Measuring the Tail Risk of Banks

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Motivation

- Recent experience has reminded us that a systemic banking crisis (many banks in trouble at the same time) can induce large costs for the economy
- It is important to have advance information about bank exposures to a crisis (tail risk)
  - identify exposed banks before large shock realizes
  - monitor tail-risk in the financial system
  - understand factors contributing to tail risk exposure

Key Issues When Measuring Tail Risk of Banks

- Tail risk events are rare and hence exposure to tail risk is difficult to quantify
- Banks' business is rapidly changing: tail risk events in the past may not be informative for the future
- "normal times risk" and tail risk may differ
  1. institution that follows tail risk strategy => may have low correlation with market in normal times but may have large exposure to catastrophic risk
  2. high-risk, high-profit institution may protect its franchise value => may have high exposure to market in normal times but may be resilient to crisis events

Some Existing Methods to Measure Tail Risk

- Individual bank tail risk
  - Value at Risk (VaR) or Expected Shortfall (ES)
- System-wide tail risk:
  - Hartmann et. al. (2005), Acharya et. al. (2009), Huang et. al. (2010) and many others
  - Tail Beta (e.g., deJonghe, 2008): Extreme value analysis of relationship between bank return and market return conditional on market being in lower end of distribution
  - CoVaR (Adrian and Brunnermeier, 2009): quantile regression of market growth of assets on bank growth of assets, conditional on bank asset growth being in lower part of distribution
  - both measures effectively study relationship between market and bank in days (weeks) of large share price drops

Our Measure

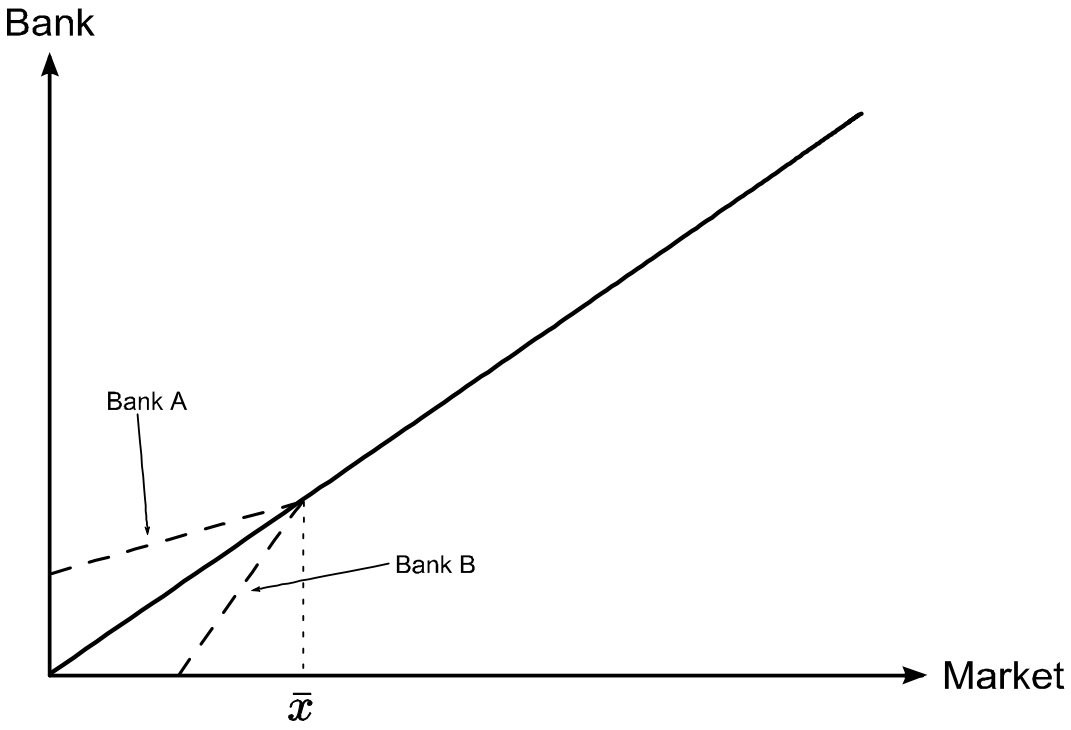
- System-wide risk measure
- Tail risk: substantial decline in market index over longer time (e.g., 30% in 6 months)
- Does not require actual observation of tail risk event
- Forward-looking: perceived exposure of banks to a (possible) future market downturn

