

# Changing Dynamics In The Securities Markets

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# Good Old Days

$$dS = mSdt + sSdz$$

Constant risk free rate (borrow/lend)

Constant volatility

Lognormal dynamics

Constant dividend rate

Continuous Trading

Zero Transaction Costs

# Equity Realities

Equity Smile (Derivatives Market)

Local Vol

Stochastic Vol (Heston?)

$$d\mathbf{S} = k(\nu - \mathbf{S})dt + \mathbf{x}\sqrt{\mathbf{S}}dW$$

Lognormal?

$$\mathbf{S}(S) = \mathbf{S}_0 S^a$$

# Equity Realities

## Equity Dynamics

Jumps in price space

Default Occurs

Dividends are discrete and sticky

Transactions are costly

Liquidity issues

Large volumes move prices (not a price taker)

# Interest Rate Market

HJM Model

$$df(s, t) = \mathbf{a}(s, t)dt + \mathbf{b}(s, t) * d\overline{W}(t)$$

Initial Forward Rate Curve Known

Volatility Known

Usual Assumptions

# Interest Rate Market

HJM Model

$$df(s, t) = \mathbf{a}(s, t)dt + f^d(s, t)\mathbf{b}(s, t) * d\overline{W}(t)$$

Initial Forward Rate Curve Not Known

Volatility  $B(s, t)$  is stochastic

$d = d[f(s, t)]$  may be stochastic

# Interest Rate Market Realities

- Which Interest Rates
  - Libor
  - Treasury
  - Muni
- Treasury Bonds
  - Strong Interaction between prices/yields and financing in repo markets
  - Strong Interaction between prices/financing/futures (cheapest to deliver)

# Interest Rate Market Realities

- Muni Market
  - Modeling of Tax Policies?
- Libor Market
  - Appropriate discounting rate (risk free?)
  - Credit issues
  - Structural factors
- Inflation Products
  - Dynamics for the CPI (or other deflation indices)

# Default Swap Models Good Old Days

- Given a Term Structure of Par Default Swaps
- Given a known (and constant over time) recovery rate
- No Liquidity costs
  
- Easily determine distribution of default arrival times

# Default Swap Models Realities

- Lucky to see par quotes for three different maturities
- Recovery rate is stochastic
- Liquidity is an issue for many names
- Default Swap Spreads Are Stochastic - Dynamics?
  - No arbitrage conditions
  - Low quality names require upfront payment  
(No Spread [seems to] Clear the Market)

# Commodity Markets Good Old Days

- Black-Scholes for Petroleum Markets
- Black-Scholes for Precious Metals
- All counterparties are money good (forever)
- Free Disposal

# Commodity Markets Realities

- Petroleum Markets
  - Options Smile - Stochastic Volatility
  - Storage Costs
  - Geopolitical shocks - major price jumps
  - Differentiated Products (Sulfur content, refined products)

# Commodity Markets Realities

- Electricity
  - No Storage (Prohibitively Costly Storage)
  - Hourly, daily, monthly contracts
  - Sizeable price spikes
  - Forward/Futures curve out to 3 years (at best)
  - Counterparty risks
  - Transmission constraints
  - Regional delivery
  - No Free Disposal

So Far - It has been Easy

Now Comes the Hard Part  
Joint Dynamics

# Interest Rate Products

- Correlated versus Cointegrated
  - US \$ Products - LIBOR/UST/Tax Exempt
- Strong, but not absolute, tendency to maintain economic relations
  - Treasury rates < LIBOR (but not always)
  - AAA Tax Exempt < Treasury Rates
- Derivatives exist on individual products and on combinations of underlying products
  - Outperformance of SWAP and CPI (quantoed into YEN)!

# Credit Products

- Tranched Basket Products
  - Tranched by loss amounts (a%-b% notional)
  - Collateral, bonds, default swaps, other tranches from other deals
  - Cash or synthetic collateral and structures
- Issues
  - Valuations depend upon timing and clustering of losses
  - Joint dynamics of default arrival times and recovery rates

# Credit Products

- Tranched Basket Products
  - Static and managed collateral
  - Options on tranches
  - >100 corporate names in collateral
- Issues
  - What is the structure of the dynamics
  - Computational feasibility of a valuation model
  - Hedging Paradigm

# Commodity Products

- Load following electricity - joint electricity and weather
- Outperformance of electricity and natural gas
- Issues
  - Apparent regime switching with periods of high correlation and low correlation
  - Markets are not complete - calibration of models using historical data for correlation need not be correct
  - Present and future government regulations - impact dynamics

# Philosophical Conundrum

The most complex dynamics are in the least transparent incomplete markets

The most complex products are structured for these difficult markets

Calibration is iffy

Model testing is limited

# Modeling Conundrum

Stocks and bonds are different parts of the capital structure of the same company

Default is critical in the modelling of bonds but ignored in the modelling of equity

Equity is modelled as an eternal process, yet often disappears at the time of default

Corporate bond prices are modelled as a stopped process (at default), yet corporate bonds often convert to equity as a result of default

# Model Requirements

- Reasonable representation of market dynamics
- Generation of hedging strategy that extracts value from structures priced away from the model price
- Computational feasibility
- Calibration to observed markets

# Why Does It Matter

- Markets are becoming increasingly more competitive
- Derivatives and Synthetics are increasingly the best source of liquidity
- Risk Positions are growing - no longer sufficient to hedge out “first order” risk
- Sarbanes-Oxley Requires the firm’s senior officers (CEO, CFO) to sign firm’s financial statements under penalty of criminal law
- May not recognize “day 1” P&L unless either:
  - Visible Market with transactions of comparable size
  - Approved Models calibrated to visible market inputs