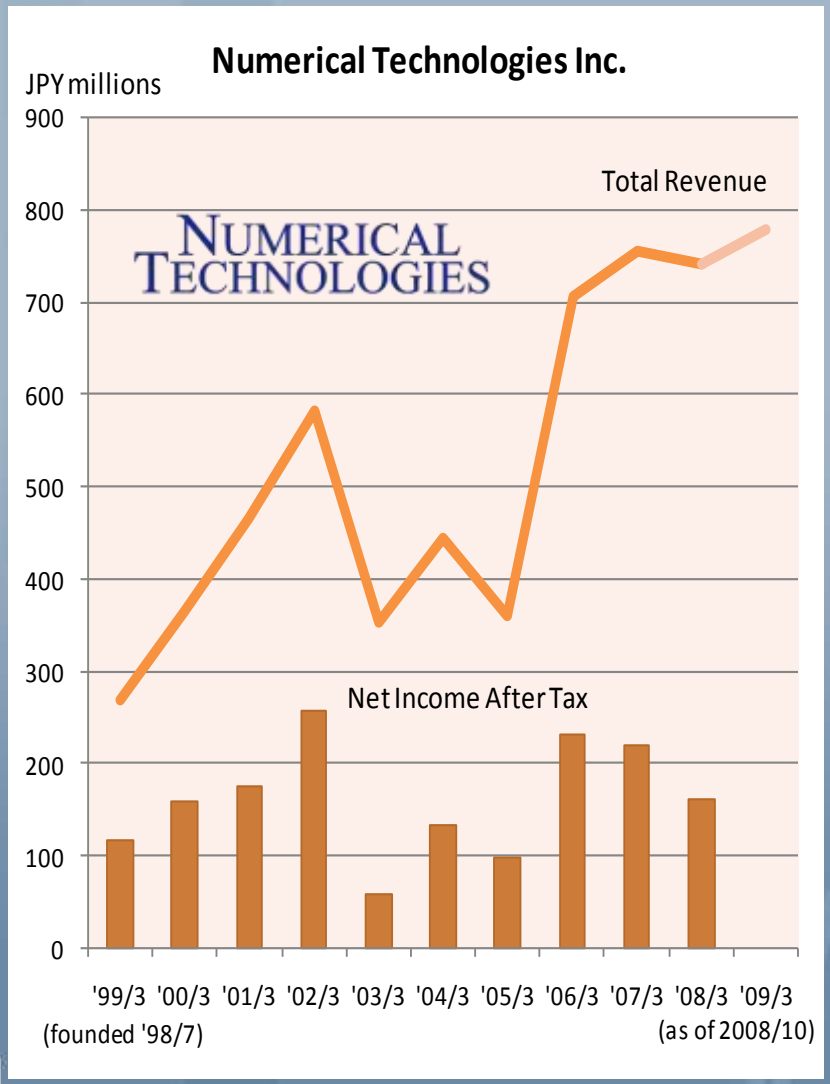
NUMERICAL TECHNOLOGIES

vision

Financial Crisis and HPC

Numerical Technologies Inc., November 2008

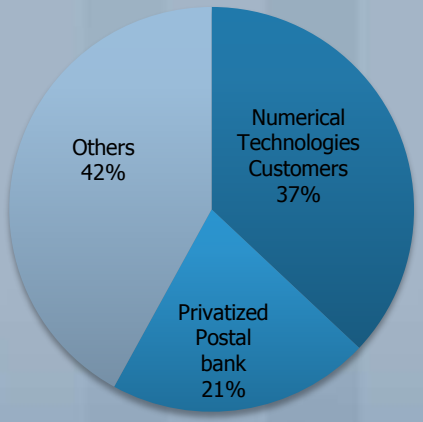
Corporate Profile



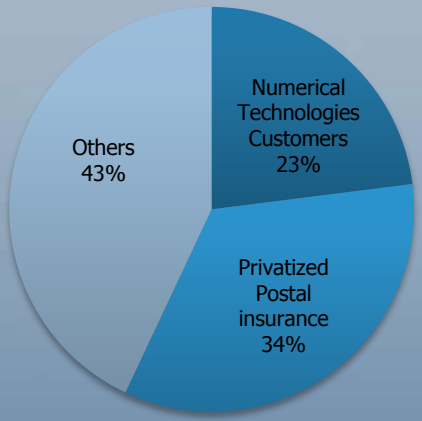
- Fast-growing financial risk management software company based in Tokyo.
- Specialization in parallel Monte Carlo and financial modeling.
- Founded by ex-employees of SMBC, 10 years ago.
- Independent and neutral. 100% owned by original three founders, no debt, no external capital, same key member from the first.

Small firm but large share

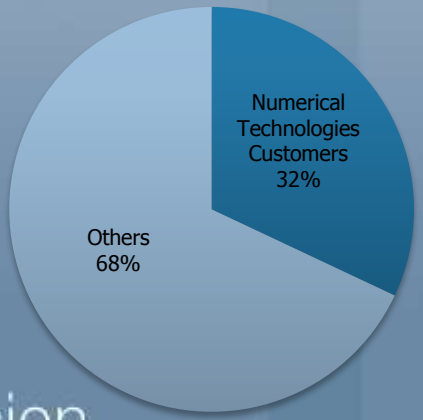
Asset share in Japan's banking industry



Asset share in Japan's life insurance sector



Asset share in Japan's non-life insurance sector



- Numerical Technologies is a small, laboratory-style firm, doing business in Tokyo.
- Its competitors were RiskMetrics Group in New York and Algorithmics in Toronto. By producing more powerful and sophisticated systems, Numerical Technologies gradually replaced their share over the past decade.
- Now, most of major financial institutions in Japan are our customers. MUFG, SMBC, Nippon Life, and more.

Our contribution to the financial industry

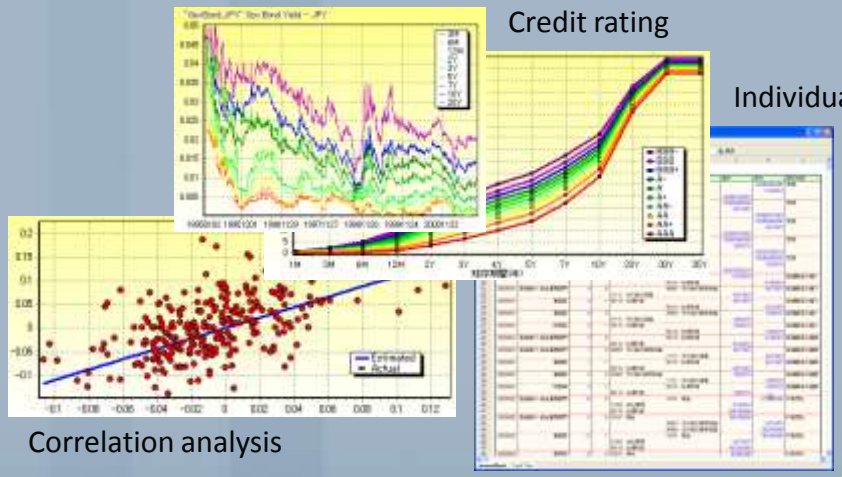
- Poor risk management by US banks has been another side of their money machine.
  - Before the securitization boom and US housing bubble, Basel Capital Accord considerably limited banks' leverage ratio; this meant limited profitability.
  - Subsequently, some US banks detected a "security hole" in the Accord. This led to greater utilization of securitization to increase leverage ratio. They also established SIVs/conduits, the shadow banking system, also known as financial statements cooking vehicles by slicing off risky assets and liabilities.
- On the other hand, Tokyo has been characterized by a strong penchant for risk management systems.
  - In light of the lessons learned from severe financial crisis of the 1990s, Japanese financial institutions reduced leverage ratio and carried out sound balance sheet management. This made for low risk, but slowness in profitability-related decision making.
  - Instead of investing securitization and trading room systems, companies in Tokyo have invested in risk management systems. They require far more precise figures than similar internal systems used by US banks.
  - The huge scale of computation this requires often means dependence on HPC technologies, the software for which is provided by Numerical Technologies.
- And what happened in 2008? The IMF says US crisis is "the largest financial shock since the Great Depression".

