Regulating Systemic Risk

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I. Summary

We argue that financial regulation be focused on limiting systemic risk, that is, the risk of a crisis in the financial sector and its spillover to the economy at large. To this end, we provide a simple and intuitive way to measure systemic risk in the financial sector and suggest novel regulations to limit it.

Current financial regulations seek to limit each institution’s risk. Unless the external costs of systemic risk are internalized by each financial institution, the institution will have the incentive to take risks that are borne by all. In other words, each individual firm may take actions to prevent their own collapse but not necessarily the collapse of the system. It is in this sense that the financial institution’s risk is a negative externality on the system. An illustration of the current crisis is that financial institutions took bets on securities and portfolios of loans which faced almost no idiosyncratic risk, but large amounts of systematic risk.

Our approach to regulating systemic risk is twofold:

- The regulator would assess the contribution of each firm to the downside aggregate risk of the economy. The firm’s individual contribution to aggregate risk would then determine the extent of regulatory constraints, which can be implemented as ex ante capital requirements and required contributions to capital insurance.

- Each firm would be required to buy insurance against its own losses in a scenario in which the whole financial sector or economy are doing poorly. In the event of a payoff on the insurance, the payment should not go to the firm itself, but to the regulator in charge of stabilizing the financial sector. This would provide incentives for a company to limit systemic risk (to lower its insurance premium), provide a market-based estimate of the risk (the cost of insurance) and avoid moral hazard (because the firm does not get the insurance payoff).

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2 An analogy can be made to an industrial company who produces emissions that might lower its costs but pollutes the environment.
II. Measuring Systemic Risk

(i) Intuition:

Suppose that the economy incurs a systemic cost (a negative externality of the financial sector) whenever there is a "crisis", measured as the return to the financial sector being sufficiently bad, say in the 5% left tail of the market return distribution. Suppose further that the cost is proportional to the extent of loss incurred below the 5% cutoff. Then the contribution of each individual financial institution to this cost is proportional to its size and to the percentage loss or negative return it suffers when the market is in its left 5% tail. The "tax" to be imposed on each institution should thus be the average of this contribution, or in other words, its Marginal Expected Shortfall (MES) multiplied by its (dollar) weight in the economy. To summarize, MES of a financial institution can be interpreted as the per dollar systemic risk contribution of that institution.

(ii) Marginal Expected Shortfall (MES)

The idea behind MES is that one calculates the losses experienced by each firm when aggregate losses are large. The MES is the contribution of each firm to the aggregate losses.
III. Quantifying Systemic Risk

For the example to follow, we calculate the losses of the market value of equity of financial firms in the prior year’s 5% worst-case periods of aggregate stock market losses (measured on a daily basis). We focus on financial firms with at least $5 billion in market capitalization (as of June 2007), leaving us with 102 financial firms.

We explore three periods:

- A pre-event period for systemic risk measurement (June 2006 – June 2007)
- An event period to explain realized performance (July 2007 – December 2008)
- An historical period from 1963 to 2008

Some general conclusions (not shown here but available in the working paper) are:

a. Systemic measures like MES and Beta outperform institutional risk measures like expected shortfall (ES).

b. In a horse race, MES contains more relevant information than Beta.

c. The MES measures seem to have predictive power up to 3-4 months lead time.
A. June 2007

This figure depicts the dollar valued marginal expected shortfall, MES5, for the 20 companies with the largest dollar values. MES5 is the average return of an individual stock conditioned on the market return being below the 5th-percentile as determined by the distribution of market returns. MES5 was computed using the pre-crisis period June 2006 till June 2007. To obtain an estimate in dollar values the measure was multiplied by the size of the firm determined by the market cap as of end of June 2007.
Scatterplot of the marginal expected shortfall measure, MES5, against the return during the crisis. The sample consists of the 102 companies selected based on their inclusion in the U.S. financial sector and their market cap as of end of June 2007.
### B. June 07 Rankings of MES

- Top 4 out of 10 firms ranked by MES pre-crisis have effectively failed (Bear, Lehman, ML, CIT), two received government support (GS, MS), others interesting (eTrade, CBRE, Charles Schwab, Ameritrade)
- On a dollar basis for MES or insurance costs, Citigroup and JPMorgan also enter top 10.

<table>
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<tr>
<th>MES (per share &amp; $)</th>
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<th>MES (%)</th>
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<td>EATON VANCE CORP</td>
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C. Historical Perspective

The graph depicts for each year from 1963 until 2008 the market-cap weighted Marginal ES(5%) for each of the four categories conditioned on above 22 days of trading within a year.

