Pre-recording:
Value-at-Risk and Intermediary Leverage

Rhys Bidder

KBS/QCGBF

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Disclaimer

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VaR definition

A bank's Value-at-Risk at confidence level c, given initial value of assets, A_0, is the smallest non-negative number V_c such that

$$Prob(A < A_0 - V_c) \leq 1 - c$$

or, expressed in terms of the drop of value in assets, $-\Delta A$,

$$Prob(-\Delta A < V_c) \leq 1 - c$$

With probability $1 - c$, I won't lose more than V_c

- 1% VaR $\Rightarrow$ 99% of the time, my losses will be bounded by V_c

VaR and leverage

Following Adrian and Shin (2014) (AS), we can also define *unit VaR* as VaR per Dollar of assets

$$\mathcal{U}_c \equiv \frac{V_c}{A_0}$$

which is useful as it normalizes VaR by the size of the stock of assets.

In addition, leverage is defined as the ratio of assets to equity

- Balance sheet identity $\Rightarrow A = D + E$ where D is debt and E is equity

$$L \equiv \frac{A}{E} = 1 + \frac{D}{E}$$

Decomposing leverage

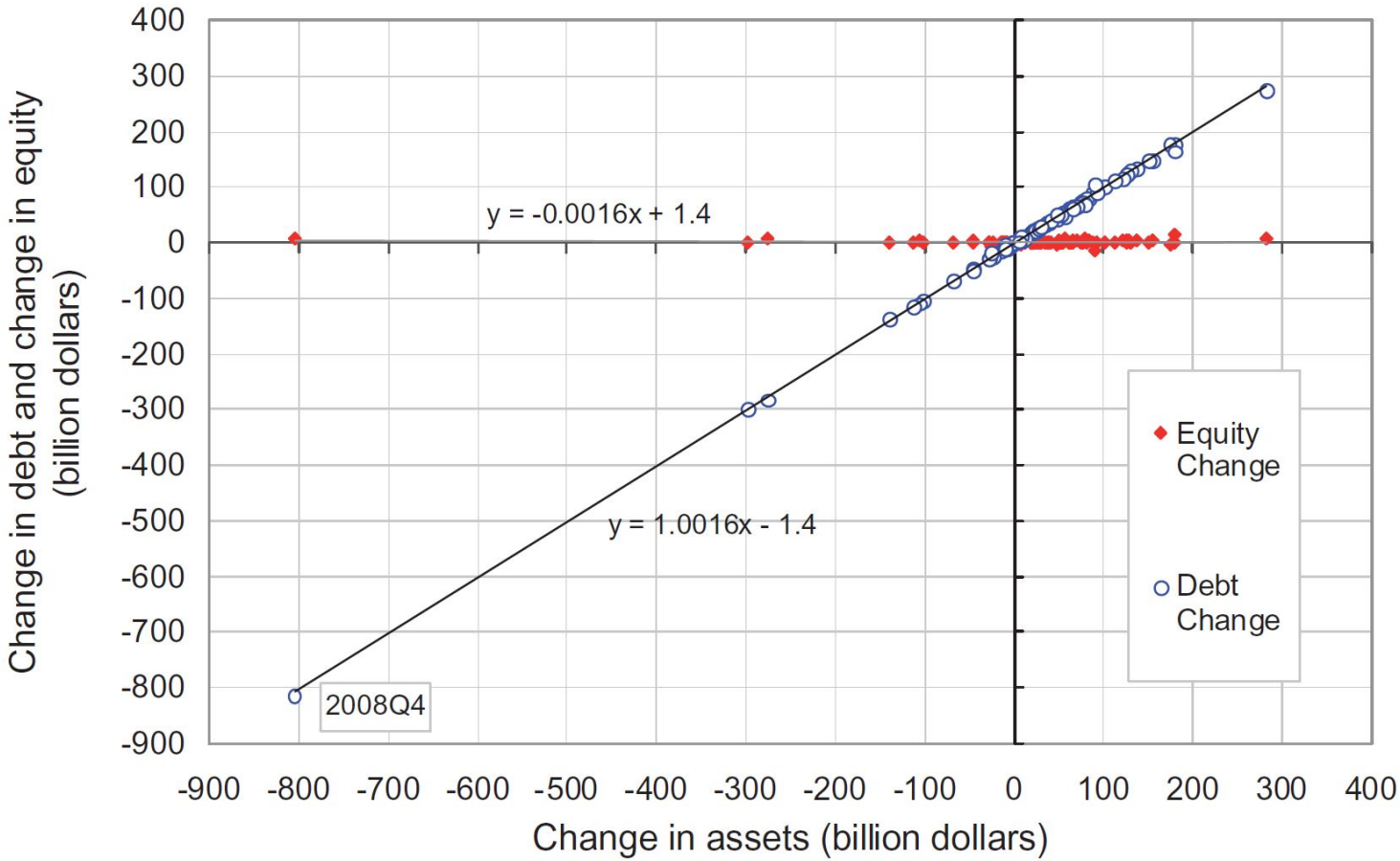
We have

$$L \equiv \frac{A}{E} \equiv \frac{A}{V} \cdot \frac{V}{E}$$

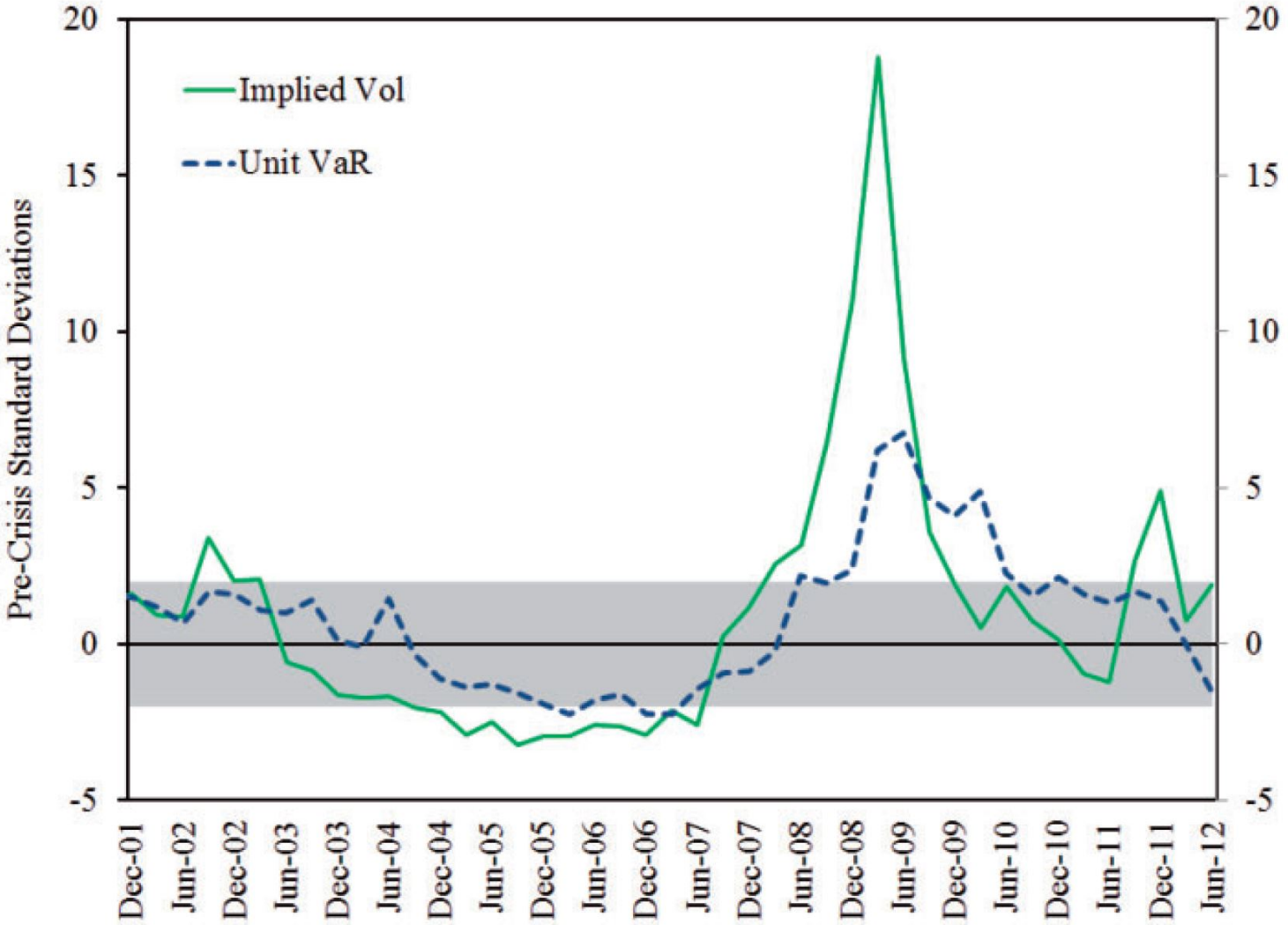
or, in logs (remember the math note)

