

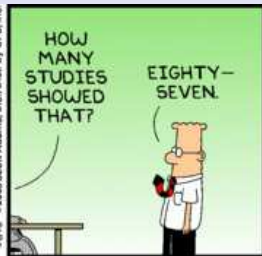
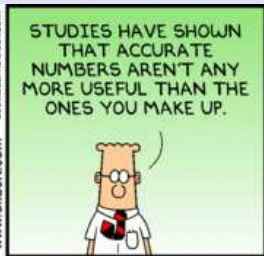
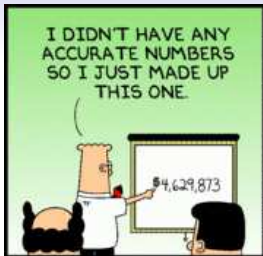
Model Risk of Systemic Risk Models

Dealing With Systemic Risk When We Measure Systemic Risk Badly

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<http://www.RiskResearch.org>



Bank failures and the financial system

- Bank failure probabilities are dependent
- The social cost of a failure increases with the failure probabilities of *other banks*, so...
- A banks socially optimal level of capital depends upon both its shock distribution and the state of the financial system

Some popular sysrisk models

- CoVaR — Adrian & Brunnermeier
- SES — Acharya, Pederson, Philippon & Richardson
- Shapley — Tarashev, N., C. Borio and K. Tsatsaronis
- Banking stability measures — Segoviano & Goodhart

All start with daily 99% or 95% value-at-risk (VaR)

Model

- R_i is risky outcomes of institution i
- R_S is outcomes from the entire financial system
- Joint distribution is:

$$f(R_i, R_S)$$

- VaR, (where Q is a quantile)

$$\text{pr}[R_i \leq Q] = p$$

Common measures

Marginal risk measure	Condition on system	Condition on institution
	MVaR	<i>CoVaR</i>
VaR	$\text{pr}[R_i \leq Q_i R_S \leq Q_S] = p$	$\text{pr}[R_S \leq Q_S R_i \leq Q_i] = p$
	<i>MES</i>	CoES
ES	$E[R_i R_S \leq Q_S]$	$E[R_S R_i \leq Q_i]$

- Other measures like Shapley fit into this
- All depend on daily VaR

Data

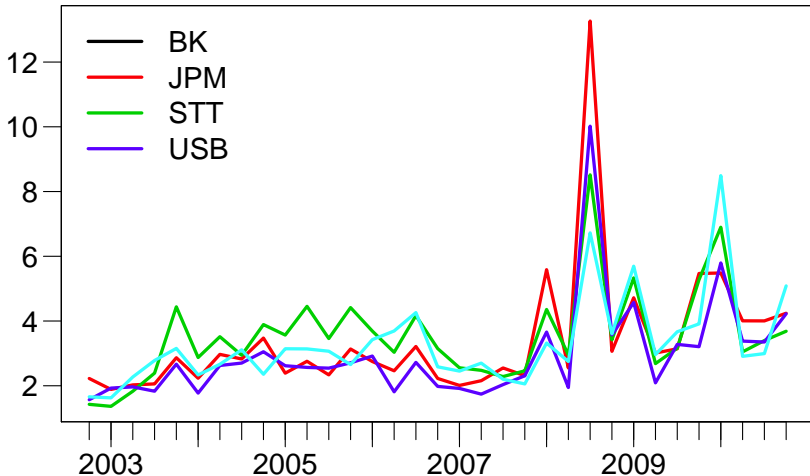
- Daily total returns January 1997–December 2010 (+ some state variables for CoVaR)
- 92 largest US financial institutions
- Here four representative stocks: Bank of New York Mellon (BK), JP Morgan Chase & Co. (JPM), State Street (STT) and US Bancorp (USB)
- Full results and all code for estimation can (will) be found in the Webappendix, www.RiskResearch.org/sysrisk

