Crisis of Mathematical Abuse and Misuse

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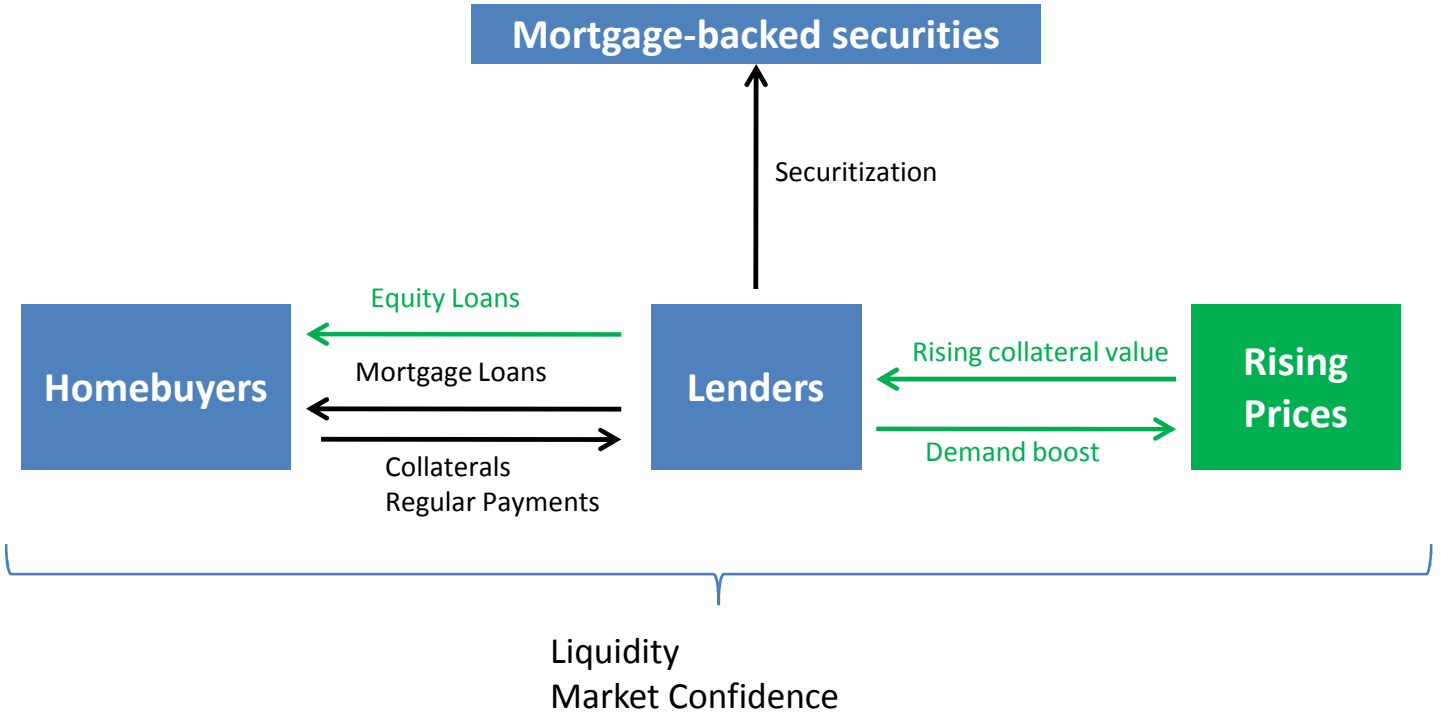
The First Credit Crisis of the 21st Century

- Prelude
  - Repeal of the Glass-Steagal Act
  - 9/11 and aftermath: Easy Money
    - Petrodollars
    - Monetary easing
  - Infectious Greed
    - It is not that humans have become any more greedy than in generations past. It is that the avenues to express greed had grown so enormously.
  - CDSs unregulated
    - The Commodity Futures Modernization Act of 2000
    - CFTC and SEC exempted
  - Banks: Manage risks or simply distribute them
  - Leveraging
  - Real Estate Myth

What is next?...

The vicious cycle



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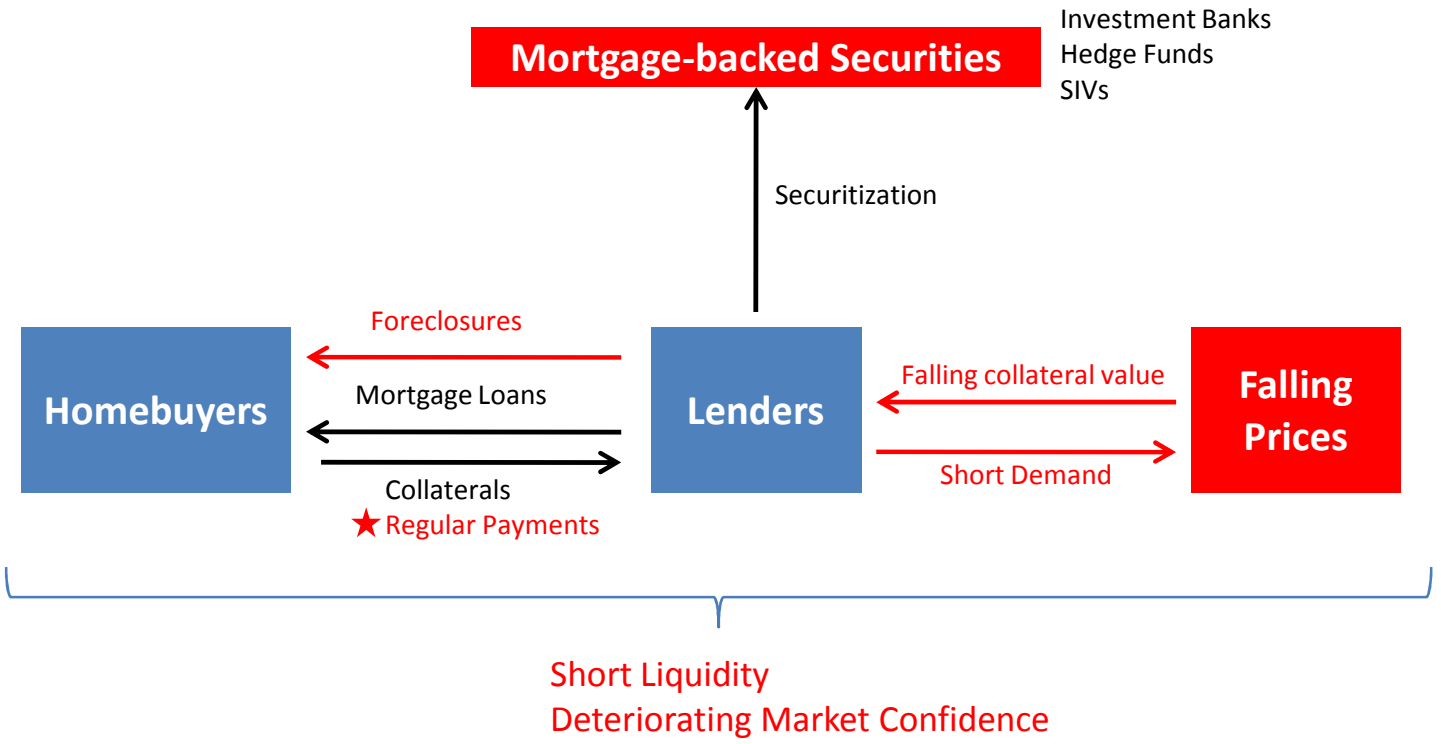