Numerical Technologies Altitude®

HPC System for Asset Liability Management

PRODUCT AT A GLANCE

Basic concept: to simulate a whole company



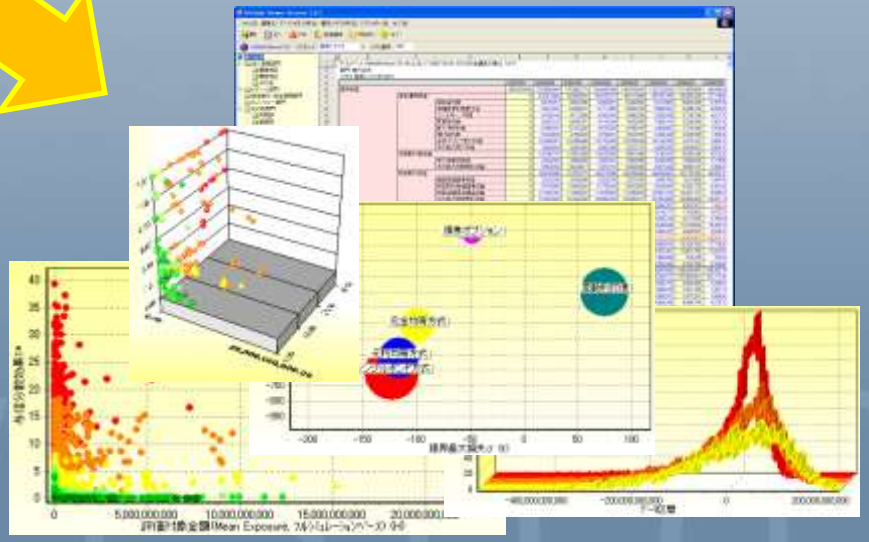
Credit rating

Individual deal data

Correlation analysis

A 5-10 year future simulation run on a daily basis, typically involving 1,000 to 1,000,000 Monte Carlo simulations is required to establish non-linear/future characteristics.