The graph depicts for each year from 1963 until 2008 the equally weighted Marginal ES(5%) for each of the four categories conditioned on above 22 days of trading within a year.
IV. Uses of Systemic Risk

A. Some Specific Uses

- Capital Requirement

Capital requirements could be set as a function of a financial firm's MES, in particular, the systemic capital charge (SCC) could be written as:

\[ SCC = S \times MES\% \times A \]

where \( S \) would be the systemic factor chosen by the regulator to achieve a given degree of aggregate safety and soundness, \( MES\% \) is the marginal expected shortfall expressed in percent of assets, and \( A \) would be the assets of the firm.\(^3\) This gives the right incentives to firms to limit their holding on aggregate risk since keeping capital reserves is costly and, additionally, it gives the firm an appropriate safety buffer in systemic crises.

- Forced Conversion of Debt

Financial institutions have incentives to take excessive risks as long as there is a lack of market discipline, that is, as long as distressed risk is not borne by the creditors. This is because of government guarantees – deposit insurance and too-big-to-fail -, as well as a zero price for systemic risk. One way to avoid the ex post problem of dealing with failed institutions during the crisis is to require financial firms to issue some amount of debt that automatically gets converted into equity during a crisis.

The amount of this debt should be directly tied to the MES of the firm, that is, to the amount of systemic risk the firm imposes on the system. Because the holders of these securities receive no government guarantees, the investors will impose market costs on the firm. Presumably, the more the firm has to issue this type of debt, the greater the costs.

- Insurance Charge

As mentioned above, the systemic risk of financial institutions is a “pollutant”, imposing a negative externality on financial markets. One efficient solution to handle a negative externality is to tax it. This provides financial firms with incentives to organically limit their systemic risk and it also contributes “taxes” to a systemic fund.

The next page describes an example of how it would work.

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\(^3\) Note that \( S \) could be chosen in such a way as to be counter cyclical, in other words, higher in boom times than current periods. The primary function of the \( MES\% \) is to separate more systemic institutions from the field.
B. Insurance Charges

Steps

- Each financial institution would be required to take out insurance against its own losses during a general crisis (i.e., against its MES). The price of this insurance would be set by the private insurance industry.
- If losses take place, the payment does not go to the financial institution, but to a systemic fund. Thus, the insurance acts like a tax.
- The pricing of the insurance is a multivariate put option on the firm’s losses conditional on the aggregate market falling.
- One of the issues is that there may not be enough capital available in the private insurance industry to cover the potential losses from a systemic event (as with the monolines and A.I.G.). Thus, we advocate that the majority of the insurance (say 90%) is offered by the government. The insurance fees would be paid to the government, and the government would provide self-insurance. There is already a successful program that does something similar, namely the Terrorism Risk Insurance Act of 2002.

On the next page, we provide a table of the ranking of estimated insurance charges for financial institutions during the 2004-2007 period. In practice, the insurance (i) should have a maturity that covers business cycles (say five years), (ii) should be purchased on a rolling, quarterly basis to prevent gaming of the insurance (e.g., $1/20^{th}$ of the total amount purchased each quarter), and (iii) should be bought only from well-capitalized institutions (even given the public-private insurance scheme).

For the estimated costs below, we have assumed multivariate normality for pricing the multivariate put option. This represents a large underestimate of the true cost, yet perhaps not the relative costs across firms. Equity returns have fat tails and tend to be more highly correlated in severe down states, both of which contribute to higher option prices. The benefit of a private-public insurance scheme in which the insurance would be priced by the market would allow fat tails and high correlation to be priced directly into the option. Even without this market pricing, however, the estimated costs from theoretical option pricing allow the regulator

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4 We treat the liabilities of insurance companies, investment banks and commercial banks on the same level in terms of measuring the MES and the insurance payoff. It is desirable to perhaps treat different types of financial institutions differently.

5 Of 102 financial firms, the Tables below present the top 20 in terms of insurance costs during the period June 2004 to June 2007. The insurance payoff is triggered when the market drops 40% and the firm’s ratio of market value of equity to total liabilities + market equity value falls below 10% at the end of a four year period. The payoff equals the difference between the equity value implied by the 10% ratio and the final equity value. The volatility of the firm’s equity, the volatility of the market, and the correlation between the two, are estimated using daily data over the prior year.
to observe red flags to initiate a further investigation of the financial firm beyond the typical violation of capital requirements.

As an indicator of potential success, we rank the top 20 firms based on their insurance fee ($ and $ as a % of equity) from June 2004 to June 2007 (the month before the crisis started).

- The insurance fee chooses a list of firms familiar to observers of the crisis, namely Bear Stearns, Lehman Brothers, Merrill Lynch, Morgan Stanley, Countrywide, Freddie Mac, Fannie Mae, Goldman Sachs, Citigroup and JP Morgan.

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RANKINGS of MOST SYSTEMIC FINANCIAL INSTITUTIONS BY HYPOTHETICAL $ INSURANCE CHARGES from 2004-2007
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**RANKINGS of MOST SYSTEMIC FINANCIAL INSTITUTIONS BY HYPOTHETICAL $ INSURANCE CHARGES from 2004-2007 as a % of EQUITY**