Tight Credit Markets: Managing Collateral at Risk to Understand Cash Requirements

IAEE

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Agenda

Introduction	Jay Lindgren
Why collateral risk management?	Charles Breeden
Contract basics of margining and collateral	Charles Breeden
Stochastic treatment of prices	Jay Lindgren
Collateral at Risk	Jay Lindgren

Introduction to presenters

Dr. Jay Lindgren is a Managing Consultant for PA Consulting Group and specializes in quantitative analysis. With 18 years of experience, Dr. Lindgren is responsible for developing and implementing advanced quantitative methods for client organizations. Dr. Lindgren has worked on projects related to asset/contract valuation, risk measurement and portfolio optimization. He also supports client engagements involving risk management program development and development of marketing and trading strategies. Dr. Lindgren has deep experience working on trading floors and directly with traders. Additionally, Dr. Lindgren has numerous publications and is a frequent speaker on the conference circuit. Dr. Lindgren has worked with water utility clients regarding the water market and trading exercises.

Charles Breeden, II, is a Managing Consultant in the Global Energy Practice. He specializes in the development of practical risk management systems and valuation tools for the energy industry. Charles is one of the original developers of PA's proprietary Trading Collateral Analysis model, which allows companies to understand and optimize its potential future collateral requirements and has been deployed at several client companies. He is also one of the original developers of PA's Business Portfolio Optimization (BPO) model, which helps client companies identify methods of extracting more value from its current natural gas and electricity assets and opportunities to enhance the composition of the portfolio from a longer-term perspective. Most recently, he evaluated the trading and risk management operations of a midstream oil and gas company as part of a Chapter 11 bankruptcy. Prior to PA, he was an associate in the Energy Investment Banking group at JP Morgan, where he executed capital raising and sell-side mandates. He has an MBA from New York University with concentrations in quantitative finance and accounting, an MA from American University and a BA from Vanderbilt University.

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Why collateral risk management?

Liquidity risk

- Hedging and trading activities can tie up significant amounts of cash
- By actively managing collateral risk, companies can understand when these activities could put the company's liquidity position at risk

Cash flow management

- Once collateral risk is measured, companies can proactively manage their cash flow
- Options include novation, unwinding trades, capital raising, among many others

State of the capital markets

- Unfortunately, the financial condition of the banking industry and the current sentiment among investors has made the option of debt and equity capital raising challenging
- These challenges accentuate the importance of properly managing collateral risk

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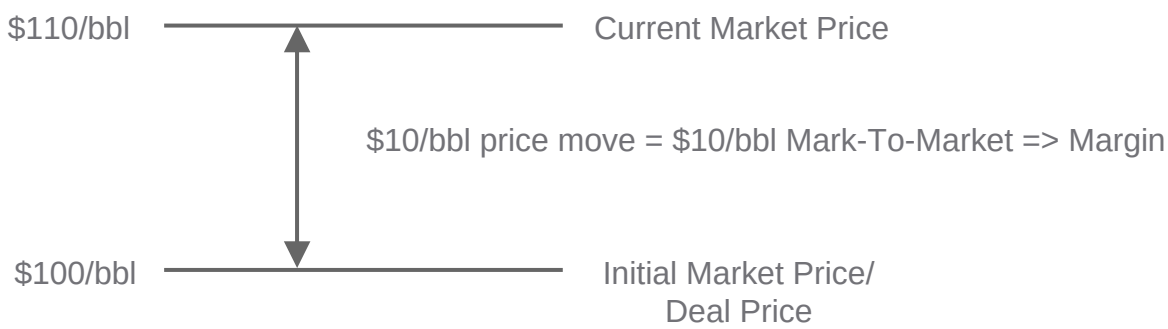
Margining essentials

- Margining is NOT the same as a buying on margin
  - Margin buying involves using securities as collateral against cash borrowed from a broker, which has the effect of magnifying any profit or loss (through greater buying power) made on the securities
- Margining is a method of managing credit risk
  - Margining keeps the party that is in the money whole should the counterparty fail to perform
- Margining is utilized by both exchanges and Over-the-Counter (OTC) counterparties
  - The exchange's clearinghouse acts as counterparty on all contracts, sets margin requirements, and also provides a mechanism for settlement
  - In OTC transactions, margin requirements are established/negotiated by the counterparties

