

Discussion of
**“Capital Shortfall:
A New Approach to Ranking and
Regulating Systemic Risks”**
By Viral Acharya, Robert Engle, and
Matthew Richardson

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Conference on Capital Requirements for Financial Firms



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Overview of Paper

- The authors present rankings for systemic risk of global financial institutions
- Systemic risk is defined in terms of the contribution to the *total capital shortfall* of the financial system conditional on another crisis

Overview of Paper

- Tools for constructing the rankings from
 - Acharya, Pedersen, Philippon, and Richardson (2010)
 - Theoretical model relating capital shortfalls of individual institutions to system-wide failure
 - MES: Marginal Expected Shortfall
 - Brownlees and Engle (2011)
 - Econometric methodology for dynamic time series estimation of MES
 - SRISK: Systemic risk measure

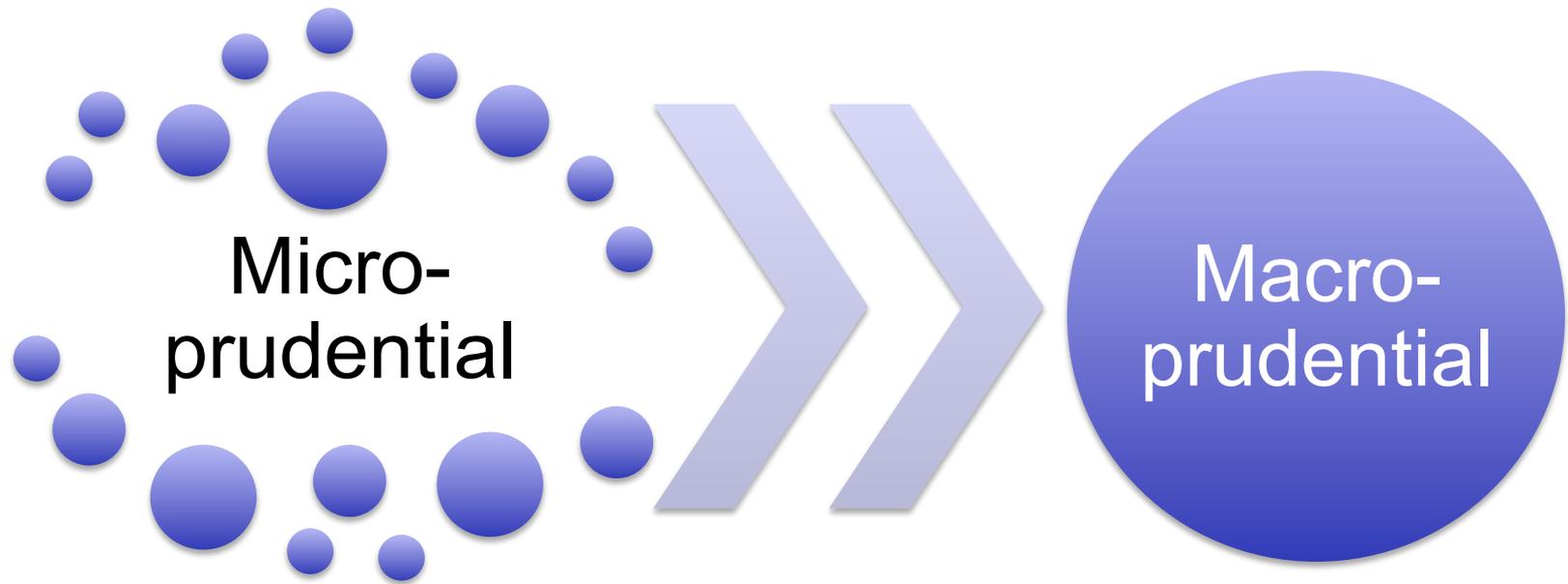


My Discussion

- Perspectives on the state of financial regulation
 - Where MES and SRISK fit
- Review of model and intuition behind it
 - How to go from individual institution's capital shortfall to systemic impact
- Comparison with alternative methods
 - *A Structural Approach*
- Possible extensions
- Concluding Remarks



Financial Regulation



From Micro-Prudential to Macro-Prudential

- Difficult for financial institutions to intermediate when capital falls short
- Failure of a given institution may have a significant impact on real economy
- Less focus on single institution's failure but on its contribution to “system-wide failure”



Quantifying Systemic Risk

- We need an integrated approach that captures the risk of system-wide failure without ignoring the role of individual institutions
- The methods in this paper take this approach
 - Driving factor is system-wide capital shortfall
 - Aggregate capital falls below some level
 - Individual firm's contribution
 - Conditioned on “crisis”

The Risk Measures

- MES: Expected equity loss when market falls below a certain threshold over a given horizon
 - SRMES: 2% market drop over 1 day
 - LRMES: 40% market drop over 6 months
- SRISK: Expected capital shortfall of an institution conditional on “crisis”
 - Defined in terms of LRMES
 - ★ *FI's with the largest capital shortfall will contribute the most to a crisis and therefore should be considered the most systemically risky*
 - Capital shortfall accounts for size, leverage, interconnectedness
- SRISK%: Captures the institution's contribution to aggregate undercapitalization of financial system

