Stress Testing Trading Desks

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Supervision Strategy for Trading Desks: The role of stress testing

MRR requires "appropriate stress tests"

Compliance evaluated at 2 levels

1. Trading desk/Line of business
   - Focus on stress tests for desk or business unit
2. Market Risk Management function
   - Focus on stress tests across trading desks

In each case: stress testing considered along with other aspects of trading desk management and controls, including market risk management

Basics

A stress test: Measures performance under plausible extreme adverse conditions.

Elements of a stress test

- Define performance measure
- Determine affected positions
- Decide on scenario of changes in market conditions
- Estimate impact on performance

Purpose:

- Aggregate exposure across positions or desks
- Identify risk exposure not captured by other measures
- Limit stress exposure reflecting mgmt tolerance

Example 1. Relation to VaR

Stress test result set to worst case in historical simulation VaR

Advantages

- Stress scenario determined by vulnerability of positions
- Stress test results in loss
- Reflects historical pattern of comovement of risk factors (plausible)

Disadvantages

- Inherits limitations of VaR measure, esp. approximate mapping of scenario to P/L
- Actual scenarios may be complicated, subtle
- Reflects historical pattern of comovements of risk factors (extreme?)

Correlation vs. Comovement

Connection: correlation = average linear comovement

- A criticism of VaR: it relies on typical correlation
- A freedom in stress: define arbitrary comovement

What would it mean to stress correlation?

Nothing, unless correlation influences performance

- If measure is P/L: implied correlation is relevant for pricing some derivatives
- If measure is VaR: correlation affects the estimated percentile.

Example 2. Spot-Vol grid

P/L for an option depends on 2 risk factors: Underlying Price and Implied Volatility

- Construct a 2-D grid with range of moves in each risk factor
- Calculate P/L for each cell in the grid
- Stress test = worst outcome

Stress scenario is portfolio dependent

Worst outcome may not be at extreme values of risk factors

Issue: full repricing vs. linear approximation

Alternative measure: delta or gamma for given scenario

Example 3. Using historical scenarios

Combination of 3 desks: Bond trading, CDS, and correlation products (tranched CDO)

- Scenarios based on history of bond spreads, IR, and FX changes during the Bond backup (1994)
- Estimated P/L: linear approximation using CS01 and DV01 and FX exposure
- Calculated for each desk for rolling 1-month horizons during the historical period
- Sum of worst for each is the stress number

Historical series automatically include multi-dimensional risk factor changes

Missing risk factors: CDS didn't exist in 1994

Example 4. Hypothetical scenarios

Scenarios of changes in multiple risk factors: FX, IR by currency/region, swap and corp spreads, equities

- Headline event + judgment for impact on markets, e.g. Emerging Mkt crisis, US stock crash, etc.
- Results tabulated for each line of business, e.g.
  - EM crisis: FX –10MM, IRDeriv –5MM, EqD –25MM for Total –40MM.
  - US crash: FX –2MM, IRD +5MM, EqD +40MM for Total +43MM

Gain in a stress scenario?

- Trading desks may avoid directional risk
- Scenario may not test actual vulnerabilities
- Long option positions gain from mkt volatility

Example 5. Pricing stress protection

Structured equity investment: gives client option-type payoff – long put for downside protection and short call giving up some upside.

Bank constructs discrete portfolio insurance strategy taking on risk that equity prices drop too fast to perform the necessary rebalancing

Extensive risk mitigants and triggers part of the deal so probability of gap risk is beyond 99th percentile

Client pays spread in excess of bank funding costs

What's the value of the deal?

- NPV of excess spread
- Cost of structuring: tax, legal, deal monitoring
- Value of gap risk coverage

Pricing stress protection (cont.)

Construct stochastic process for equity value using stressed parameters, higher volatility, low liquidity

Evaluate prob-weighted gap losses via simulation

- As part of setting up deal: set triggers for rebalancing, cushions - use stress historical parameters
- As part of valuing gap risk for given deal: calibrate parameters to match observable prices and then apply to deal (risk neutral prob and risk-free discounting)

Challenges:

- Does the history include the stress events?
- Finding market observables to calibrate
- Relation between market terms and structure