A simple example – perfect margining

- Consider a long swap contract on crude oil that is entered into with a swap price of $100/bbl
- Assume the current market price of crude oil is $110/bbl
- The counterparty would financially prefer to sell into the market at $110/bbl rather than honor the contract at $100/bbl
- $10 = ($110 - $100) would be placed in a margin account
- If the counterparty defaults, the party long the swap is made whole by
  - Buying the barrel at the current market price of $110/bbl
  - Keeping the money in the margin account $10
  - Giving an effective price of $110/bbl - $10 = $100/bbl, the original contract price



Types of margining and collateral

There are several different types of margin:

- Exchange-based
  - Initial/maintenance margin – meant to cover the potential margin exposure across margining periods (typically one day)
  - Variance margin – varies with Mark-To-Market (MTM)
  - Money posted to an account
- OTC-based
  - Threshold – an amount that the variance margin can move before margining starts
  - Independent amount – similar to initial margin
  - Letter of credit (LC) – a promise from an entity to provide cash if required
  - Corporate guarantee – similar to an LC but from a parent company
  - Variance margin – varies with MTM
  - Money posted to an account (not LC's or guarantees)
  - AR/AP (accounts receivable / account payable)

Initial/maintenance margin for exchange-based trades

- For exchange-based trades, the initial margin is the required amount of funds that must be deposited by a trader before the positions are initiated
- Sample indicative initial margins (as of June 19th) are below for the NYMEX:
  - Crude oil - $7.736/bbl
  - Natural gas - $0.6750/mmBtu
  - Heating oil - $0.217/gal
- Initial margins vary with
  - Time to maturity
  - Relationship with the exchange
    - Member
    - Non-member
  - Different for
    - Cross commodity hedging
    - Intra commodity (cross month) hedging
  - SPAN

Variance margin for exchange-based trades

- While initial margin requirements must be met at the time of the trade, variance margin will only become a factor as the account value changes
- The variance margin is a daily offset of profits and losses
  - Futures are marked-to-market every day, so the current price is compared to the previous day's price
  - The profit or loss on the day of a position is then credited to or debited from the holder by the futures exchange
  - This is possible, because the exchange is the central counterparty to all contracts, and the number of long contracts equals the number of short contracts
  - Certain other exchange traded derivatives, such as options on futures contracts, are marked-to-market in the same way
- When the margin posted in the margin account is below the minimum margin requirement, the broker or exchange issues a “margin call”; the trader now either has to increase the margin deposit, or close out the position
  - Done by selling the securities, options or futures if long and by buying them back if short
  - If the trader does not voluntarily do any of this, the broker can close positions
  - After the position is closed-out the client is liable for any resulting deficit in the client’s account

Netting groups

For OTC trades, netting is the ability to offset trades of different values against each other

- Margin is calculated by netting across trades that are governed by a master contract
- Different commodities frequently have different master contracts and as such all commodity positions may not offset each other

- Consider a simple example
  - Company A sells a barrel of crude oil to Company B with terms of physical delivery
  - Company A then buys a barrel of crude from Company B to offset the initial trade
  - Company B then goes bankrupt
  - With out netting across the trades
    - Company A may be obligated to pay for the barrel of the second trade
    - Company A may have to deliver the barrel for the first trade
    - Company A losses twice
  - With netting, the two trades contractually offset and Company A is protected

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A basic price process

- One simple stochastic price process is Geometric Brownian motion (GBM), which assumes that price returns can be described by a normally distributed, random process
- The following equation describes such a process:

$$dS = \mu S_t dt + \sigma S_t dW_t$$

Change in price	Drift	Change in time	Volatility	Increment in Brownian motion

- The equations are modified to the risk neutral measure (beyond the scope of this talk)
- A multi-factor model of the HJM (Heath, Jarrow and Morton) class

$$dF_j = \sum_k \sigma(t) F_j dZ_k$$

Change in price	Volatility Term structure	Factor

Stochastic price treatment

- Collateral model come in various levels of sophistication
  - Top of the line model feature Monte Carlo simulations with full revaluation
    - This is important if the portfolio contains a material amount of options
  - The price processes may contain jump diffusion processes and mean-reversion
  - A middle of the road model features some of the standard Value-at-Risk assumptions of prices
    - Delta normal (first-order approximation)
    - Delta gamma theta normal (second-order approximation)
    - These models are cheaper to build and implement
      - May have a “blind” spot for options
    - Delta-normal assumptions will be assumed in this talk for ease of explanation