VaR

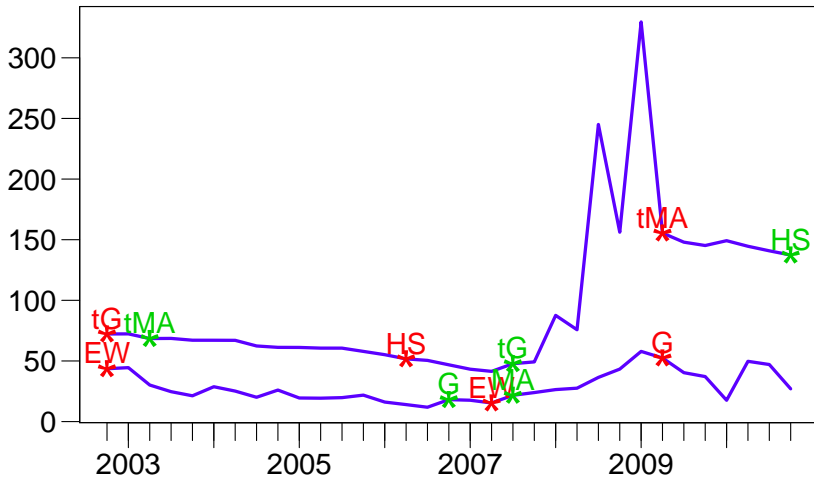
- Forecast 99% VaR with the most widely used state-of-the-art methods
 - HS, MW, student-t MW, EWMA, GARCH and student-t GARCH
 - Range of estimation windows (500, 1000, 1500)
 - \$1000 portfolio

Ratio of highest to lowest daily 1% VaR

End of quarter results. Probability is 1%



JP Morgan highest and lowest VaR

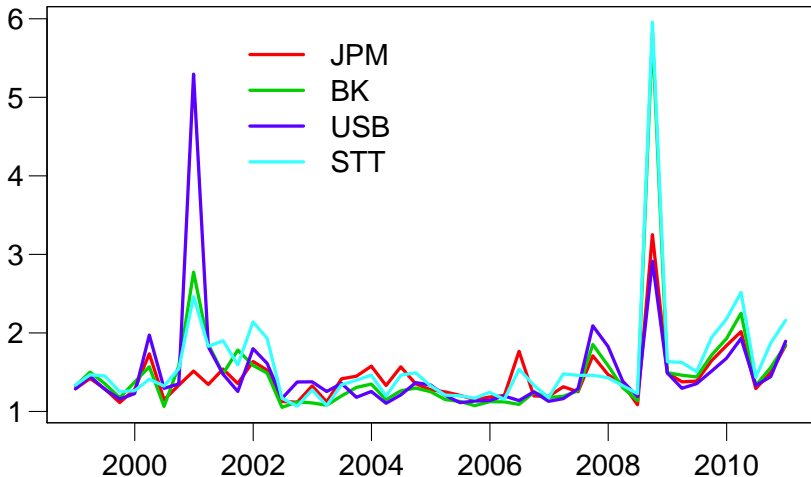


MES

- Expected return on bank given system is in a crisis (well having the worst day of the month)
- 5% daily probability
- $E[R_i | R_S \leq Q_S]$

MES model risk

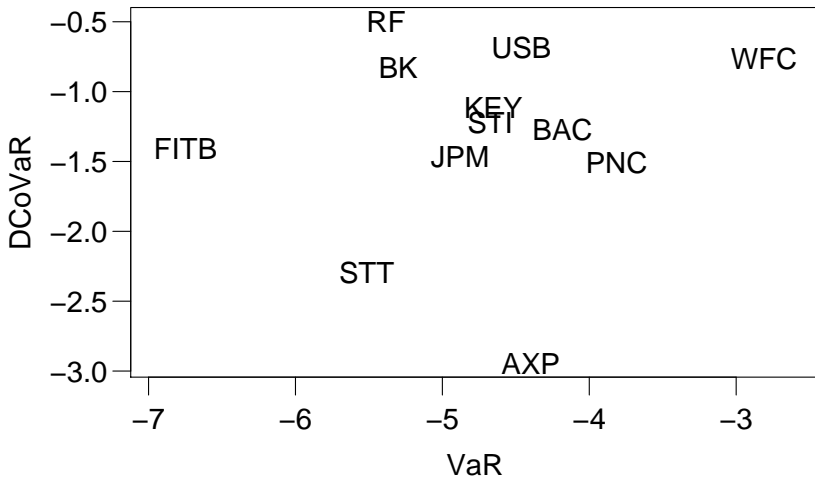
Ratio of maximum and minimum daily 5% MES