How We Identify Tail Risk Exposures in This Paper

- Share prices of banks will generally respond to news about the likelihood of market crash
  - however, a bank with higher systemic tail risk exposure should react stronger

We identify tail risk exposure by bank's sensitivity to tail risk news

Our Method I



Relationship of Bank and Market Values

Why an Institution's Normal Risk and Tail Risk May Differ

- Writes CDS protection
- Invests in senior tranches
- Provides liquidity lines or credit enhancement
- Tail-risk trading strategies: steady payoff in normal times but catastrophic losses when the market crashes (e.g., exploiting yield spread between on-the-run and off-the-run bonds)
- Relies on short-term funding (short-term funding may dry up in systemic event)

Our Method II

- Tail risk news are measured through changes in the price of a deep out-of-the-money put option on the market
  - such an option only pays out when the market crashes
  - hence variations in its price relate to changes in expectations about likelihood of tail-risk event (or aversion to tail risk)
  - note: tail risk event in the market not banking system

Our Method III

- We use the following regression specification

$$\frac{dy}{y} = \alpha + \beta \frac{dx}{x} - \gamma \frac{dp}{p + \overline{x}} + \varepsilon \tag{1}$$

- (1) is simple regression of share price return of bank on market return and put-option return (note that term is $\frac{dp}{p+\overline{x}}$ and not $\frac{dp}{p}$)
- Coefficient on put-option (γ) gives us tail-risk exposure
- Note that estimated coefficient is the bank's tail risk exposure over and above the beta exposure

Empirical Questions Adressed in This Paper

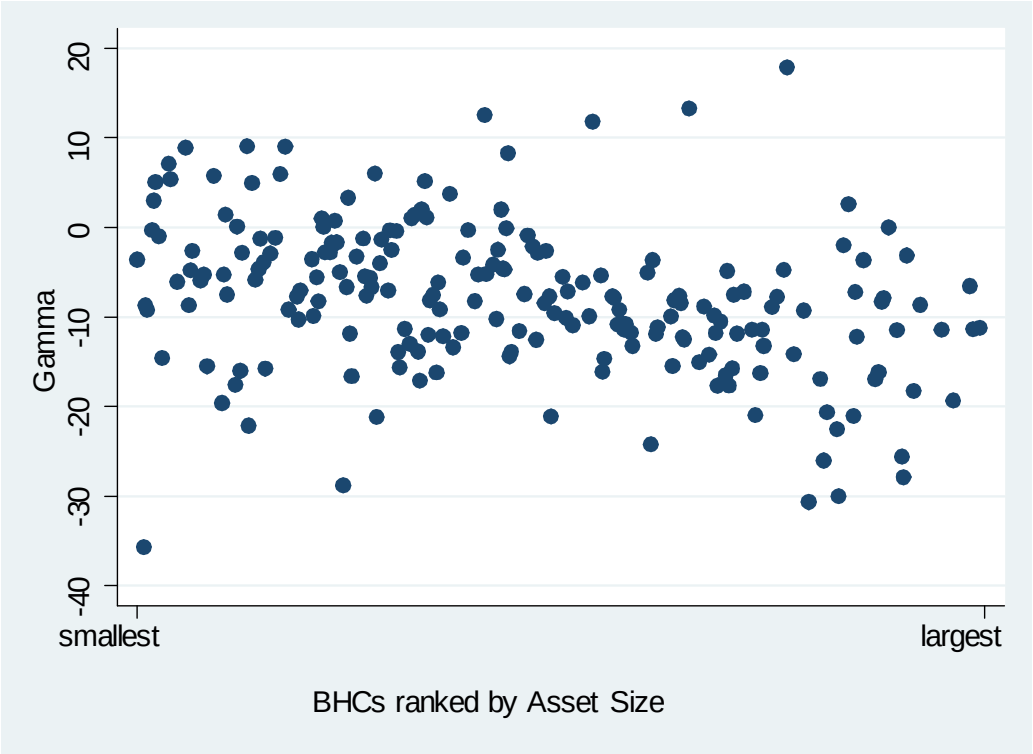
1. Do share prices of banks react differently to tail risk news?
2. If so, is information in our measure different from other measures (e.g. beta)?
3. Which banking activities contribute to a bank's tail risk exposure?