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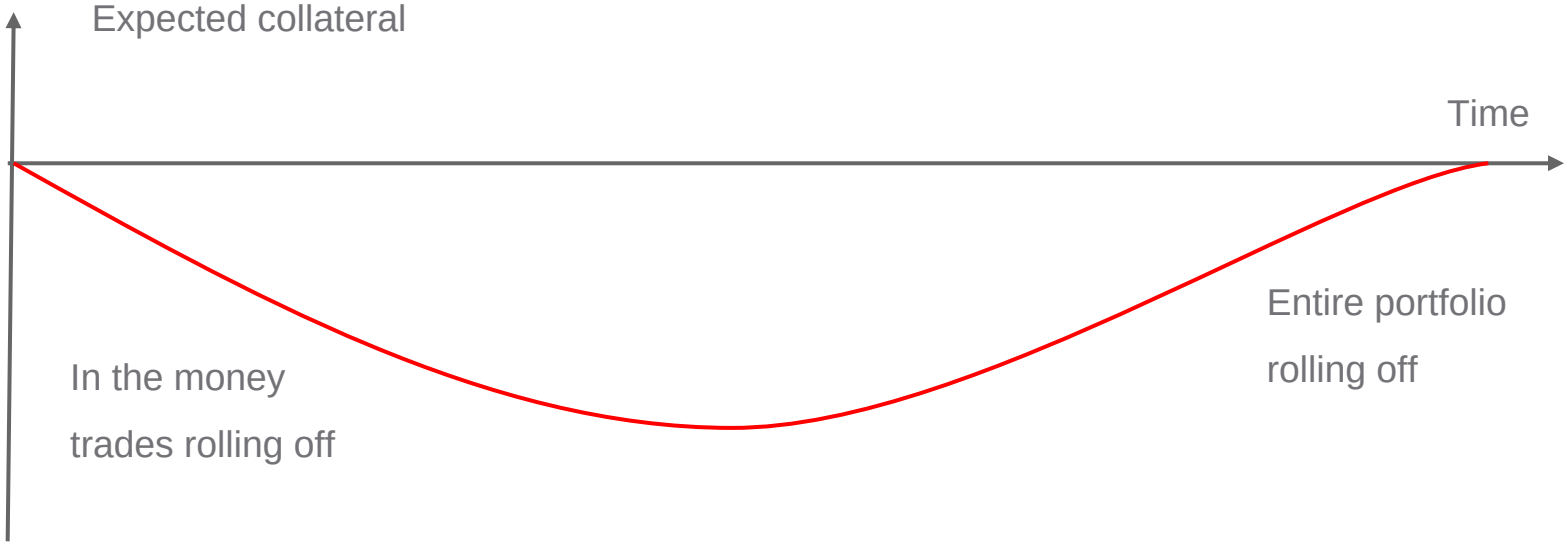
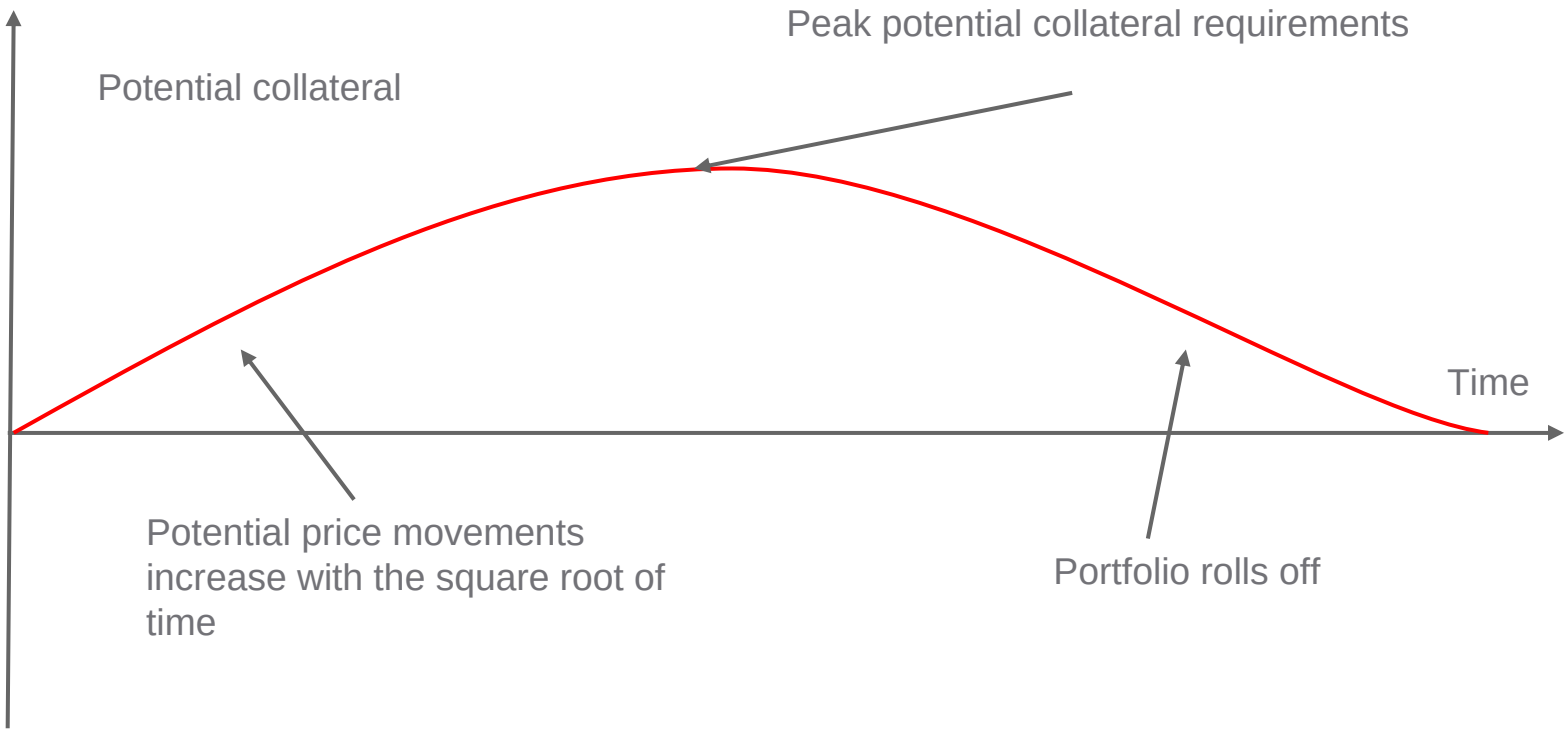
Example of an unintuitive deterministic forecast