Theoretical Model (1)

- Developed in Acharya, Pedersen, Philippon, and Richardson (2010)
 - Simplified version presented in Brownlees and Engle (2011) [Section 2]
 - Two-period model
 - N financial institutions

F_i = Face value of risky debt

G_i = Guaranteed debt

W_i = Capital (i.e. equity)

Invest in J assets with exposure: $\langle X_{i1}, X_{i2}, \dots, X_{iJ} \rangle$

In period 1 risky debt trades at a discount = $B_1 < 1$

The gross return on the j^{th} asset is $R_j : X_{ij} \rightarrow X_{ij}R_j$

Theoretical Model (2)

- In period 1, the “budget constraint” (aka FI’s balance sheet identity) is:

$$W_{i1} + F_{i1}B_1 + G_{i1} = \sum_{j=1}^J X_{ij}$$

- Choose leverage and asset mix to maximize expected period 2 equity value, subject to budget constraint and cost of distress.
- In period 2 the net worth is:

$$W_{i2} = \sum_{j=1}^J X_{ij}R_j - G_{i1} - F_{i1} - \phi$$

Theoretical Model (3)

- **Capital Shortfall**

- Assume there is a prudent capital ratio k

- The FI experiences a *capital shortfall* if

$$k(F_{i1}B_1 + G_{i1} + W_{i1}) - W_{i1} > 0$$

$$\Rightarrow k(F_{i1}B_1 + G_{i1} + W_{i1}) > W_{i1}$$

$$\Rightarrow k > \frac{W_{i1}}{(F_{i1}B_1 + G_{i1} + W_{i1})}$$

$$\Rightarrow k > \frac{W_{i1}}{\sum_{j=1}^J X_{ij}}$$

- i.e. capital as a percentage of assets is below what is deemed “prudent”

Theoretical Model (4)

- **Capital Shortfall → SRISK**

- Within this framework, we can look at the expected capital shortfall conditional on a “crisis”
 - Crisis is defined as market index falling below a given level

$$\begin{aligned}
 SRISK_i &= E_{t=1} \left[k(F_{i1} + G_{i1} + W_{i2}) - W_{i2} \mid M_2 < I^* \right] \\
 &= k(F_{i1} + G_{i1}) + E_{t=1} [kW_{i2} - W_{i2} \mid M_2 < I^*] \\
 &= k(F_{i1} + G_{i1}) - E_{t=1} [(1-k)W_{i2} \mid M_2 < I^*] \\
 &= k(F_{i1} + G_{i1}) - (1-k)E_{t=1} [W_{i2} \mid M_2 < I^*] \\
 &= k(F_{i1} + G_{i1}) - (1-k)E_{t=1} [W_{i1}R_{i2} \mid M_2 < I^*] \\
 &= k(F_{i1} + G_{i1}) - (1-k)W_{i1}E_{t=1} [R_{i2} \mid M_2 < I^*] \\
 &= k(F_{i1} + G_{i1}) - (1-k)W_{i1}E_{t=1} [1 + r_{i2} \mid r_{m2} < \xi] \\
 &= k(Debt) - (1-k)Equity(1 - LRMES)
 \end{aligned}$$

Theoretical Model (5)

- Capital Shortfall → SRISK → SRISK%
 - FI's with very large capital shortfalls are more likely to pose a threat to the financial system
 - Therefore they have higher SRISK measures
 - Can look at the relative contribution to the system-wide undercapitalization:

$$SRISK\%_{i,t} = \frac{SRISK_{i,t}}{\sum SRISK_+}$$



Alternative Methods

- CoVaR
 - 2011 NBER Working Paper already has 337 cites (and counting) on Google Scholar
 - Measures the impact that a financial institution has on the entire system when that institution is in its left tail, accounting for correlation with the market

Comparison

MES	CoVaR
Function of correlation with market and the institution's volatility	Function of the correlation with the market and the market volatility (does not account for the individual institution's volatility)
Accounts for size and leverage	Does not explicitly incorporate leverage or size

A Structural Approach

- Contingent-claims model for estimating capital shortfall
 - Structural Credit Risk Models
- Links risk to both sides of the balance sheet in a consistent, comprehensive way
- Provides a lot of insight
 - Comparative statics, etc.