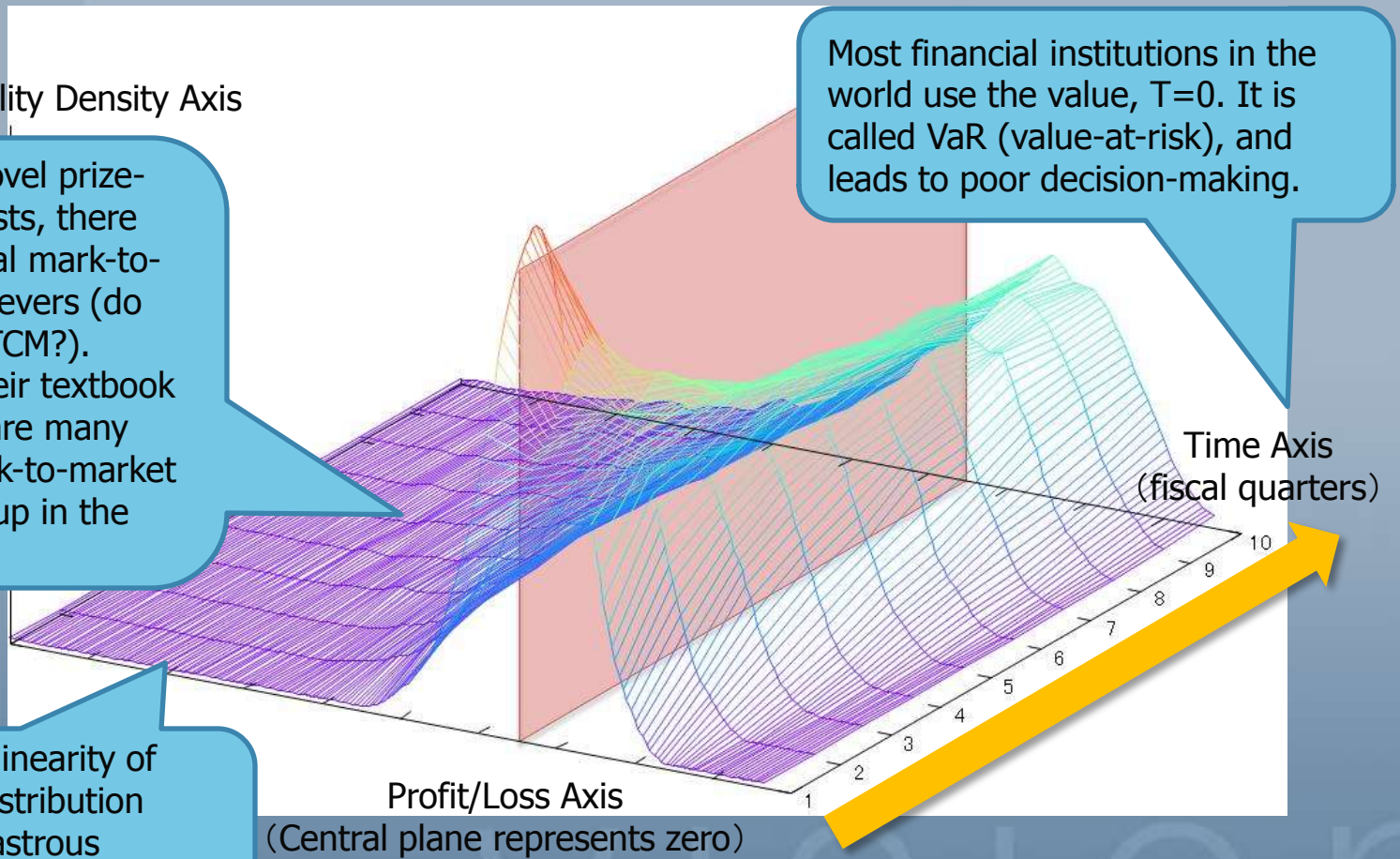
Future financial statement simulation



Maximum loss estimation

Contribution effect analysis for decision making, expand business or withdraw…

Simulate *everything* along the time axis

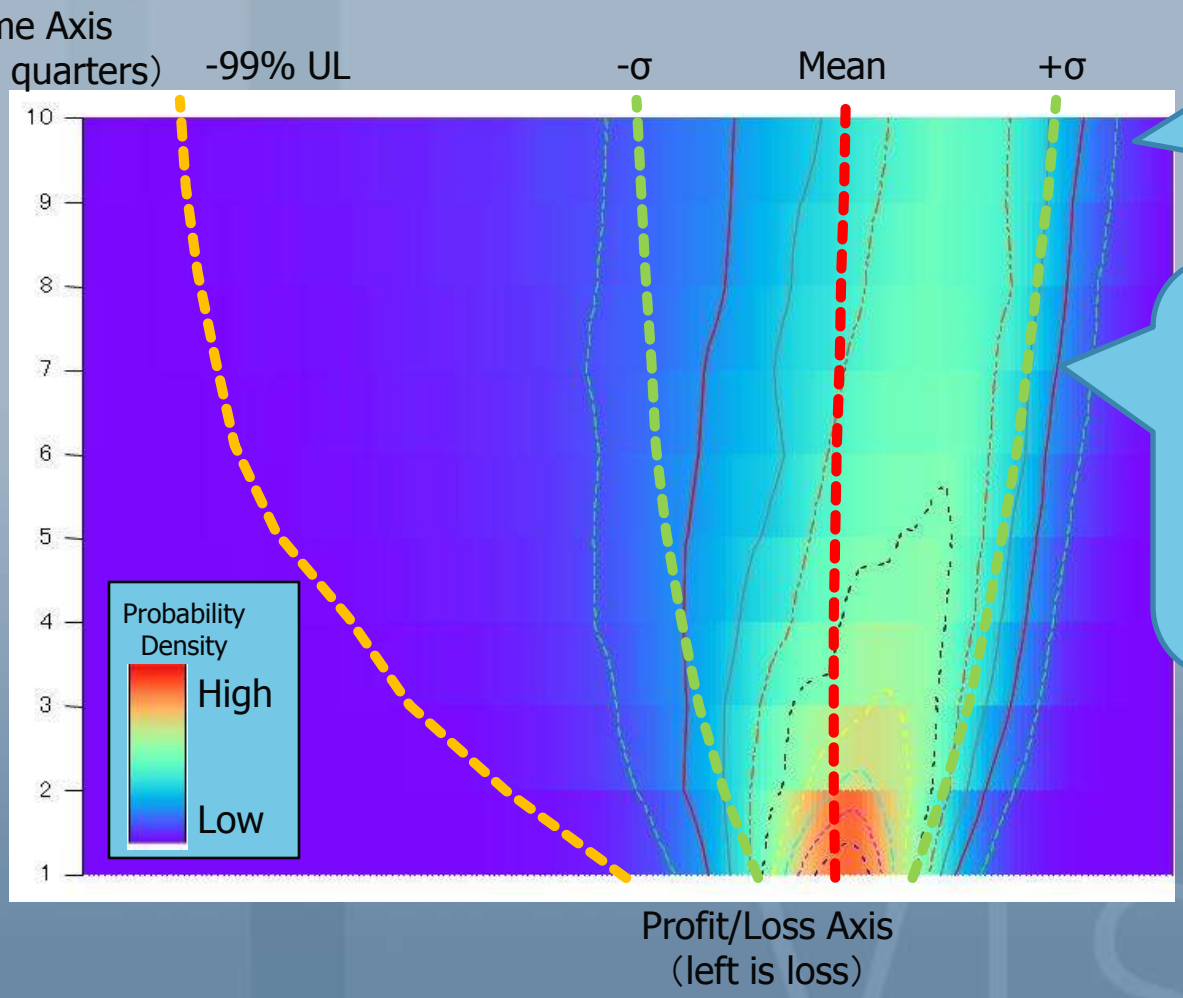


Most financial institutions in the world use the value, T=0. It is called VaR (value-at-risk), and leads to poor decision-making.

Even amongst Novel prize-winning economists, there are many fanatical mark-to-market value believers (do you remember LTCM?). Unfortunately, their textbook is wrong. There are many reasons why mark-to-market does not square up in the real world.

Ignoring the non-linearity of marginal/future distribution often leads to disastrous consequences, as in the case of US banks right now.

Translate the simulation result for risk managers



This is a top view of the last 3D chart in the previous page.

Mean and/or standard deviation value does not indicate proper risk profile. Risk managers have to capture non-linear, time-line-based characteristics. That means business school style risk/return analysis does not work.

These are quants' job. Next, we convert this chart into a traditional financial ratio analysis.

Evaluate business plans: make sense!

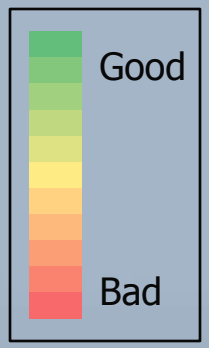
Are you from a financial background? Yes? Take a look at these charts. Which is the best business plan?

Two profitability indicators and two safety indicators displayed here.

BUSINESS PLAN 1: "Greed is right"		As of (time horizon)									
		2009/Q1	2009/Q2	2009/Q3	2009/Q4	2010/Q1	2010/Q2	2010/Q3	2010/Q4	2011/Q1	2011/Q2
Expected Value	Capital adequacy ratio (%)	12.09	12.24	12.39	12.38	12.37	12.46	12.54	12.59	12.64	12.66
	Tier I capital ratio (%)	7.56	7.54	7.53	7.73	7.93	7.90	7.88	7.88	7.88	7.84
	ROA (%)	1.07	1.22	1.37	1.36	1.35	1.44	1.52	1.57	1.62	1.64
	ROE (%)	11.25	11.40	11.55	11.54	11.53	11.62	11.70	11.75	11.80	11.82
Worst case (−99%UL)	Capital adequacy ratio (%)	6.69	5.16	4.40	3.62	2.98	2.66	2.38	2.05	1.80	1.41
	Tier I capital ratio (%)	3.24	1.88	1.13	0.72	0.41	0.07	−0.25	−0.56	−0.79	−1.03
	ROA (%)	−1.30	−1.32	−1.31	−1.31	−1.31	−1.32	−1.33	−1.34	−1.32	−1.31
	ROE (%)	−4.42	−4.49	−4.45	−4.44	−4.44	−4.48	−4.52	−4.55	−4.48	−4.46

BUSINESS PLAN 2: "Status quo"		As of (time horizon)									
		2009/Q1	2009/Q2	2009/Q3	2009/Q4	2010/Q1	2010/Q2	2010/Q3	2010/Q4	2011/Q1	2011/Q2
Expected Value	Capital adequacy ratio (%)	11.97	12.04	12.12	12.12	12.11	12.13	12.13	12.16	12.18	12.20
	Tier I capital ratio (%)	7.48	7.48	7.47	7.53	7.60	7.60	7.60	7.60	7.60	7.57
	ROA (%)	1.06	1.11	1.19	1.18	1.18	1.22	1.25	1.27	1.31	1.32
	ROE (%)	11.14	10.17	10.28	9.64	9.85	10.05	9.50	9.67	10.01	10.18
Worst case (−99%UL)	Capital adequacy ratio (%)	7.20	5.55	4.74	3.90	3.20	2.86	2.56	2.20	1.94	1.51
	Tier I capital ratio (%)	3.30	2.02	1.22	0.78	0.45	0.07	−0.17	−0.40	−0.55	−0.71
	ROA (%)	−1.24	−1.22	−1.22	−1.22	−1.21	−1.21	−1.21	−1.22	−1.22	−1.22
	ROE (%)	−3.71	−3.65	−3.65	−3.65	−3.64	−3.63	−3.64	−3.67	−3.67	−3.67

