



## Discussion on “VaR and Stress Tests: The Impact of Fat-Tail Risk and Systemic Risk on the Safety and Financial Institutions?” By Jacky So (University of Macau)

**Eric Wong**

**Research Department  
Hong Kong Monetary Authority**

**4 August 2016**



- This paper proposes a method to estimate market-based systemic risks (SRISK) of financial institutions (similar to Acharya et al., 2010; Adrian and Brunnermeier, 2016).
- Specifically, a new numerical method based on the Fourier-cosine expansion to compute SRISK and other risk metrics with flexible distributional assumptions, addressing fat-tail and backward-looking problems of currently available estimates.
- This method attempts to provide more accurate risk and capital estimates for regulators and banks.
- Mostly related to the literature of identification of SIFIs and tax on systemic risk.



- Acharya et al. (2010, 2012) ask questions: (1) how to measure each FI's contribution to systemic risk should crisis occur and (2) what an optimal tax scheme is?
- Using a simple general equilibrium model, Acharya et al. (2010) shows that
  - An optimal tax on systemic risk  $\propto \text{SRISK}_{i,t} = E_{t-1}$  (capital shortfall | crisis)
- Assuming
  - Regulators impose a minimum market value of equity/assets  $k$  (e.g. 8%);
  - Current market value of equity to assets,  $\text{LVG}_{i,t}, E_{i,t}/(E_{i,t}+D_{i,t})$ ; and
  - the LR expected loss of equity of an FI given that a crisis occurs,  $\text{LRMES}_{i,t}$
  - $\text{LRMES}_{i,t} = f(\text{crisis frequency, } p/(t_N - t); \text{ expected equity loss in a crisis, } \text{MES}_{i,t})$
- Then,  **$\text{SRISK}_{i,t} = k(D_{i,t}) - (1-k)(1-\text{LRMES}_{i,t})E_{i,t}$**
- $\text{SRISK}_{i,t}$  is the expected amount of capital needed to restore the bank's  $\text{LVG}_{i,tN}$  to  $k$  given  $\text{LRMES}_{i,t}$  and  $\text{LVG}_{i,t}$
- $\text{SRISK}_{i,t}$  satisfies the additive property.



## 1. MES in Acharya et al. (2010):

We estimate *MES* at a standard risk level of  $\alpha=5\%$  using daily data of equity returns from CRSP. This means that we take the 5% worst days for the market returns ( $R$ ) in any given year, and we then compute the average return on any given firm ( $R^b$ ) for these days:

$$MES_{5\%}^b = \frac{1}{\# \text{days}} \sum_{t: \text{system is in its 5\% tail}} R_t^b \quad (16)$$

## 2. A new numerical method to approximate MES:

- Incorporating possible heteroskedasticity and asymmetric returns
- With flexible distributional assumptions: Stable, sstable, nstable, normal, GED and student-t

## 3. LRMES estimated using the model is shown to be the upper bound estimate – a more prudent estimate of SRISK



1. Instead of using SRISK, the paper proposes the Tail Risk Tolerance (TRT):

$$\rho_{i,t} = \frac{\ln(\frac{1-k}{k*LVG})}{(t_N - t)MES}$$

2. The maximum frequency of crisis that bank  $i$  does not require to raise capital (i.e.  $SRISK=0$ ) to satisfy the regulatory requirement  $LVG \geq k$  in a period  $t_N - t$  given  $MES$
3. A simple rule is proposed to determine unhealthy banks: if  $\rho_{i,t} < \rho$  where  $\rho$  is the expected frequency of crisis
4. In Table 7, TRTs of 10 largest US banks computed using data between Jun2007 and Jun2008 under stable distributional assumptions are found to have perfect predictive power on their capital adequacy between 30Jun2008 and 31Sep2008 (i.e.  $LVG > 8\%$ ).
5. Significant predictive power is also shown for the aggregate TRT (figure 4) and for individual US banks (figures 5-7)



- An alternative method to estimate MES, and thus SRISK without using the MC simulation
- Addressed issues related to distributional assumptions generally and fat-tail in particular
- A potential early warning system

## On identification of SIFIs:

- A horserace with other risk measures would be useful to test the robustness:
  - MES (Acharya et al., 2010); SRISK (Acharya et al., 2012); DIP (Huang et al., 2009); CoVaR (Adrian and Brunnermeier, 2016); SRISK with MES (So and U, 2016); TRT, market model  $\beta$ , VaR,...
  - Comparing the predictive power on realised equity/ CDS/ LVG movements during crises, BCBS's SIFIs, results of stress tests by central banks
  - E.g., Acharya and Steffen (2012), "Analyzing Systemic Risk of the European Banking Sector"



## On systemic risk tax for SIFIs:

- How TRT is compared to SRISK in revealing marginal contributions of an FI to systemic risk?
- Conceptually, SRISK seems to be a better measure as ultimately regulators may be more interested to know how much capital is needed for a bank than a probability.

More broadly, however, researchers may need to improve further the practicality of market-based systemic risk measures. In particular, future research should deal with different views between bank regulators and researchers on

- Bank capital requirement (i.e. market value of capital vs regulatory capital)
- How to reveal systemic risk: regulators rely stress testing exercises by analysing individual banks' balance sheets under a specified stress macro scenario, while market-based measures implicitly assume that equity prices reflect potential vulnerabilities.