The First Credit Crisis of the 21st Century

- And we are in
  - TED Spread hitting a peak of 4.5%
    - Deteriorated market confidence
  - Lehman's collapse
    - Run on equities
  - Fed's Emergency Economic Stabilization Act (Section 128)
    - Producing more pressure on credit markets. By mid-January 2009, excess on reserve balances topped $870 billion when compared to $10 billion at the beginning of September 2008.
  - De-leveraging
    - Accelerated liqudity crisis and hit international trade

Is it affordable?...

The First Credit Crisis of the 21st Century

- Aftermath
  - Company failures
    - Realized write-offs more than $1 trillion
    - IMF says write-offs could reach $4.1 trillion
  - Company bailouts AIG | BoA | GM | Citigroup | …
  - Global equity market
    - Total loss in equity value exceeded $50 trillion.
  - Output contraction
    - Revised downward from 0.5% to 1.3% contraction for 2009
- Where we stand…
  - Financial Crisis (6-12 months)
  - Recession (12-24 months)
  - Depression (3+ years)

Models are not perfect

- Who is to blame?

  Greenspan says: "We will never have a perfect model of risk. The essential problem is that our models – both risk models and econometric models – as complex as they have become, are still too simple to capture the full array of governing variables that drive global economic reality."

  - Were the mathematical models all we had to blame?

Role of Mathematical Models: Misuse/Abuse

- Complex Financial Products

  References

  - The Use, Misuse and Abuse of Mathematics in Finance, Jan. 2000, Wilmott P., The Royal Society Publishing

- Credit Default Swaps

  References

  - "We modernised ourselves into this ice age", 31 March 2009, Dinallo E., Financial Times
  - The Use (and Abuse) of CDS Spreads During Distress, March 2009, Singh M. & Spackman C., IMF Working Paper

- Volatility

  References

  - Value at Risk: Uses and Abuses, Culp C. L. , Miller M. H. & Neves A. M., 1998, Jof Applied Corporate Finance

(i) Complex Financial Products

An example of how it all went wrong

- A non-financial firm had for some time succesfully hedged its exposure to interest rate risk. He had started to speculate on the direction of interest rates, even made profits.
- Who can predict the market forever ?
  - The firm entered into a swap: pay fixed (0.5 yrs)+ floating (4.5 yrs), receive fixed
  - If the rates had shown a parallel move, the profit would be $7.5 million over 5 yrs.
  - Historically, the probability for breakeven scenario or worse was 14%. The chance of rates rising a 1.5% or more was 3%.

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  - But they really did!

(ii) Credit Default Swaps

Unregulated.

Constant recovery rates did not signal the crisis.

- One major cause of the 1907 credit freeze was unregulated speculation on the prices of securities by people who did not own them.
- The states responded in 1908 by passing anti-gambling laws, outlawing the activity that helped to ruin the economy.
- The Commodity Futures Modernisation Act of 2000 exempted them from 1908 laws. CFTC and SEC ignored them.
- Thus, we created the rocket fuel that turned the subprime mortgage fire into conflagration.

(We Modernized Ourselves into this Ice Age, Eric Dinallo, 31 March 2009, FT)

(ii) Credit Default Swaps

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- CDS spread, the price of the protection against a company or a country's default, is a function probability of default and recovery ratio.
  - Recovery ratio is the rate at which the protection seller locks to protect in a secondary market what it may get back on bonds when companies default
- CDS spread widened quickly during distress. However, the constant recovery rate assumption did not allowed protection sellers to derive correct default probabilities.
  - The false sense of security regarding the timing of default and the recovery rates led to outsized losses by insurers.

    Landsbanki and WaMu cases

(iii) The celebrated VaR model

$$VaR_t = \Phi\sqrt{\tau}\sigma_t$$

- The loss that can occur over a given period at a given confidence level, due to exposure to market risk
- US banks have long been allowed to construct their own internal VaR models from which the capital ratio is derived. For decades, investors had felt secure with the protection of the modest equity-capital cushion, allowing banks to lend "freely".

