

# Modeling issues for capturing traded credit risk

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**Risk Management** 



#### Outline

- Overview of regulation, definition of the IRC
- Important modeling issues
  - Default and migration probabilities for short horizons
  - Embedding a multivariate migration model in a multistep process
  - Estimating liquidity horizon
- Sample portfolio results
- Conclusion



- Motivation 1: regulatory capital for bank trading portfolios was too small.
- Motivation 2: losses were not simply due to defaults, but also to downgrades.
- BIS issued third consultative paper in February 2009. Implementation expected for 2010.
- New minimum trading book capital is composed of
  - 99%, 10 day Value-at-Risk (old)
  - 99%, 10 day "stressed" Value-at-Risk (new)
  - Incremental Risk Charge (new)



## Incremental Risk Charge (IRC) defined

- Covers corporate bonds, CDS, equity, NOT securitizations
- One-year, 99.9% Value-at-Risk
- Changes due to default and migration
- Liquidity horizon
  - ... represents the time required to sell the position or to hedge all material risks ... in a stressed market. The liquidity horizon ... should be sufficiently long that the act of selling or hedging, in itself, does not materially affect market prices.
  - Minimum of three months for each position
- "Constant level of risk"
  - ... a bank rebalances ... its trading positions over the one-year capital horizon in a manner that maintains the initial risk level, as indicated by a metric such as VaR or the profile of exposure by credit rating and concentration. ... The frequency of the assumed rebalancing must be governed by the liquidity horizon for a given position.

# How to estimate short-horizon transition probabilities?



- Infer from pricing
  - No migrations
  - Physical or risk neutral?
  - Through the cycle?
  - Limited liquidity inside one year
- Directly from default and ratings data
  - Estimation error
- Infer from empirical one-year transition matrix
  - Assumption of Markov process (no ratings momentum, for instance)
  - Assumption of time homogeneity (can be relaxed)
  - Not always possible ... arbitrary "regularization" needed
  - For better or worse, generally accepted



• Consider the one-year TM:

| 2/3 | 1/3 | 0   |
|-----|-----|-----|
| 1/3 | 1/3 | 1/3 |
| 0   | 0   | 1   |

- What is six-month TM under time homogeneous Markov assumptions?
  - Clearly, bottom category can default in six months
  - If top category can downgrade in six months, then it can default in one year.
  - If top cannot downgrade in six months, then it cannot downgrade over full year.



- Produce monthly conditional default probabilities.
- Under simplest model, this profile is flat, and there is no benefit to rebalancing.
- Examine conditional default probabilities, normalized by first month.
- Rebalancing for constant level of risk should help if curve is upward sloping. (Groundhog Day is better than real life.)

# Infer from empirical one-year matrix Time homogeneous case









See Bluhm and Overbeck (2005).



#### CDS-implied, selected names in CDX.IG



#### Average, Jan-Aug 2008

1.7 1.7 1.6 1.6 1.5 1.5 1.4 1.4 1.3 1.3 1.2 1.2 1.1 1.1 1 1 0.9 0.9 0.8 0.8 0.2 0.4 0.6 0.8 0.2 0.4 0.6 0.8 0 1 0 1 Horizon (months) Horizon (months)

#### Average, Sep-Dec 2008



#### Multi-step, multivariate default risk model

- With the right conditional default probabilities, it is obvious how to simulate a single issuer and recover the right one-year behavior.
- What to do with multiple obligors?
- Naïve approach is to "just" apply the standard asset correlation model for each period.
- But does this recover the right *joint* one-year default probabilities?



## Watering down effective correlation by adding steps

For 27bp one-year default probability (BBB)





- Asset value explanation
  - If two firms' assets are highly correlated, then a default in one period by one firm will imply the second firm likely starts from a lower asset value for the second period. So second period conditional default probability should be higher.
  - Independent steps wash out this temporal correlation.
  - Modeling ratings migrations should mitigate this effect.
  - And do we care if we are rebalancing?
- Copula explanation
  - Replaced a single normal copula with one-year PD by an independent set of normal copulas with smaller PDs.
  - No tail dependence in normal copula ... correlation washes out.







- Cynical question ... can I claim all my positions have three-month liquidity?
- How to measure for CDS?
  - Now have net market exposure information from DTCC.
  - GE Capital 74B gross exposure, fell by 11B week of 27 April, 12B in new trades
  - Campbell's 17B gross exposure, rose by 32M
  - Dillard's 5B gross exposure, rose by 106M
  - Typical position size ... 10-100M notional
- How to measure for bonds?
  - TRACE data on transactions
  - Typical bond position ... 1-100M (based on mutual fund holdings)



#### Campbell's Soup, matures Oct 2013, 300M issuance







#### Dillard's, matures Aug 2018, 200M issuance







- If liquidity horizon is constant across the portfolio, we may use the convolution approach:
  - Simulate portfolio over the liquidity horizon. Obtain a distribution of (for example) three-month losses.
  - Assume at the end of the period, the portfolio is rebalanced back to a (scaled) version of the original.
  - Assume (scaled) second period losses are drawn from the same three-month loss distribution, and independent of first period losses.
  - Repeat ...
- This is not quite the same as "resetting" each position back to its initial state.



#### Comparisons

- Portfolios: constituents of most recent CDX investment grade and high yield indices
- Liquidity horizons: three, six, twelve months
- Methods
  - Default only, constant hazard scaling of default probabilities
  - Default only, scaling of default probabilities from time homogeneous Markov assumptions on the transition matrix (data from before)
  - Migration, with Markov scaling of transition matrix
- What are the impacts of
  - Term structure of default probabilities?
  - Migrations?
  - Rebalancing, liquidity horizon?
  - Correlation "washout"?











## CDX Investment Grade, Series 12 (issued Mar 2009)





## CDX High Yield, Series 12 (issued Mar 2009)



- Short-horizon probabilities ... we know what to expect qualitatively, but lots of wiggle room
- Even more wiggle room in how we create a multistep process ... be careful about what correlation really means.
- Liquidity horizon ... will be hard to argue that we can always liquidate in three months.
- Portfolio results
  - IG benefits from rebalancing (expected), HY does not
  - IG vol risks are comparable to default and migration
  - HY sees most risk from default, little impact of migration
  - IG has higher correlation sensitivity
  - Hard to disentangle correlation washing from other effects, but rebalancing seems to have a larger impact.