RUN RISK*

- Deteriorating Global Economy
- Increasing income differential between rich and poor countries
- Rising fundamentalism
- Rising social unrest
  
- Increase the risk of War and Terrorism

## *DEPRESSED ASSET PRICES*

- Long run risks lower asset prices as investors are more cautious.
- This raises the cost of doing business and raising capital
- This reduces income of entrepreneurs
- And costs jobs

# *WHAT TO DO?*

## ***PROMOTE PEACE***

- MANY, MANY APPROACHES THROUGH POLITICS, SCIENCE, MEDICINE, CULTURE, EDUCATION, LAW
- SOME ECONOMIC PROPOSALS:
  - TRADE
  - CAPITAL FLOWS
  - BUILD ECONOMIC INTERDEPENDENCES
  - FIGHT POVERTY
  - REFORM EDUCATION to show value in cooperation

***PEACE PERMITS PROSPERITY***

# *BENEFITS*

- Reducing future risk of war
- Yields benefits today by
- Improving business and stock market valuations and
- Creating jobs

The background of the slide features a collage of orange-toned images, including several 50 Euro banknotes and white line graphs overlaid on a grid. The overall aesthetic is financial and data-oriented.

*VERY LONG RUN RISKS!  
ARE WE READY FOR THESE?*

# *GLOBAL OVERHEATING – WHAT ARE THE RISKS?*

- Scientific evidence seems clear that the climate is changing.
  - CO<sub>2</sub> concentrations are rising rapidly
  - Glaciers and polar ice are melting
  - Warmest years on record are almost all within 10 years.
- But what are the costs? Scientific evidence is not precise.

# *ECONOMIC COSTS*

- THE GLOBAL ECONOMY WILL BE UNABLE TO PRODUCE AS MUCH IN THE FUTURE AS IT WOULD WITHOUT CLIMATE CHANGE
- TAXES WILL BE RAISED TO PAY FOR PUBLIC EFFORTS TO MITIGATE THESE COSTS
- COMPANIES WILL HAVE EXTRA COSTS OF DOING BUSINESS SO PROFITS WILL BE LOWER.

## *FINANCIAL MARKET EVALUATION OF CLIMATE RISK. IS CLIMATE RISK PRICED?*

- Can we see evidence of climate risk in financial markets?
- We would expect that stock prices would be depressed by climate risk.
- If it is a risk for all stocks, then it would imply simply a lower price.
- If it is more of a risk for some companies or countries than others, then they would have bigger discounts.
- If these risks are not priced, then there could be profitable portfolio strategies.



*A SOLUTION*

I NEVER DREAMED  
I'D SEE SUCH AN  
AGENT FOR CHANGE  
IN MY LIFETIME!

OBAMA?



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*[Handwritten signature]*

4 DOLLARS A GALLON.



## *A SOLUTION*

- Most Economists believe the best solution to global overheating is a comprehensive tax on carbon emissions and other greenhouse gases.
  - Only if it is comprehensive will it encourage alternative energy solutions
  - Only if it is comprehensive will efforts to avoid the tax be socially beneficial.

# *TAX REVENUE MUST BE PART OF THE ANALYSIS*

- **Send a check to every resident for an equal fraction of the total revenue.**
  - This compensates everyone equally so it offsets the hardship of an emissions tax for low incomes.
- **Send the checks first.**
  - It will enable people to buy fuel efficient cars, insulate homes, improve appliance efficiency. This will stimulate industries that have been badly hurt by the financial crisis.
- After recession is over, invest passively in a sovereign fund to support social security and public health care.

## *High Oil Prices are a Good Thing!*

- These encouraged consumers and industry to use less oil
  - Driving in the US was down
  - Hybrid Cars were selling and SUV's were not
  - House prices in the suburbs were declining more than in the central city
  - Ridership on public transportation was up

## *But this is Not Enough.*

- Oil prices are falling again.
- Coal is still a cheap and dirty alternative.
- Entrepreneurs with ideas for alternative energy sources cannot be confident that energy prices will stay high.
- Businesses and Consumers will hesitate before making energy investments



Microsoft Corporation, 1978



## *CONCLUSION*

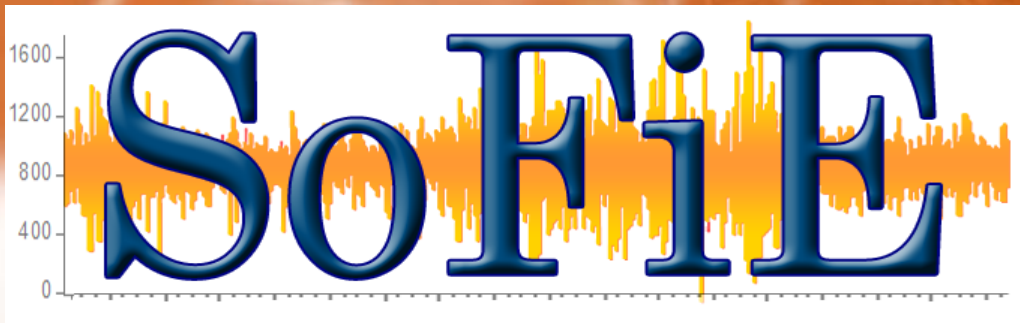
- Make sure you take only the risks you intend to take
- Keep an eye on long run risks
- Policy makers remember: reducing long run risks gives benefits today

The book cover features a complex abstract design composed of several overlapping rectangular blocks. The top-left corner has a light blue square. Below it is a darker purple square, followed by a dark purple square. To the right of these is a vertical strip of black and white horizontal stripes. The main title area is a large, light blue rectangle. Below the title is a purple square, followed by a pink square. To the right of these is a vertical strip of black and white vertical stripes. Below that is a dark grey square, followed by a light grey square. To the right of these is a dark grey square, followed by a vertical strip of black and white vertical stripes. The bottom-left corner is a dark red square, and the bottom-right corner is a dark orange square.

# ANTICIPATING CORRELATIONS

A New Paradigm for Risk Management

ROBERT F. ENGLE



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