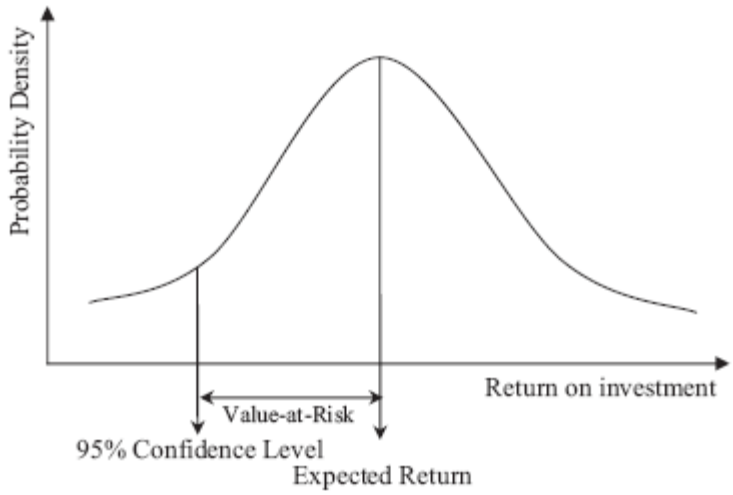
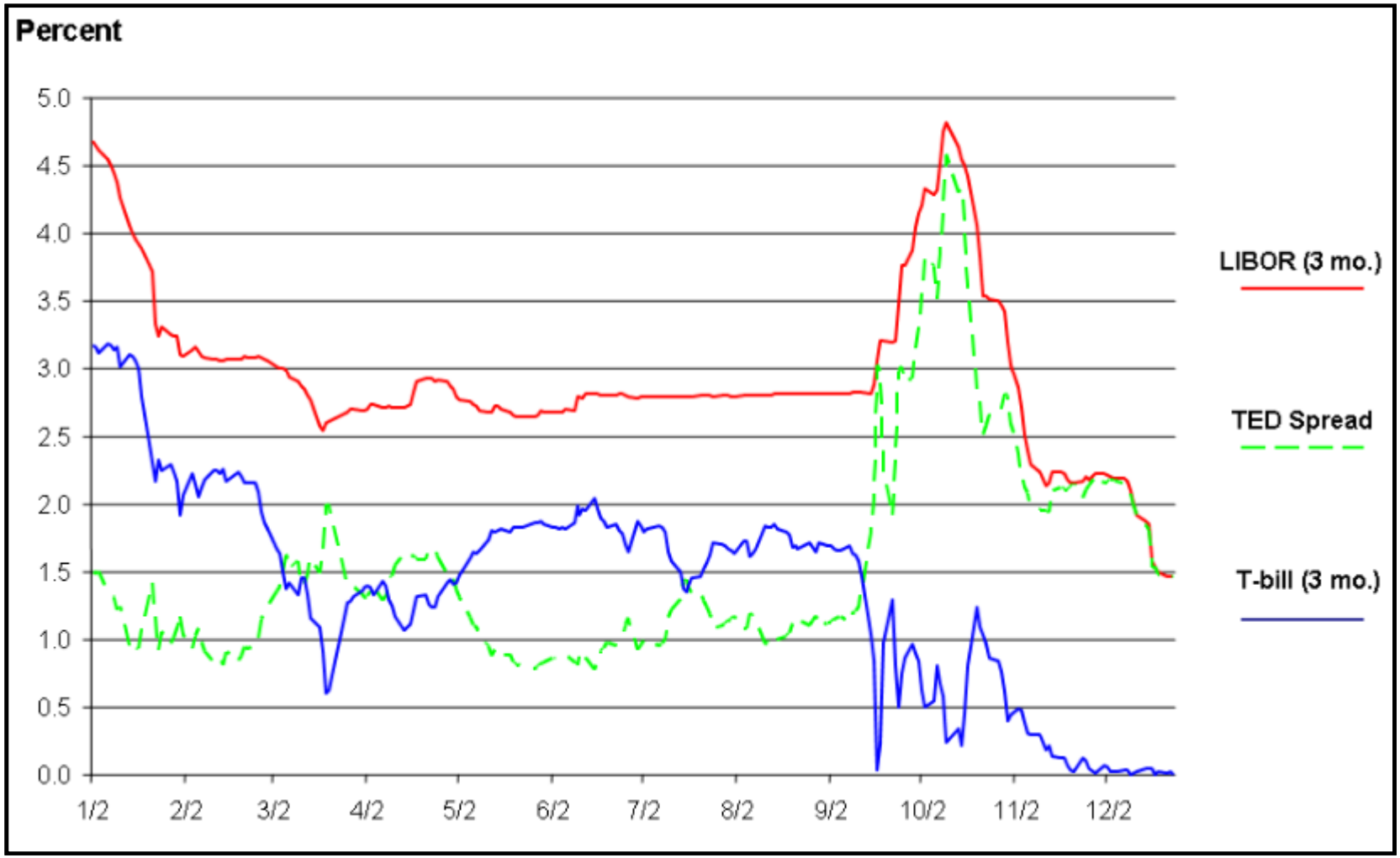