BUSINESS PLAN 3: "Fasten safety belts"		As of (time horizon)									
		2009/Q1	2009/Q2	2009/Q3	2009/Q4	2010/Q1	2010/Q2	2010/Q3	2010/Q4	2011/Q1	2011/Q2
Expected Value	capital adequacy ratio (%)	12.03	12.12	12.20	12.20	12.19	12.23	12.29	12.31	12.36	12.37
	Tier I capital ratio (%)	7.52	7.51	7.50	7.51	7.68	7.67	7.65	7.65	7.65	7.62
	ROA (%)	1.02	1.00	1.01	1.01	1.01	1.00	0.99	0.98	1.00	1.00
	ROE (%)	10.69	8.98	9.05	7.32	7.77	7.54	7.35	7.58	8.22	8.61
Worst case (−99%UL)	capital adequacy ratio (%)	7.20	5.98	5.10	4.20	3.45	3.08	2.76	2.37	2.09	1.63
	Tier I capital ratio (%)	3.32	2.18	1.32	0.93	0.48	0.18	−0.08	−0.3		
	ROA (%)	−1.10	−1.12	−1.12	−1.13	−1.12	−1.10	−1.10	−		
	ROE (%)	−2.86	−2.90	−2	−2.93	−2.92	−2.87	−2.86			



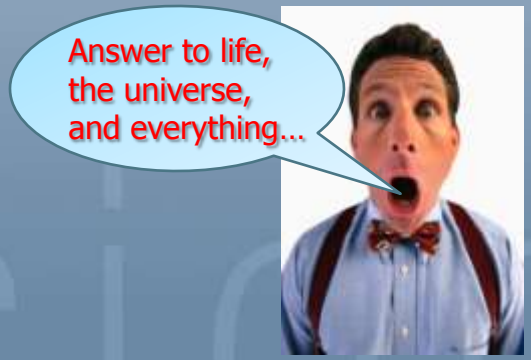
There is no simple answer. At least we can advise that so called investment banking culture tends to prefer Plan 1. Sound banking systems should prefer Plan 3 to avoid spewing toxic agent as the result of bailout. This is the lesson from the Great Depression. The Banking Act of 1933, effectually meant saving low leverage commercial banks but forgetting investment banks. That law lapsed when the Gramm-Leach-Bliley Act1 (GLBA) took effect in 1999.

The simulator clearly says that banking system reform is inevitable. This is America's duty for the sake of its own future and that of the rest of the world.

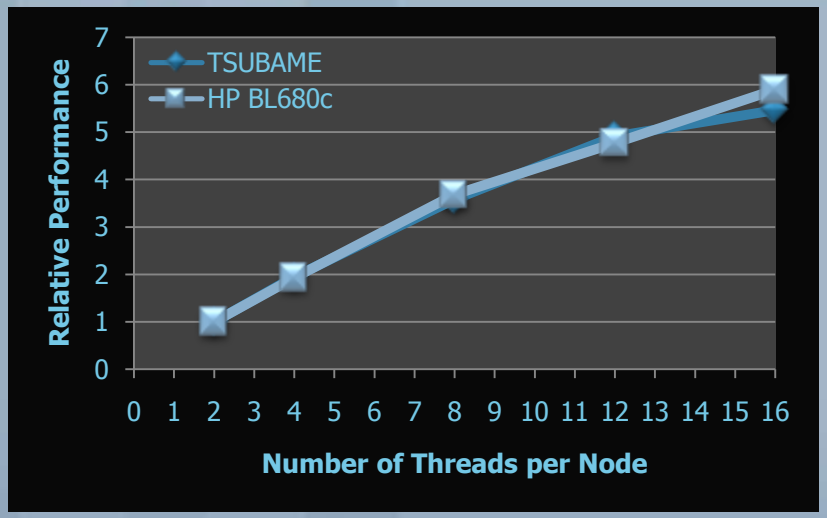
The calculation needs huge data set (GRID demonstration sample)

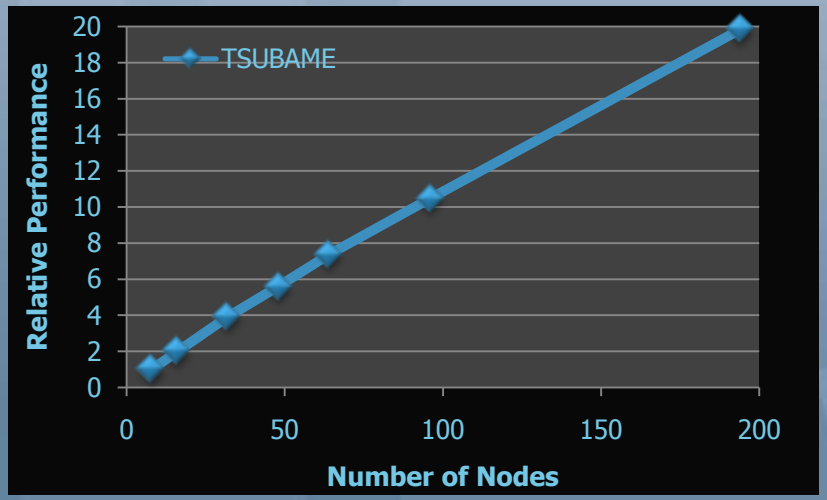
Number of transactions	3.4 million (i.e., the portfolio of the largest commercial bank in the world)
Number of cash flows	500,000,000
Number of T-account transactions	4.4 billion per Monte Carlo scenario
Number of obligors	200,000
Term of daily simulation	3 years (1096 days), or 5-10 years (actual use)
Number of Monte Carlo scenarios	1000, or 10,000-1,000,000 (actual use)
Number of grid server nodes	Tested for 1 to 231 nodes

- We calculated this data set using the Tokyo Institute of Technology's "TSUBAME" super computer, ranked 24th most powerful in the world (TOP500 , June/2008).
- This calculation corresponds to one million times the magnitude of the Tokyo Stock Exchange's daily transactions!