- Given the current market forward curves
- Given the current portfolio
- What is the expected collateral going forward
- Consider a portfolio that has trades over six months in tenor
  - The first three months are in-the-money, the last three months are out-of-the-money
  - The current market to market is zero and the current collateral is zero
  - Look at what happens moving forward in time



Example of a typical Potential Future Collateral result

- Assume a portfolio of a strip of at the money futures
- Look at the potential future exposure over time
- This pattern is repeated time and again in collateral results



Undiversified Value at Risk (UVaR)

- UVaR measures how much a position can move against a company at a given confidence level
- Delta-normal VaR is one model for calculating this potential move, described by the following equation:

$$UVaR_t = \Delta \; Q \qquad z \; \sigma \; S_t \sqrt{t}$$

Unit Delta | Contract volume | Z-score

- The instrument's delta, Δ, measures how much the value of an instrument changes for an infinitesimal change in the underlying price
  - For long forward contracts, Δ is close to 1 (but slightly less than 1 due to discounting)
  - For long calls, Δ is less than 1 (but greater than 0); how much less than 1 depends on the moneyness of the contract
- ΔQ is generally referred to as the delta volume
- The Z-score, z, represents the number of standard deviations away from the mean, corresponding to the selected confidence level (e.g., z = 1.65 at the 95% confidence level)
- Must then be mapped through the contract information such as thresholds, etc…

Diversified Value at Risk (DVaR)

- The above UVaR model most likely overstates the potential change in the value of a company's portfolio
- The UVaR calculation ignores the benefits of diversification that are available through the netting provisions in the company's master agreements
- The DVaR calculation, shown below, incorporates the benefits of diversification by taking into account the correlation between commodities for each master agreement where netting is allowed

$$DVaR_t = \sqrt{UVaR_t \times C \times UVaR_t^T}$$

Correlation matrix

UVaR vector transposed

- Once DVaR is calculated, it can be incorporated into the calculation for collateral requirements (described above and repeated in part below) to determine potential future collateral requirements for each netting group on each date of the analysis

Net Collateral Required by Counterparty = MAX(MTM + AR/AP + Floating Ind Amt – Threshold, 0) – Guarantee + LC + Margin

Add DVaR value here

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