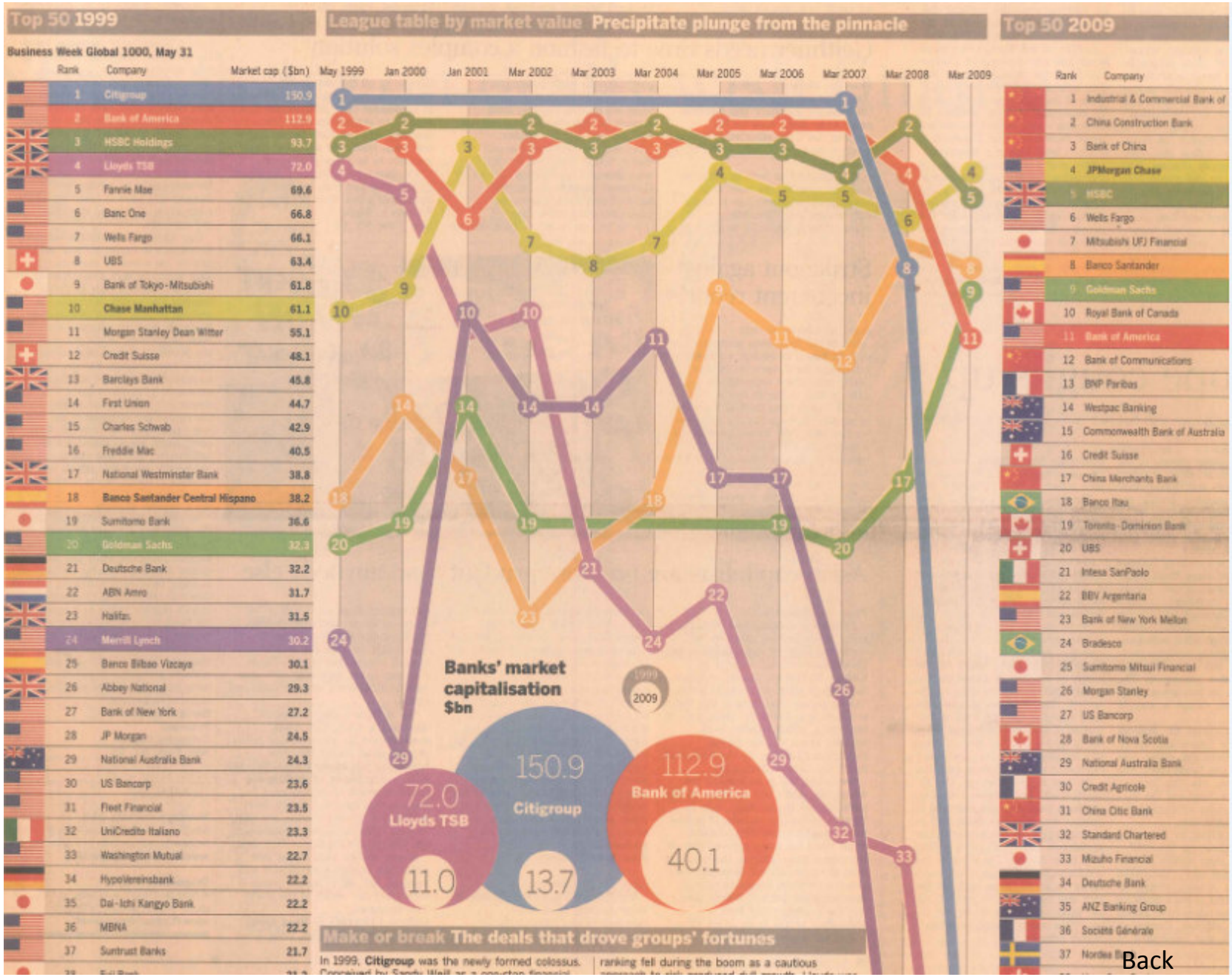
Fig. 1. VaR quantification using the probability density function of returns.

- Manipulation of volatility models created insolvent banks at a time when the solvency could change everything.
- This story also ended up with gloom when the regulatories proposed stress tests to decide on health of the largest US financial institutions.

“ You do smart things, you eventually get very rich. If you do smart things and use leverage and you do one wrong thing along the way, it could wipe you out, because anything times zero is zero… Everybody thinks they’re going to leave at two minutes to 12. But the trouble is, there are no clocks on the wall.”


Percent
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/2
2/2
3/2
4/2
5/2
6/2
7/2
8/2
9/2
10/2
11/2
12/2
LIBOR (3 mo.)
TED Spread
T-bill (3 mo.)