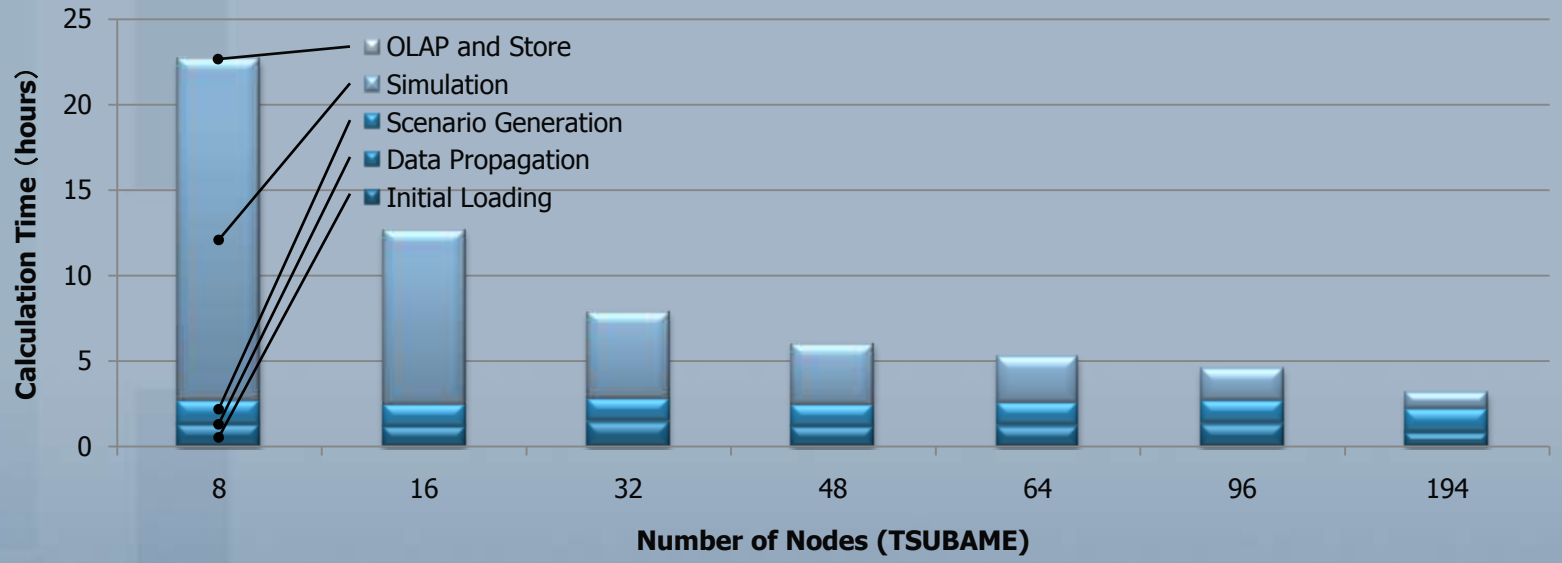
Ready for HPC





- For both SMP and Grid, the application shows an almost linear performance profile.
- Test beds (both are 16 core per node)
  - TSUBAME: dual core AMD Opteron 2.4GHz x 8 per node, SUSE Linux, Lustre, Infiniband
  - HP BL680c: quad core Xeon E7340 (Tigerton) 2.4GHz x 4 per node, RedHat Linux, local HDD, Infiniband
- The application also supports Windows 2003 Server or later.
  - Already shipped to 3 customers.
  - We have also tested Windows CCS 2003 with GbE. As everybody knows, its network performance is poor, but the application itself is OK.

Required system size: huge

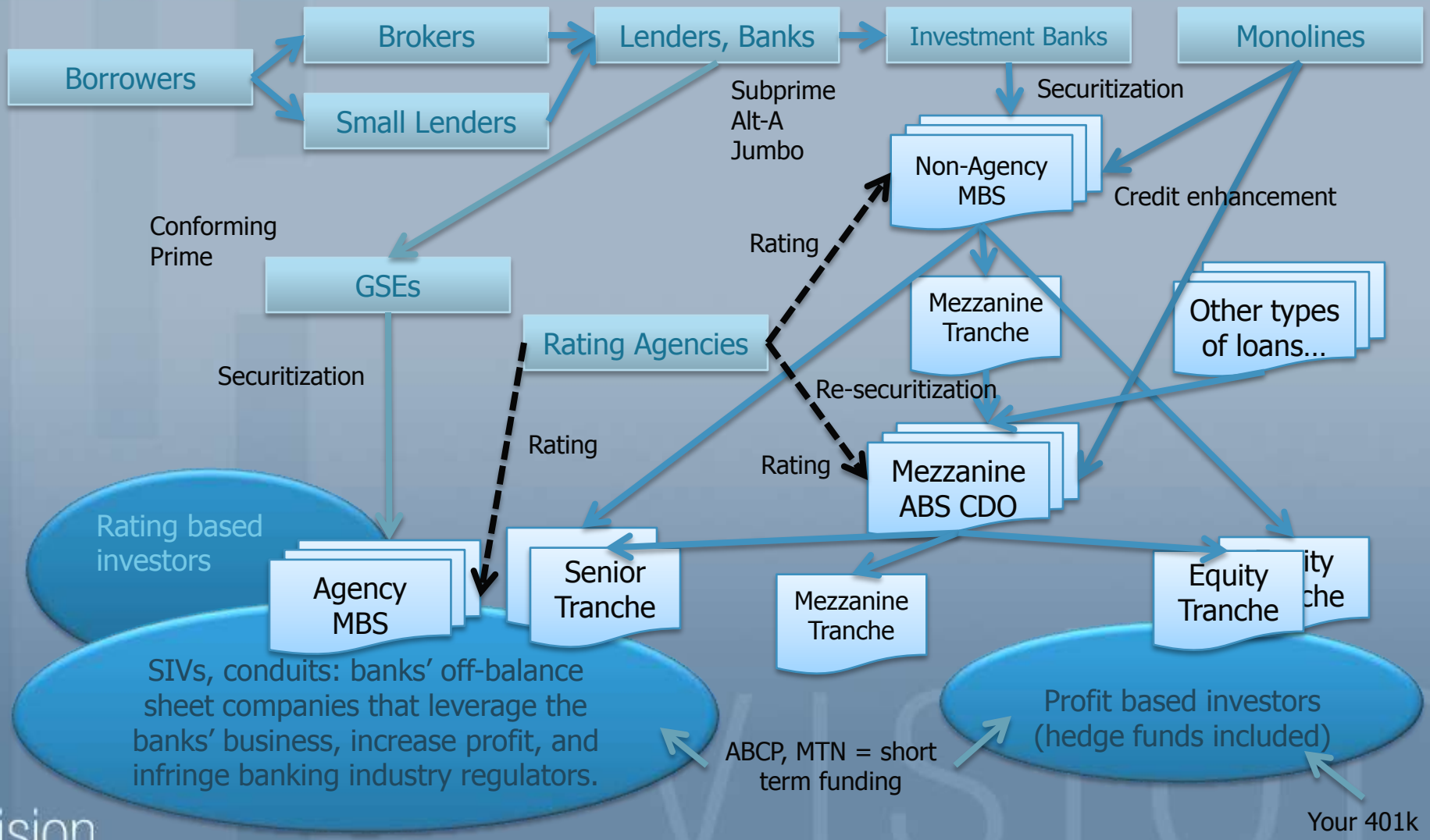


- To meet our customer's potential requirement, 144-288 nodes with 4 sockets quad core server clusters seems to be an appropriate solution.
- MPI and faster network are very much welcomed. However, because the application has in-built alternative pthreads/socket based communication algorithms, the application can run with GbE, through performance may be sacrificed.