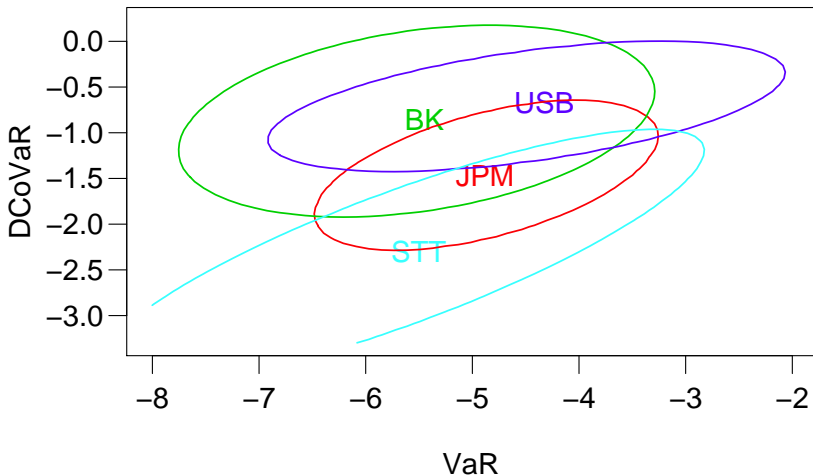
CoVaR and ΔCoVaR

- VaR for system given institution is in crisis
- $\text{pr}[R_S \leq Q_S | R_i \leq Q_i] = p$
- They prefer ΔCoVaR
- $\Delta\text{CoVaR}_{t,i} = \text{CoVaR}_t^{R_i = \text{VaR}_i^p} - \text{CoVaR}_t^{R_i = \text{VaR}_i^{50\%}}$

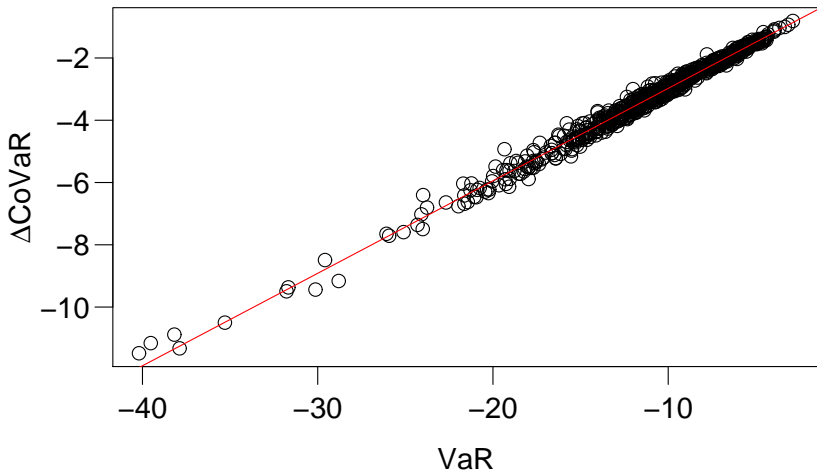
VaR and ΔCoVaR in Q4 2006



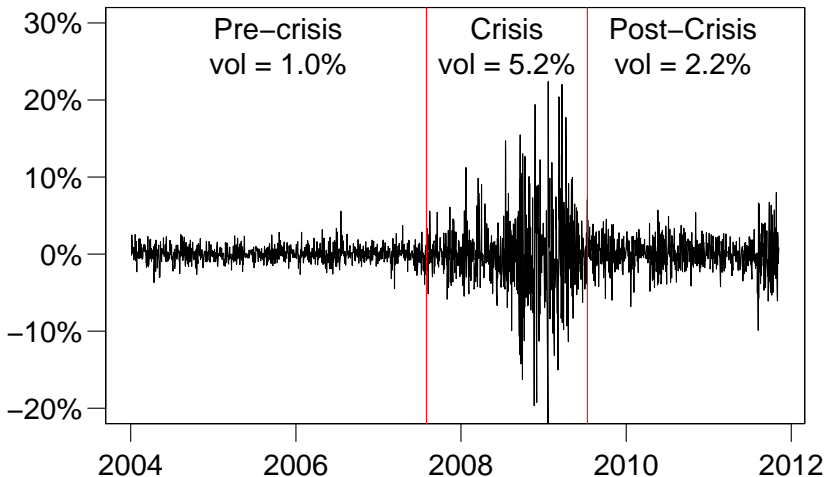
99% confidence intervals



Time Series VaR vs ΔCoVaR , JPM



Usefulness of pre-crisis data: JPM



Quality control for systemic risk measures (SRMs)

1. Point forecasts are not sufficient: need confidence intervals incorporating both estimation risk and model risk
2. Data should be predictive and not reactive
3. Statistical method needs to include backtesting
4. Event probabilities need to correspond with the probability of actual market turmoil
 - If such events happen once every 10 years, 99% probabilities (2.5 times a year) are of little relevance

Is a bad SRM better than none?

- Current SRMs are quite bad, perhaps indistinguishable from random noise or at best weakly better in prediction
- SRMs to be used for policy purposes
- High cost of using an incorrect method
- A bad SRM should not be acceptable for policy purposes, it should be of a proven quality
- Avoid the fallacy of requiring a number for decision-making regardless of the number quality