Back


Top 50 1999
Business Week Global 1000, May 31
Rank Company Market cap ($bn)
1 Citigroup 150.9
2 Bank of America 112.9
3 HSBC Holdings 93.7
4 Lloyds TSB 72.0
5 Fannie Mae 69.6
6 Banc One 66.8
7 Wells Fargo 66.1
8 UBS 63.4
9 Bank of Tokyo-Mitsubishi 61.8
10 Chase Manhattan 61.1
11 Morgan Stanley Dean Witter 55.1
12 Credit Suisse 48.1
13 Barclays Bank 45.8
14 First Union 44.7
15 Charles Schwab 42.9
16 Freddie Mac 40.5
17 National Westminster Bank 38.8
18 Banco Santander Central Hispano 38.2
19 Sumitomo Bank 36.6
20 Goldman Sachs 32.3
21 Deutsche Bank 32.2
22 ABN Amro 31.7
23 Halifax 31.5
24 Merrill Lynch 30.2
25 Banco Bilbao Vizcaya 30.1
26 Abbey National 29.3
27 Bank of New York 27.2
28 JP Morgan 24.5
29 National Australia Bank 24.3
30 US Bancorp 23.6
31 Fleet Financial 23.5
32 UniCredito Italiano 23.3
33 Washington Mutual 22.7
34 Hypovereinsbank 22.2
35 Dai-Ichi Kangyo Bank 22.2
36 MBNA 22.2
37 Suntrust Banks 21.7
League table by market value Precipitate plunge from the pinnacle
May 1999 Jan 2000 Jan 2001 Mar 2002 Mar 2003 Mar 2004 Mar 2005 Mar 2006 Mar 2007 Mar 2008 Mar 2009
Banks' market capitalisation $bn
2009
150.9
Citigroup
112.9
Bank of America
72.0
Lloyds TSB
40.1
13.7
11.0
Make or break The deals that drove groups' fortunes
In 1999, Citigroup was the newly formed colossus.
ranking fell during the boom as a cautious
Top 50 2009
Rank Company
1 Industrial & Commercial Bank of
2 China Construction Bank
3 Bank of China
4 JPMorgan Chase
5 HSBC
6 Wells Fargo
7 Mitsubishi UFJ Financial
8 Banco Santander
9 Goldman Sachs
10 Royal Bank of Canada
11 Bank of America
12 Bank of Communications
13 BNP Paribas
14 Westpac Banking
15 Commonwealth Bank of Australia
16 Credit Suisse
17 China Merchants Bank
18 Banco Itau
19 Toronto-Dominion Bank
20 UBS
21 Intesa SanPaolo
22 BBV Argentaria
23 Bank of New York Mellon
24 Bradesco
25 Sumitomo Mitsui Financial
26 Morgan Stanley
27 US Bancorp
28 Bank of Nova Scotia
29 National Australia Bank
30 Credit Agricole
31 China Citic Bank
32 Standard Chartered
33 Mizuho Financial
34 Deutsche Bank
35 ANZ Banking Group
36 Société Générale
37 Nordea
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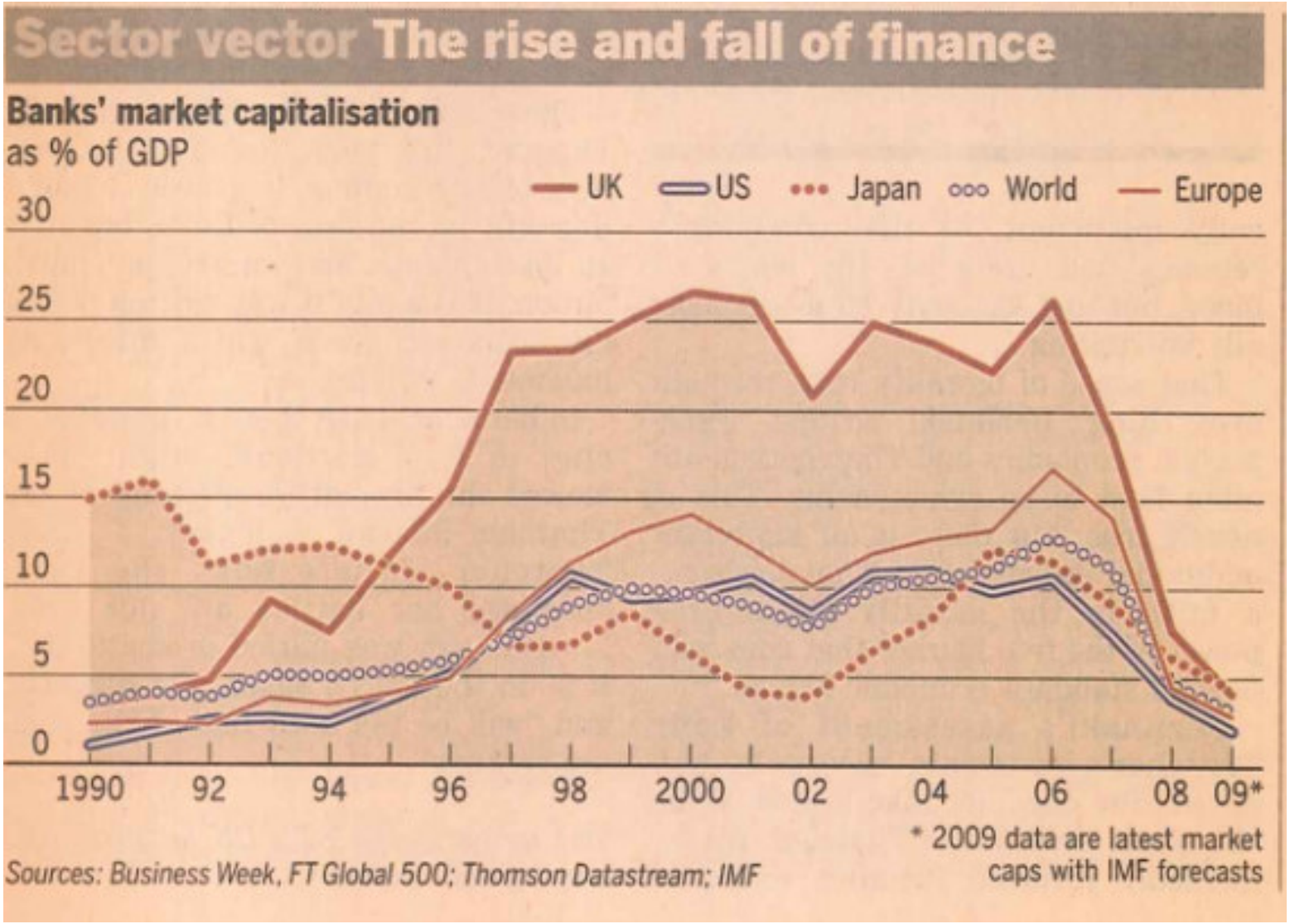
Sector vector The rise and fall of finance
Banks' market capitalisation
as % of GDP
UK
US
Japan
World
Europe
30
25
20
15
10
5
0
1990
92
94
96
98
2000
02
04
06
08
09*
* 2009 data are latest market caps with IMF forecasts
Sources: Business Week, FT Global 500; Thomson Datastream; IMF