CASE STUDY:

US FINANCIAL CRISIS 2008

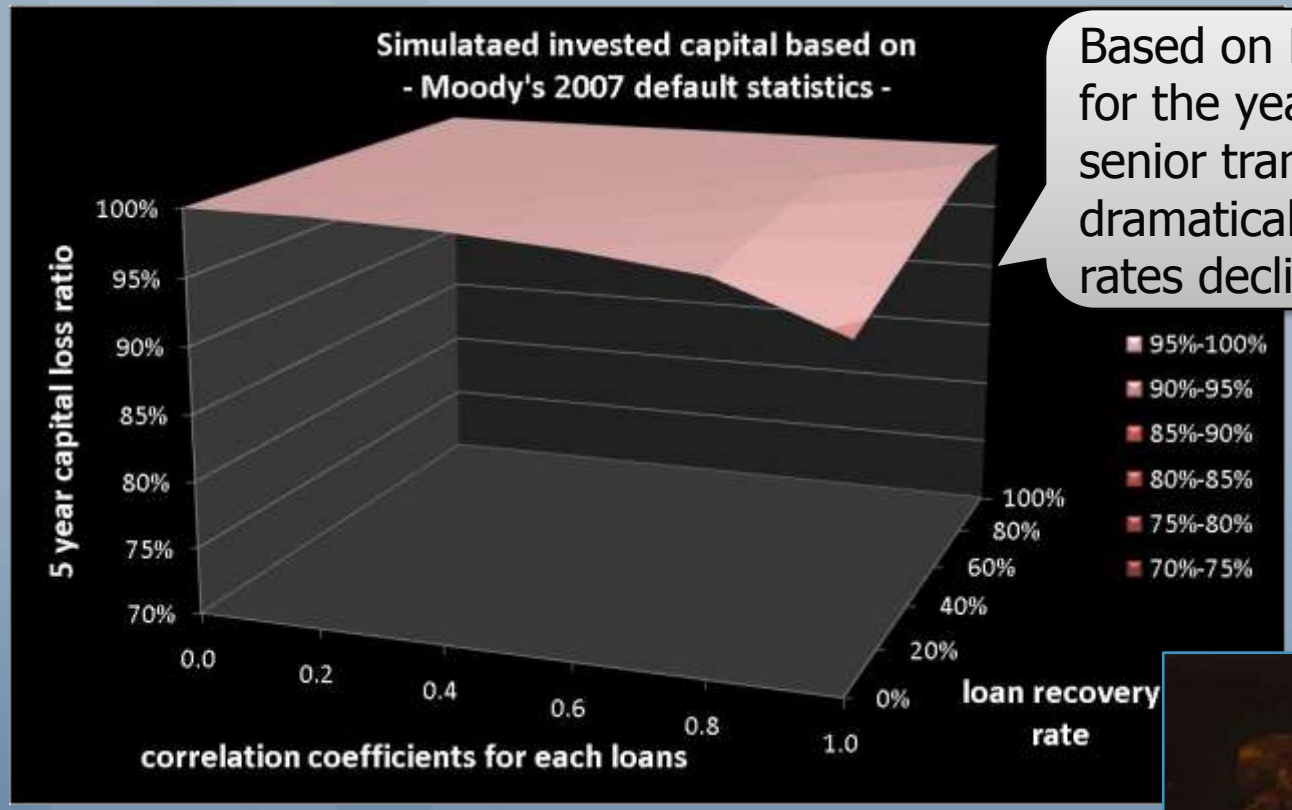
US retail mortgage securitization process



What happened in the best secured CDOs?

From the next page, we demonstrate price calculation of senior tranche CDOs based on our Monte Carlo simulator.

If things going well, everybody is happy.

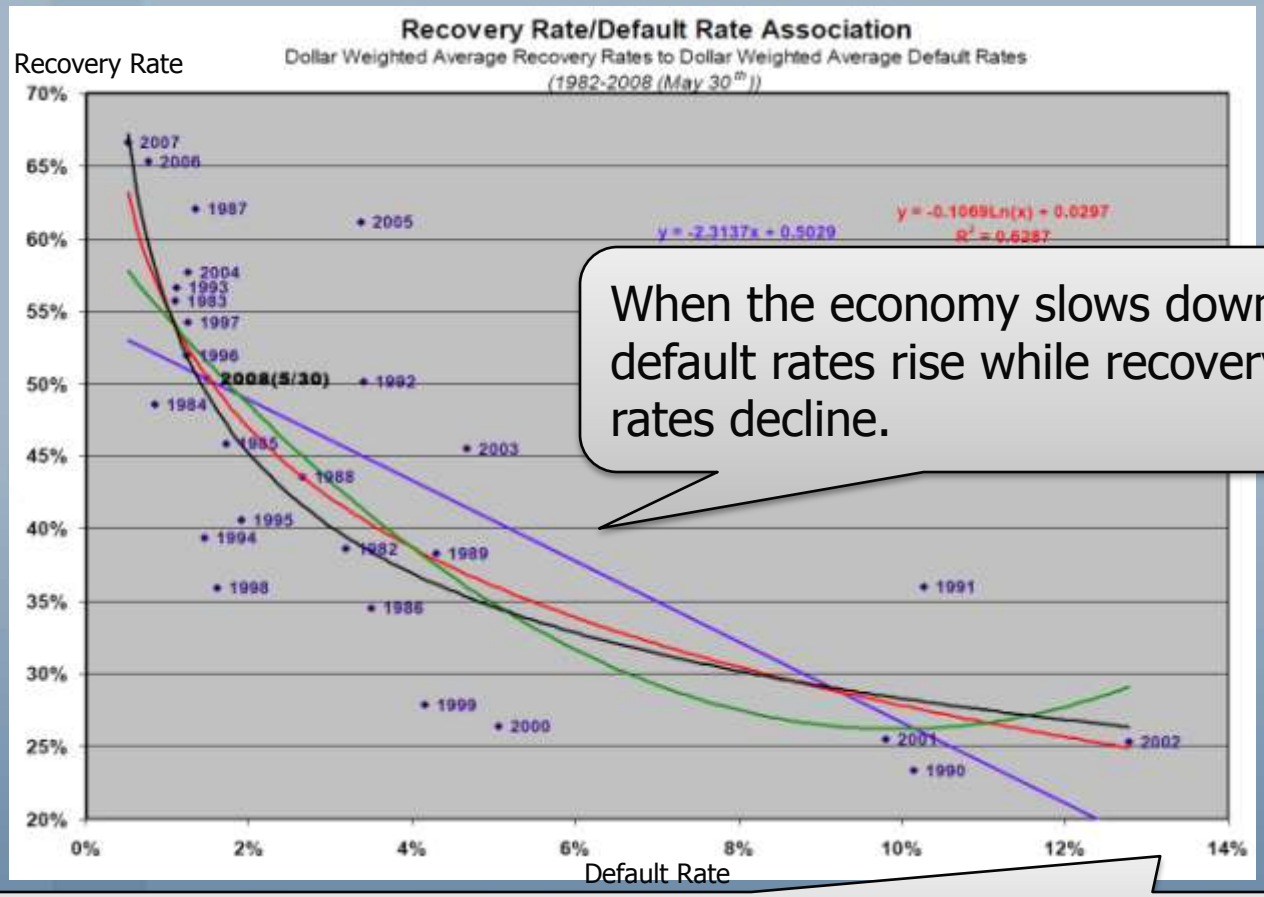


Based on Moody's default statistics for the year 2007, the price of senior tranche CDOs never falls dramatically even if loan recovery rates decline.