Data

- Sample of 209 large U.S. Bank Holding Companies
- Sample period: October 2005 to September 2008
- Market data (share prices, stock market index, put-options on market)
- Balance sheet data

1) Are Banks Perceived to Have (Different) Tail-Risk?

- Estimated tail risk parameters using equation (1) for each bank (high γ high tail risk)

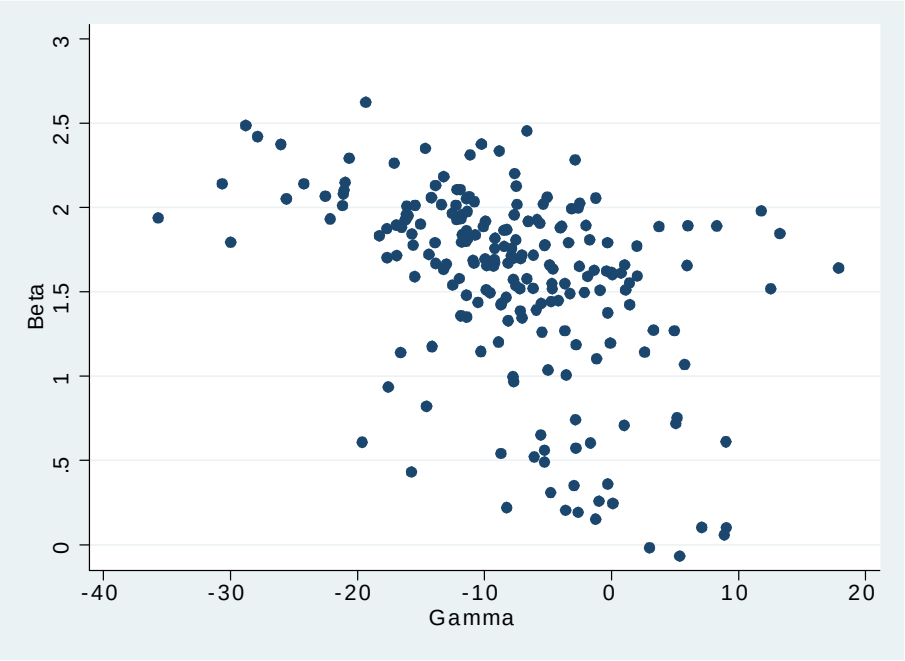


1. Considerable cross-sectional variation => market perceives differences in bank tail risk exposures
2. Tendency for smaller banks to have more tail risk

2) Do the Estimates Contain Different Information Than Other Measures?