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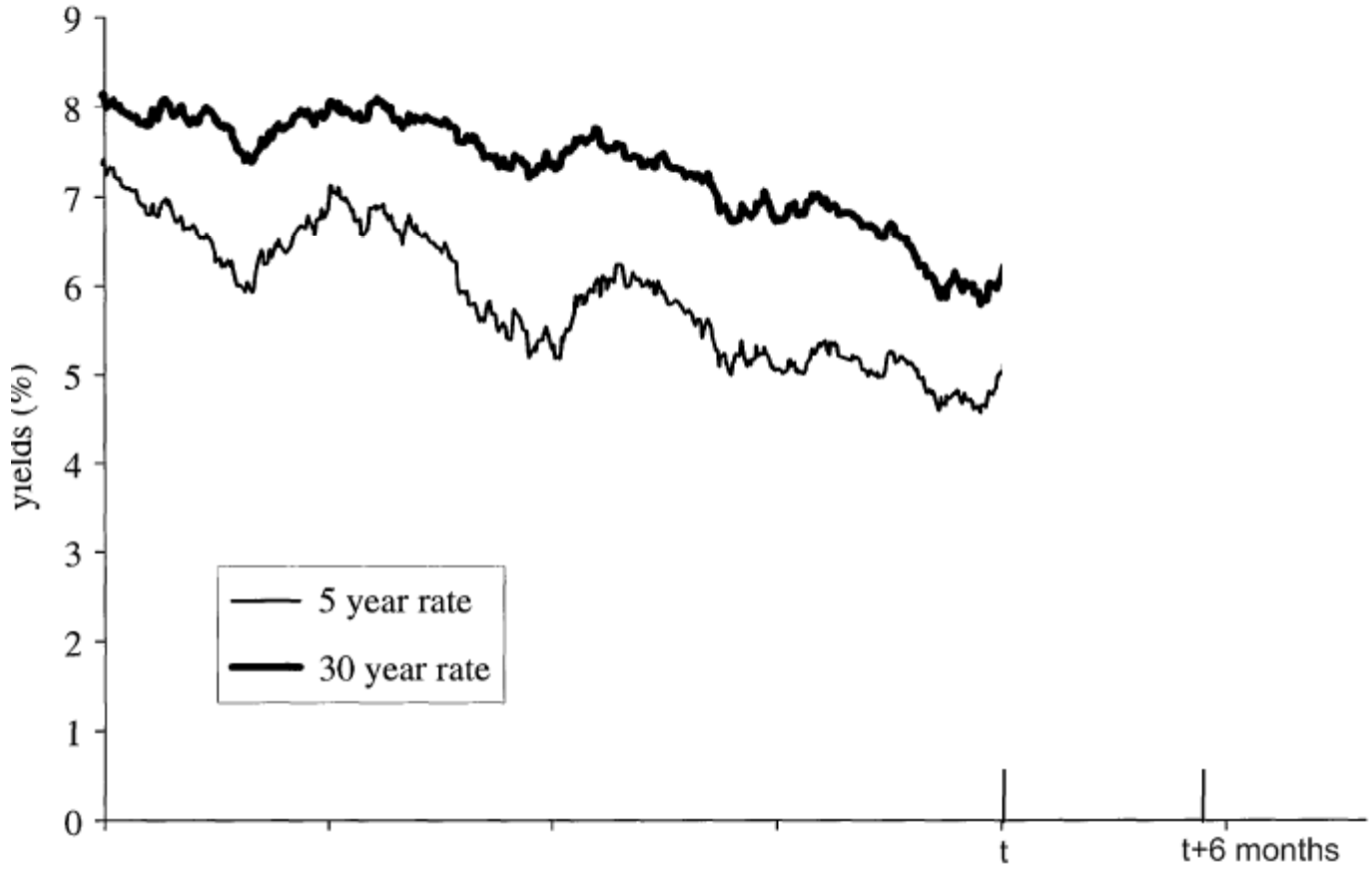
Complex Financial Products

An example of how it all went wrong

$$r_c = 0.0075 + 0.01 * \max\left\{\frac{98.5}{5.78} * Y_5 - P_{30}, 0\right\}$$



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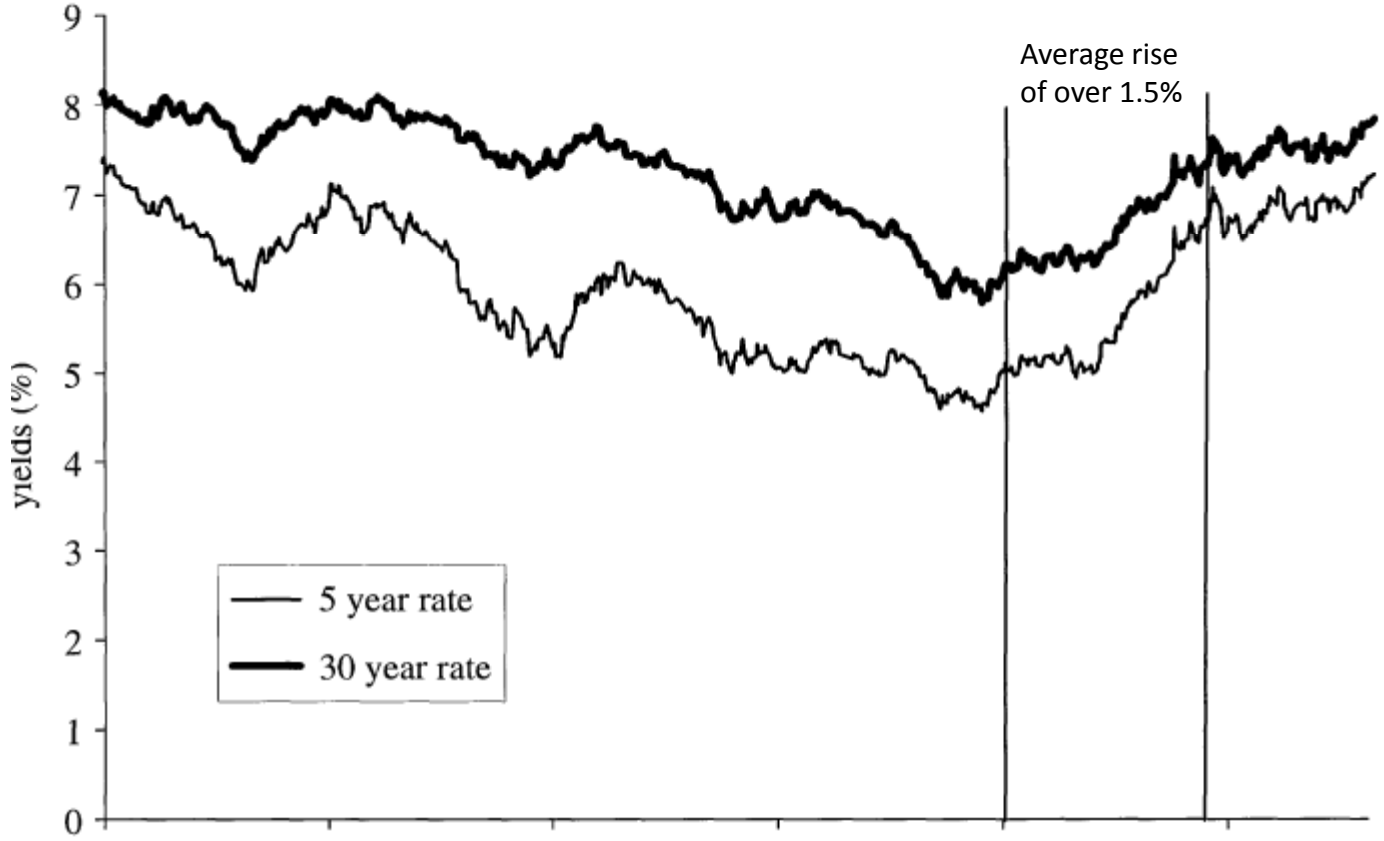