That means investors can enjoy higher-valued coupons, thanks to securitization.

Is this fraud?

But Wall St. does not learn from history…



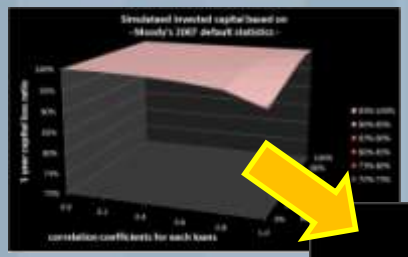
When the economy slows down, default rates rise while recovery rates decline.

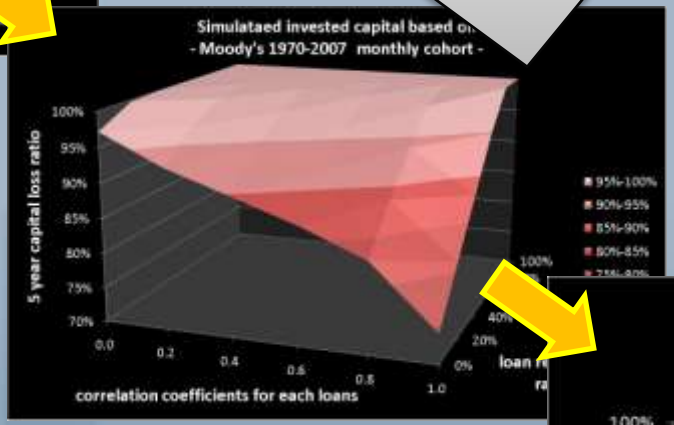
Defaults tend to happen simultaneously in a bad economy, so the correlation coefficient is higher than that in a healthy economy.

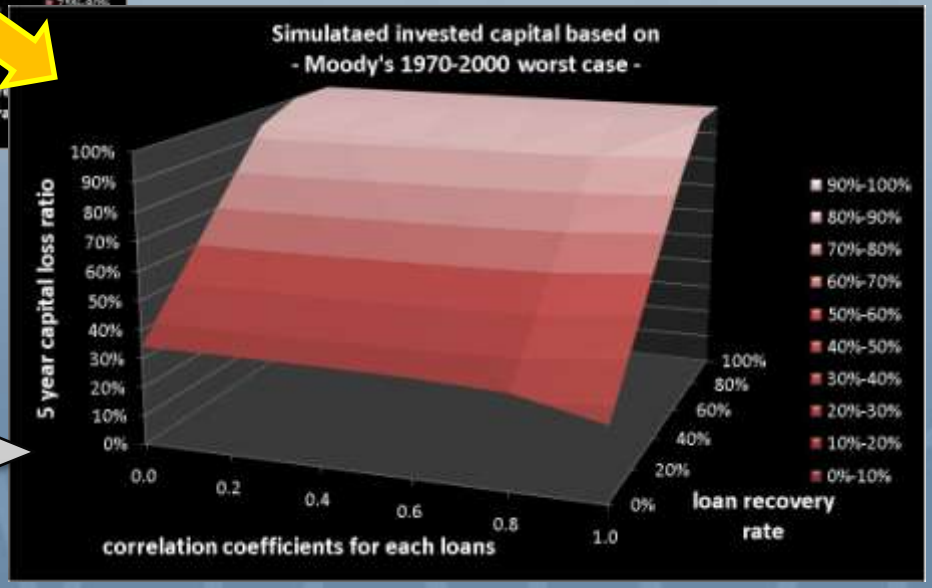
Source: E. Altman, et. al., "The Link Between Default and Recovery Rates", NYU Salomon Center, S-03-4.

Once in a blue moon? Or unavoidable destiny?

When a small percentage of loans start to getting default, capital loss surges very rapidly…







This Monte Carlo simulation is based on the worst case statistics from 1970-2000. The worse things get, the greater the loss. There is no escape.

And greedy banks' asset has been hit…

Citibank valued ABS CDOs as single name corporate bonds…

Most of these were AAA rated, and had adjustable coupons. Citibank trusted the ratings provided by the rating agencies and believed that there only carry a "waterfall" risk.

Actually, ABS CDOs are re-securitized product resting on RMBS, that were hit by upset mortgage market…

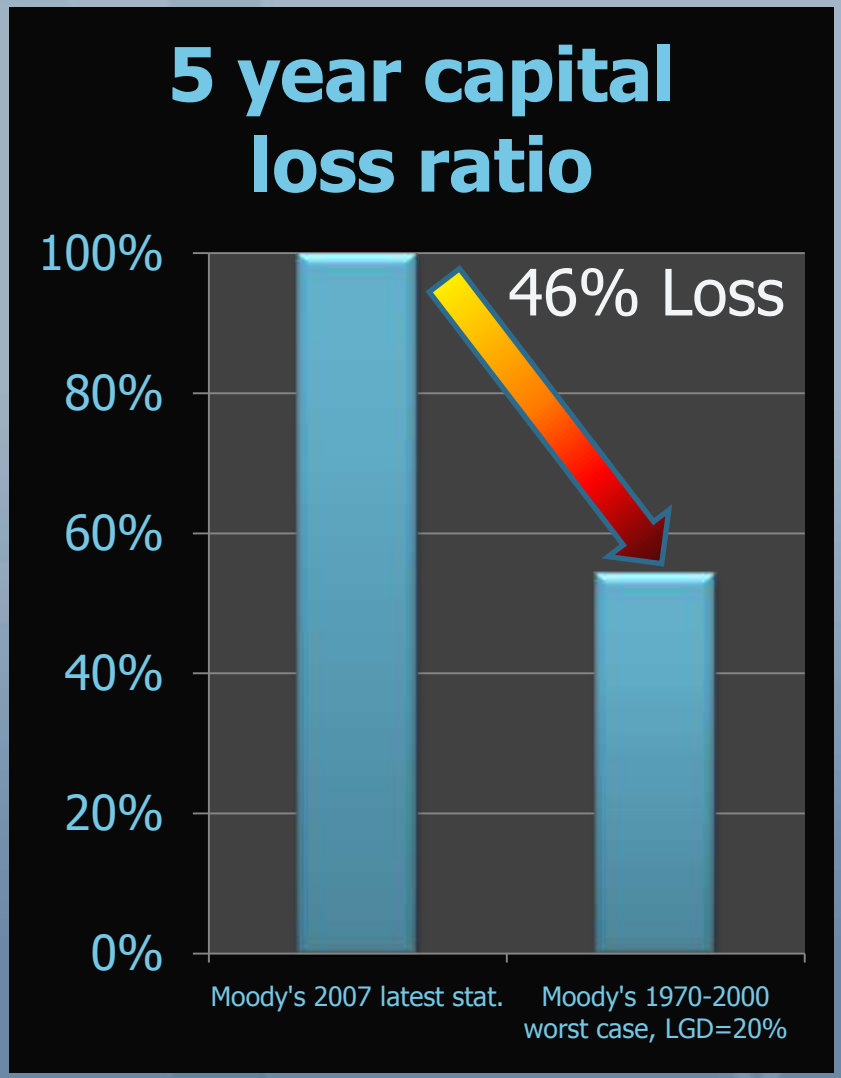
These ABS CDOs' risk profile were of the CDO^2. These had a very non-linear profit/loss, sharp inflexion, so called "cliff risk".