$$l = -u + \phi$$

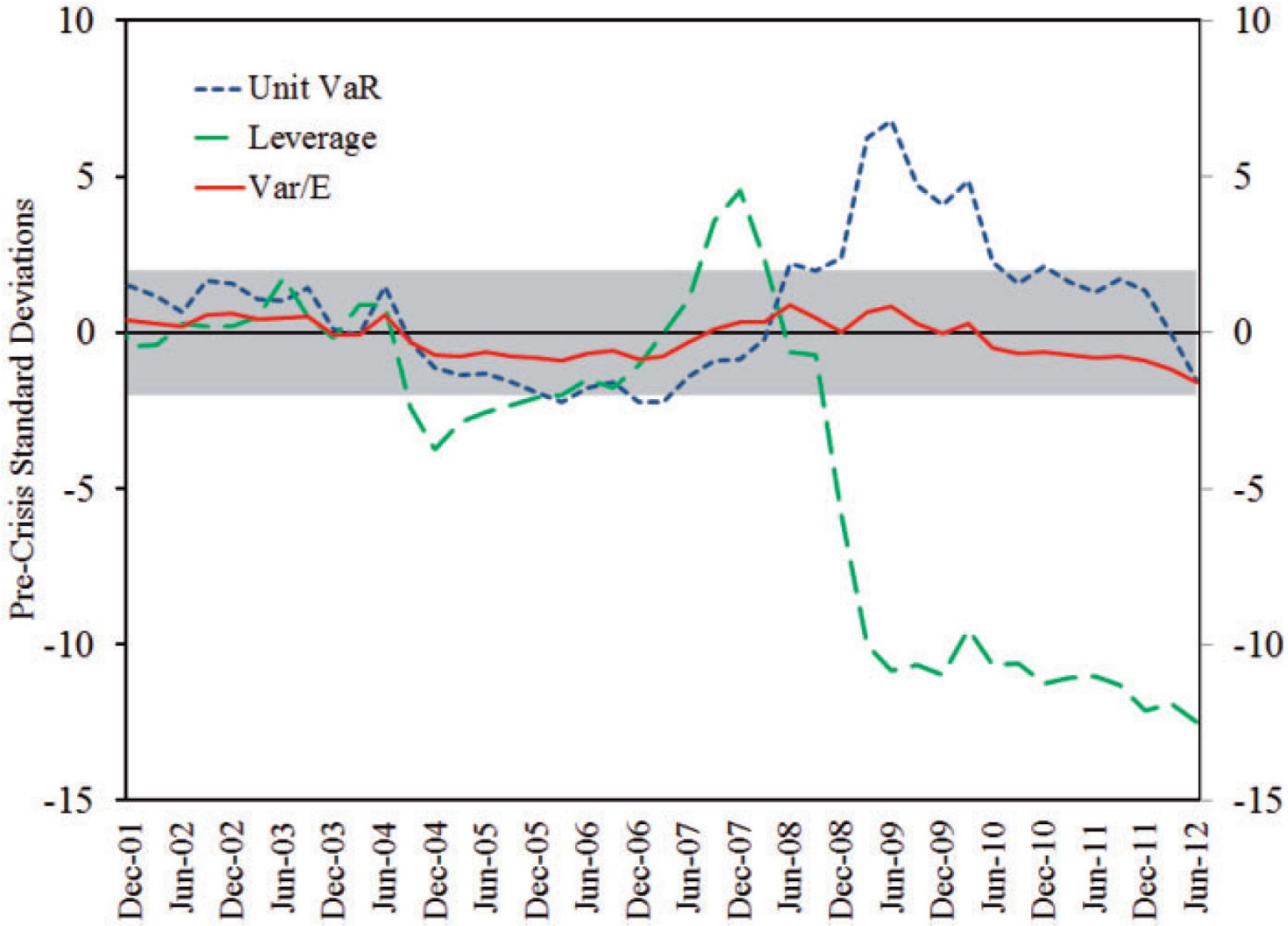
where l is log leverage, u is log unit VaR and ϕ is log VaR to equity



Changes in debt and equity in relation to changes in assets of the US broker dealer sector (1990Q1–2012Q2). Source: Adrian and Shin (2014)



Unit VaR and the implied volatility for eight large commercial and investment banks. Both variables are standardized relative to the pre-crisis mean and standard deviation. Source: Adrian and Shin (2014)



Unit VaR and intermediary balance sheet 'adjustment variables', VaR/Equity and Leverage. All variables are standardized relative to the pre-crisis mean and standard deviation. Source: Adrian and Shin (2014)

VaR rules and variation in risk

Adrian and Shin (2014) made various observations

- Equity does not vary much (in their sample period and among dealer/investment banks)
- Balance sheet size (total assets) varies a lot
- This implies fluctuations must be fluctuating
- But why these patterns?

There appears (maybe) to be a risk story at play

- Argue that banks are targeting approximately constant prob(fail)
- So ϕ is approximately constant (indeed in their simplest interpretation they treat V=E)
- Why does this imply constant failure probability?
  - Remember definition of VaR and recall
  - 'Failure' is reasonably defined as zero equity (book value insolvency)

Implications of VaR rule and varying risk

If banks are setting VaR $\approx$ E (for an implicit $c = 1 - P(fail)$) then higher (lower) risk implies lower (higher) leverage

- *Simple intuition:* You can get away with more investments (more leverage) for a given probability of failure if the volatility of assets is lower

Why might banks do this?

- Various stories - Adrian and Shin offer a toy model
- Recall my paper - we begin with a contracting problem where variations in risk tighten leverage constraints

Implication: If market volatility is becalmed (because of overoptimistic beliefs, loose policy, implicit guarantees, plentiful liquidity) then leverage will build - with possibly severe consequences

- Always ask yourself if there is a market failure though!