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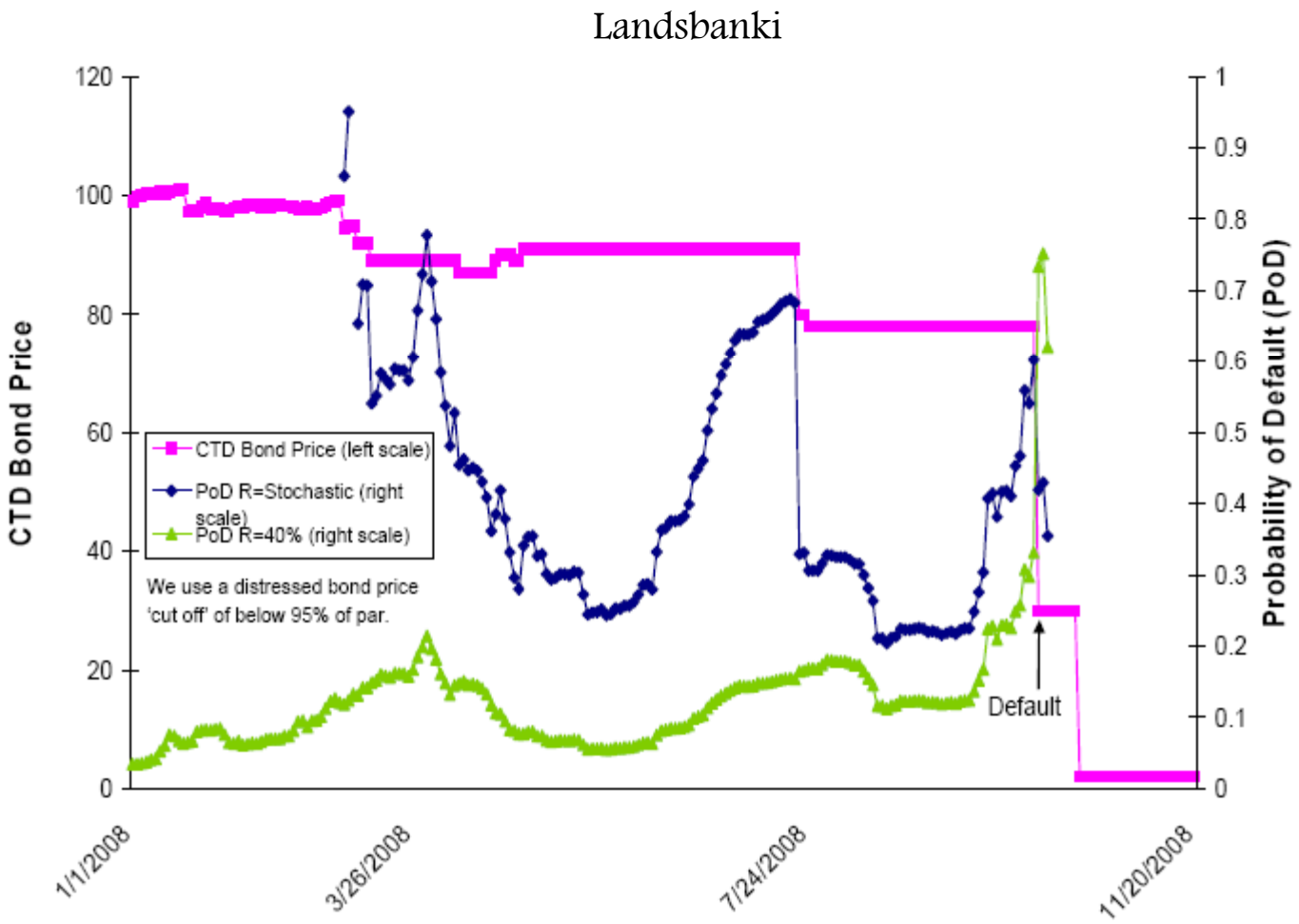
Credit Default Swaps

Unregulated.

Constant recovery rates did not signal the crisis.