- Measure only adds value if the information in the gammas is not already contained in other measures
- We plot the estimated gammas against two other measures
  - betas
  - quantile-betas obtained from quantile regression for lower part of distribution (seems natural alternative measure)

Gamma versus Beta

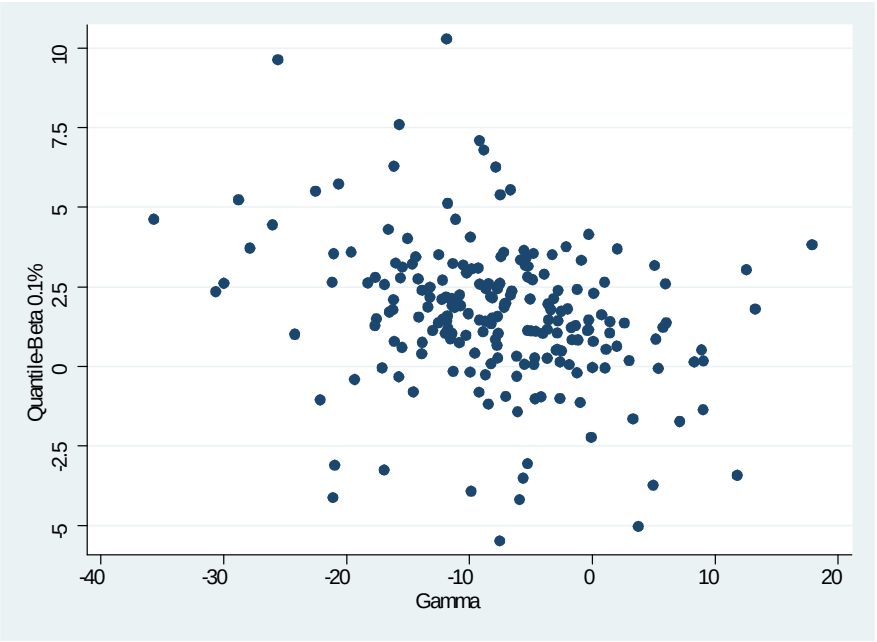


Gamma and Beta seem to be negatively correlated!

- Implication for supervision/ regulation: looking at a normal times risk (e.g., beta) may be misleading/counterproductive when judging bank tail risk
- Interpretation: Banks with high (normal times) business risk undertake measures to reduce the risk of default
- Banks with low (normal times) business risk increase returns by taking on additional tail risk

Gamma versus Quantile-Beta

- Gamma vs. Quantile-Beta: conceptually not the same, even at very low quantiles



Gamma vs. Quantile-Beta

- Result: gamma contains different information from beta and quantile-beta

- Explanations for diverging results
  - different definition of tail risk
    - quantile-beta defines tail risk by (negative) large daily (weekly) market returns
    - gamma defines tail risk as exposure to severe downturn in the market over a longer period of time (e.g. 3 to 6 months).
  - different measurement of tail risk
    - quantile-beta is computed from actual tail risk realizations
    - gamma is identified through changes in perceived tail risk (measures exposure to downturn of market in future)

3) Which banking activities contribute to a bank's tail risk exposure? Summary of Table 1

- Larger banks are perceived to have less tail risk
  - indication of Too Big To Fail?
- Traditional bank activities (loans) less risky $\Rightarrow$ in line with e.g. Demirgüç-Kunt & Huizinga (2009)
- Several non-traditional activities contribute to tail risk:
  - for-sale securities, trading assets, derivatives used for trading
- However, securitization and asset sale activities (where risk is transferred) are not significant

3) Which banking activities contribute to a bank's tail risk exposure? Here: only the big picture

- Leverage is not significant
  - does composition matter more than absolute level?
- Controlling for leverage and deposit ratio, large time deposits increase tail risk
  - these deposits (above $100.000) are not insured and hence may be withdrawn in crisis (note: now raised to $250.000)

$\Rightarrow$ Key drivers are uninsured deposits and non-traditional activities that leave assets on banks' balance sheets

Conclusion

- We propose new way to measure tail risk at banks
  - obtained from market regression amended by market put-option
  - exposure to prolonged downturn (not daily/weekly drops)
  - forward-looking: perceived exposure to future crash
- Estimated Tail Risks at U.S. BHC seem to be negatively related to normal times risk (beta)
  - important implications for supervision and regulation
- Key determinants of tail risk are
  - trading activities
  - non-traditional methods that increase risk on the balance sheet
  - uninsured deposits