Structural Models

- Contingent claims approach pioneered by Black and Scholes (1973) and Merton (1974)
- Extensions
 - not exhaustive by any means

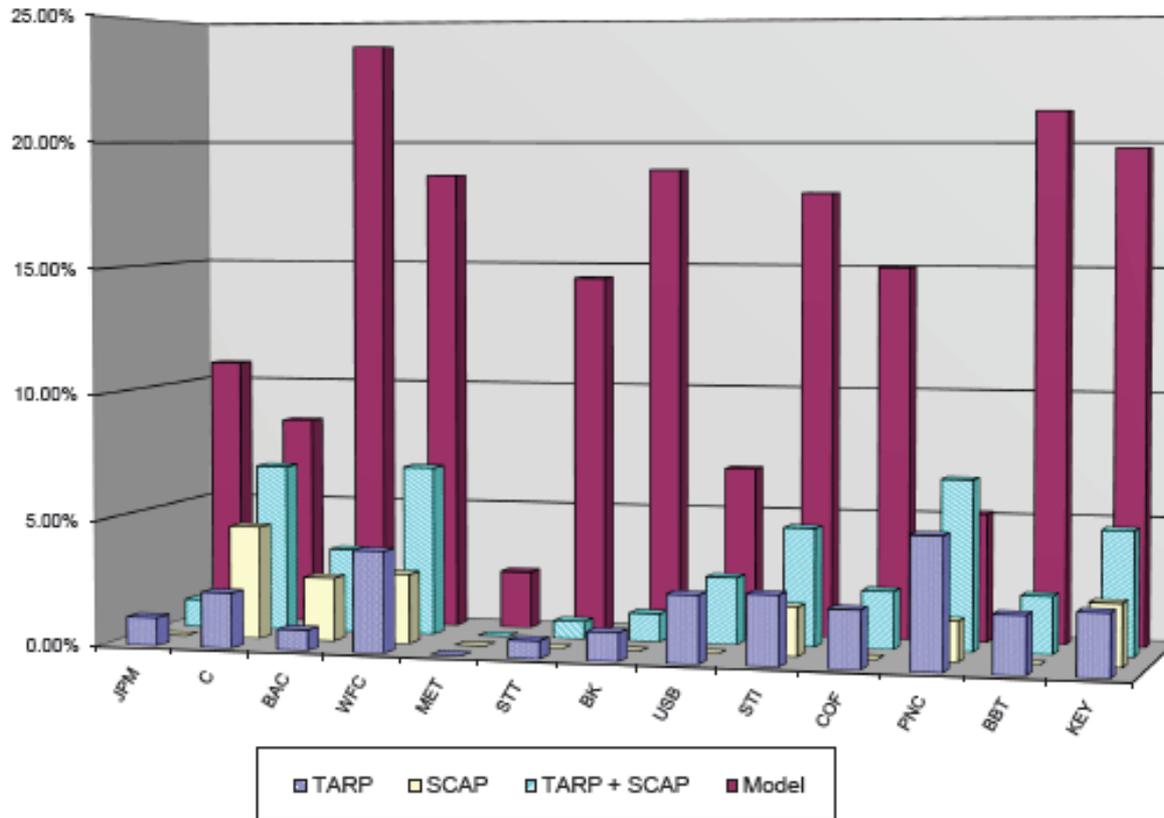
Model	Default	Recovery	Interest Rates
Black and Cox (1976)	Exogenous * Exponential barrier	Fixed fraction of PV(F)	Deterministic
Longstaff and Schwartz (1995)	Exogenous * Flat barrier	Allows for violations of APR	Stochastic
Collin-Dufresne and Goldstein (2001)	Exogenous * Mean-reverting barrier (stationary leverage)	Same as LS	Stochastic
Geske	Endogenous * Function of liabilities	Asset value at default	Deterministic
Leland and Toft (1996)	Endogenous * Flat barrier	Fixed proportion of asset value	Deterministic
Acharya and Carpenter (2002)	Endogenous * Barrier increasing in asset value	Asset value at default	Stochastic

An Example

- *From Imerman (2011)*

» Available on SSRN:

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2031763



Results Qualitatively Similar

	Rank Based on SRISK	Rank Based on Structural Model
JP Morgan Chase	1	2
Citigroup	2	3
Bank Of America	3	1
Wachovia Bank	8	*4
MetLife	9	14
State Street	12	8
Bank Of New York Mellon Corp	16	6
Regions Financial	17	5
Suntrust Banks	18	9
Fifth Third Bancorp	19	7
Keycorp	22	12
BB&T Corporation	23	10
Wells Fargo	24	*4
Capital One Financial	28	11
PNC Financial Services	51	15
US Bancorp	73	13



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Possible Extension (1)

- Merton-type model for banks, where assets and market are joint lognormal
 - Rubinstein (1976) solved a model like this for options
- Can look at how much equity value would be lost if market were to fall some given amount
 - Like MES
- Can then quantify impact on default probability
- Solve for how much capital would be needed to bring default probabilities back down
 - Ex-ante or ex-post

Possible Extension (2)

- Other comparative statics that might be useful in a stress test (ex-ante) capacity:
 - Sensitivity to firm volatility
 - Like option vega
 - Sensitivity to market volatility
 - Sensitivity to leverage
 - Sensitivity to interest rates
 - Like option rho
- Systemic risk analysis
 - Comparative statics with respect to market factor

Concluding Remarks

- Macro-prudential regulatory tools with solid micro foundation
- Does not look at role of debt maturity
 - Widely accepted that reliance on short-term, less stable funding sources put added strain on institutions and the financial system as a whole during the recent crisis
- Would like to see some comparative statics