The next thing you know, huge losses are incurred…

After July 2007, both the probability of default and correlation coefficient increased. As Citibank's pricing model was erroneously simple, its risk management system failed.

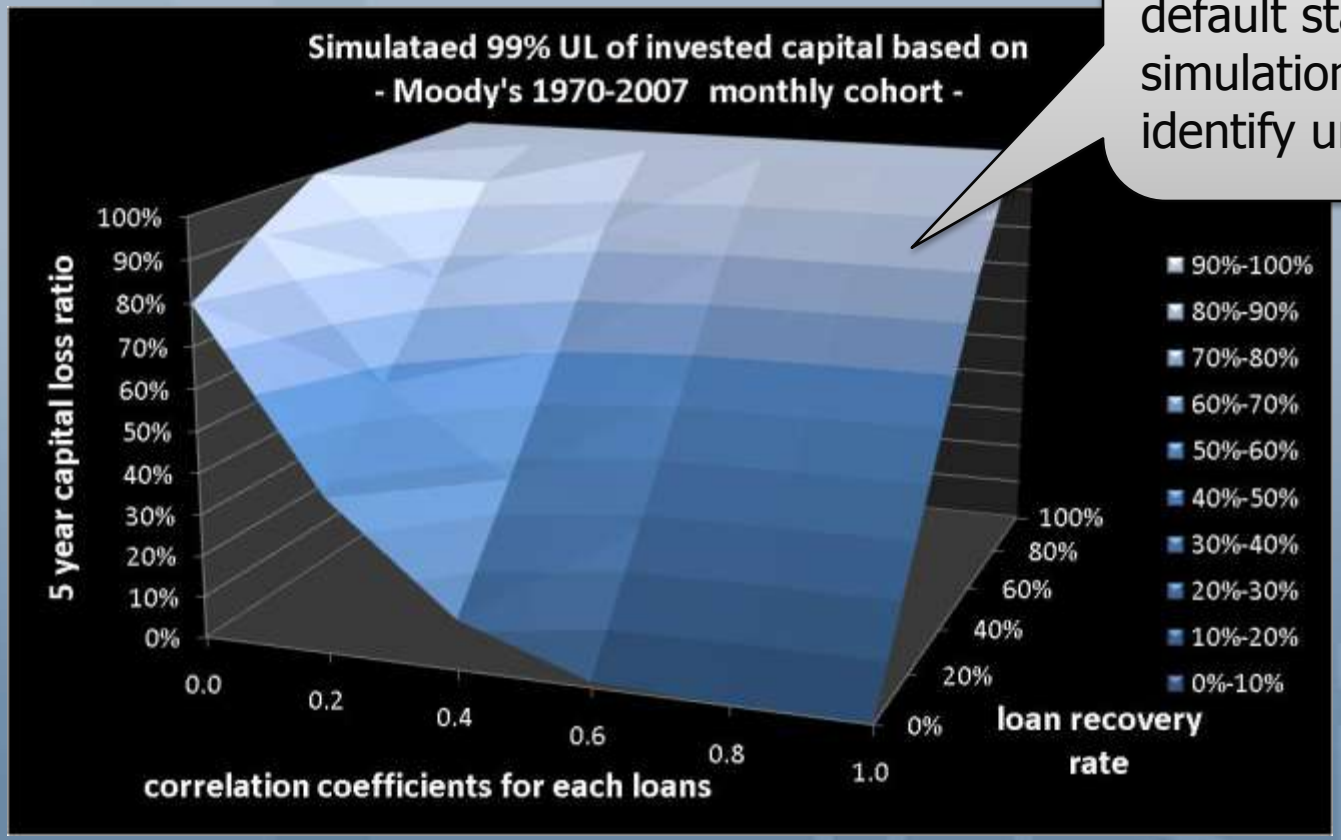
- Citibank, along with other US banks, has sustained huge losses due to its investments in ABS CDOs.
- CDO is a FAS157 level 3 category asset. Its value is hard to observe in the market.
- Banks' risk management was based on highly simplistic and incorrect model. The model simply did not work.
- Because the losses were too large to be sustained by the banks' capital, the US government decided to freeze the FAS157 accounting rule. Some US banks had required tax-payer-supported bailout.

What US tax payers should know about…



- Remember, this is the case for the best secured senior tranche CDOs. Mezzanine and Equity CDOs can be much worse: Almost zero value.
- The current US capital injection plan coincides with these capital losses in the banking industry.
- A loss is a loss, and cannot be recovered. This is the major difference between this crisis and that of Japan's in the 1990s that was triggered by the bursting of the land price. Land prices can go up, but faulty CDOs based on broken buildings cannot…
- Sooner or later, US tax payers will learn about this reality.

The right way: might be too late but prevents next crisis



Even if banks or rating agencies use overly optimistic default statistics, Monte Carlo simulation-based 99% UL can identify unwanted future risk.

Conclusion

- I don't know whether the US financial industry, rating agencies and governments will do the right thing from now or not…
- An overly simplified pricing and risk management model was one source of today's crisis.
- Correct and precise financial simulation modeling is one piece in the puzzle when it comes to preventing another financial crisis. Although an expensive technology, it is much cheaper than a bailout.
- It will save corporate America and the rest of the world.

Our vision

- We cannot create Isaac Asimov's “psychohistory”.
  - But at least we can approach Hari Selden's mathematical historical projections.
  - That will change banks’ management from “manual” to “semi-automatic”.
- The technology could reduce the probabilities of a future financial crisis.
  - It means going back to the “good old American way”. There, commercial banking is like public works: a dull, slow business. Investment banking is still wild, with higher profits and risks, but it is small enough to be allowed to go bankrupt. The government may bail out commercial banks, but never investment banks.
  - Does this mean investment banking should be no fan? No we do not think so. Yet, too much financial “innovation” can end in nothing more innovative than Ponzi schemes. Such creativity is suitable for Silicon Valley.
- It is a holy calling.
  - We would like to keep our current creative company style. At the same time, we will welcome business partners throughout the world to spread our technology.

Thank you

- Contact information:

Numerical Technologies Inc.

Address: 4-11-6, Jingumae, Shibuya-ku,
Tokyo, JAPAN postal-code 150-0001
Phone: +81-(0)3-5770-3711
Fax: +81-(0)3-5770-3712
E-Mail: hills@numtech.co.jp
http://www.numtech.com/