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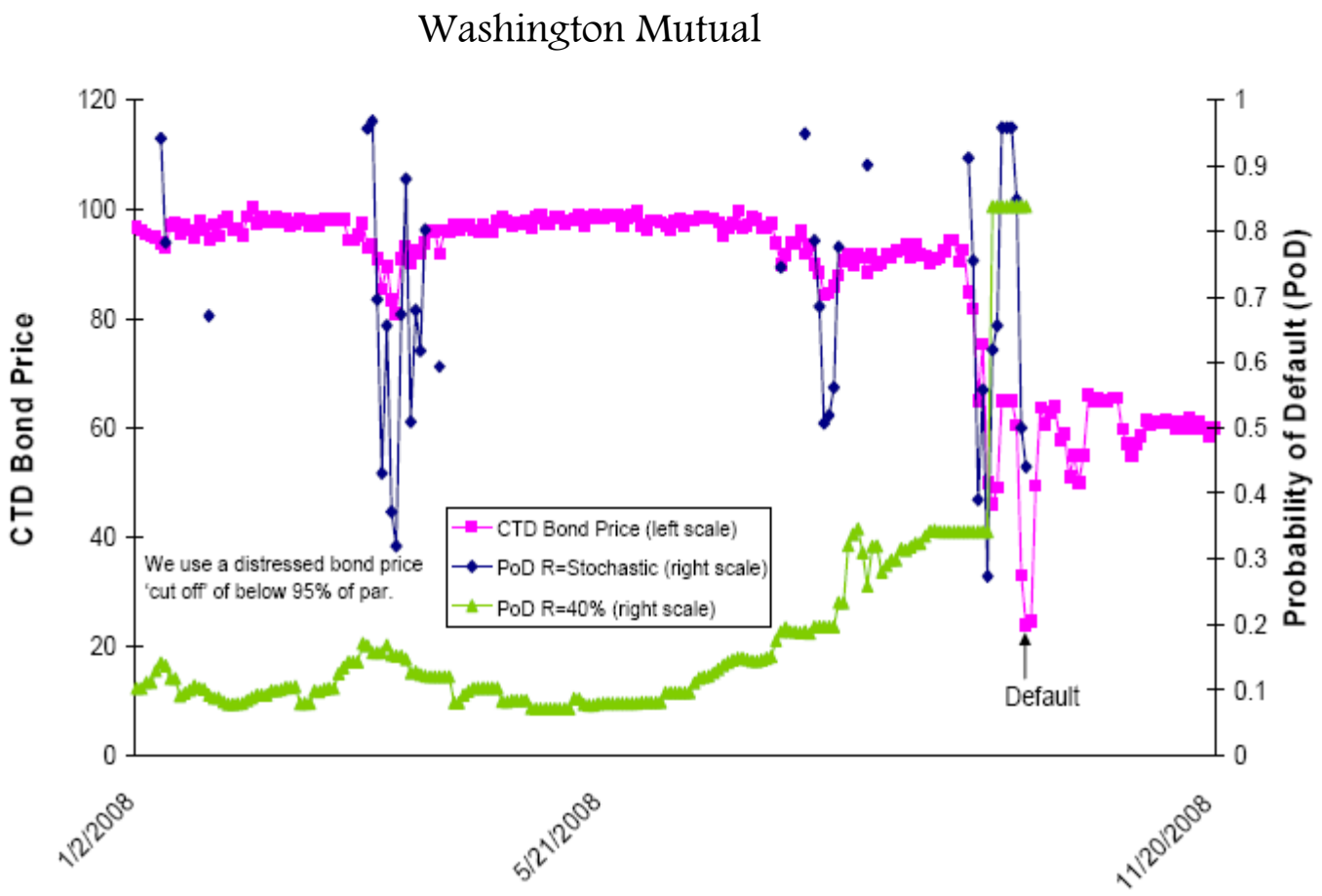

Sources: Bloomberg. L.P., Markit

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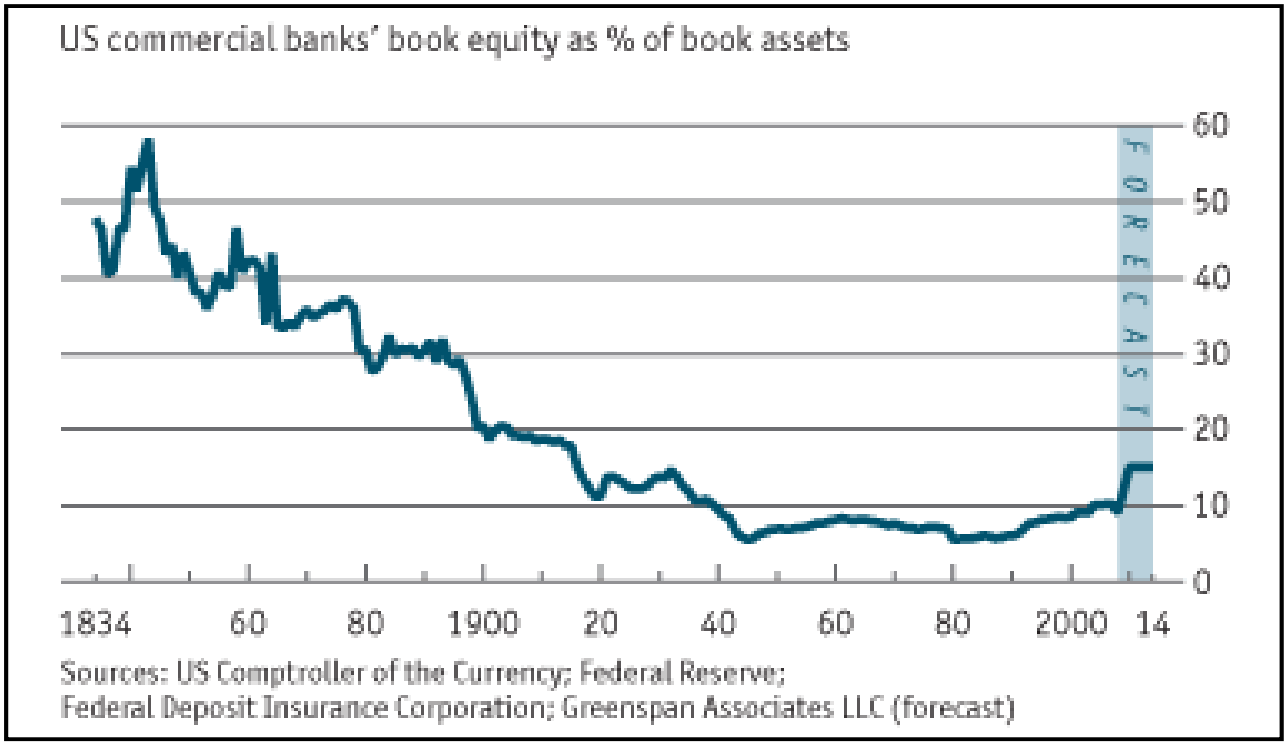
The celebrated VaR model



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