CDO Asset Selection and Structuring: The Issuer Perspective

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Introduction

Definitions

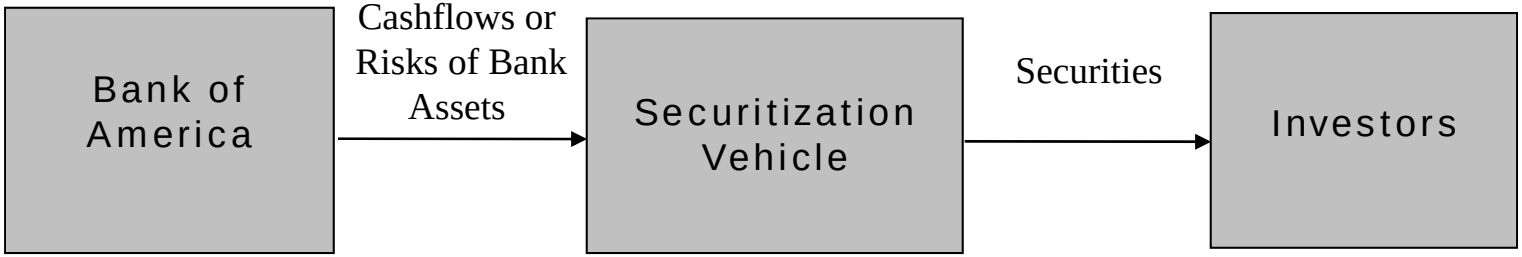
CBO = Collateralized Bond Obligation

CLO = Collateralized Loan Obligation

CDO = Collateralized Debt Obligation

What are these things?

A means of carving up the cashflows OR the risks of a pool of credit risky instruments into securities that can then be sold into the capital markets.



Introduction

CBO vs. CLO

Difference between a	BOND	and a LOAN
Security Type	Public	Private
Interest Rate Sensitivity	Fixed	Floating
Tenor	10 to 30 years	1 to 7 years
Funding	Fully drawn	Fully Undrawn to Drawn
Principle	Bullet	Amortizing
Seniority	Sub and Senior	Senior
Collateral and Covenants	None to Limited	Material to Fully Secured
Bankruptcy Recovery	30% to 50%	70% to 80%
Mark-to-Market Pricing Availability	Widespread	Leveraged Loans (150bp)
Internal Practice	Yes	No

Corporate Loans

Types:

Loan Commitment - a commitment to lend at a spread above LIBOR (for large corporate loans). Really an option sold for a fee.

Revolving Commitment - draw and repay at will for life of commitment

Term Loan - draw and pay back with an amortization schedule

Stand-by Letter of Credit - issued under commitment but is a financial guarantee. (Default swaps before the term was invented.) No draw save for default event.

Syndicated vs. Bilateral - Most large corporate loans made in syndicates with a team of banks. Many middle market loans still made directly as a bilateral agreement between the lender and the borrower

Corporate Loans (cont.)

<u>Practice</u>:

Loans viewed as a loss leader.

Use the balance sheet to get in the door and then collect on lucrative customer fee business such as M&A and Equity.

High quality (investment grade) clients do not draw (except for Xerox). Typically enter into large revolvers to back up a commercial paper facility or just as a guarantee of liquidity. Thus, very low fees associated with high grade commitments. A five year tenor credit option basically given away considering the volatility of spreads and historical credit migration patterns (Xerox again).

Issuer Goals

As bonds are marked to market daily, there is no incentive to hold a blown underwriting (assuming liquidity exists to sell it at all).

Accrual accounting provides an incentive to hold a blown syndication. Often listed as "performing" until forced to acknowledge a loss is imminent. The barrier to more active use of distressed CLOs such as Fleet Boston's Patriarch deal. Need to bridge from carrying value to market value on accounting statement to "sell".

GOALS

1. Reduce Balance Sheet/Secure Funding Source

2. Reduce Regulatory Capital Charge

3. Reduce Economic Capital Charge (reduce risk)

Introduction

Goals of Asset Selection

For a cash CLO, subject to transaction constraints, we wish to maximize funding for both regulatory capital relief and funding in its own right. We also wish to minimize risk from the asset pool to ensure credit quality changes do not affect our desired funding tenor.

For a synthetic CLO, subject to transaction constraints, we wish to maximize funding and 1 year + original life unused amounts for regulatory capital relief. We also wish to maximize risk from the asset pool to remove as much default risk as possible from our underlying assets.

Cash CLO Constraints

- Diversity (Moody's)
- Industry Concentration (Bank)
- Obligor Concentration
- WARR (Moody's)
- RR Concentration
- RR and Deal WAL

Synthetic CLO Constraints

- Diversity (Moody's)
- Industry Concentration (Moody's, S&P, Fitch)
- Rating Agency Rating Dependent Obligor Concentration (Moody's, S&P, Fitch)
- WARR (Moody's, Fitch)
- Rating Agency Rating Concentration (Moody's, S&P, Fitch)

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Introduction

Resulting Problem

How do we select assets that enable the creation of a structure that optimally meets our goals for funding, regulatory capital, and economic capital while still meeting the constraints required for market execution?

The existence of both hard and soft constraints as well as the complexity of some constraints such as Diversity Score rule out conventional optimization methods. Thus a non-standard technique, a Genetic Algorithm, was implemented.

Hard Constraint - a rule that cannot be broken or else the deal will either not be done or done under conditions of extreme prejudice. For example, exceeding S&P's 8% industry concentration - all obligors reduced by one S&P rating notch.

Soft Constraint - a rule that can be broken but we would prefer to see it followed. For example, while we would like to choose the riskiest assets for a synthetic deal, we would prefer they be of a certain tenor - at least 6 months or one year.

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Genetic Algorithm

Definition

What is it?

An approach to solving a problem that is analogous to how life evolved on earth!

1. FITNESS: Life survives in a challenging environment

2. SELECTIVE REPRODUCTION: The fittest individuals within a population are most able to pass their traits on to their descendents

3. DIVERSITY: Through cross-over and mutation, the genetic fingerprint of a new individual is a mixture of that individual's parents

Genetic Algorithm

Fitness

We desire a portfolio (a collection of loan facilities) that most meets our needs for stable funding, regulatory capital, and or economic capital.

The degree to which we maximize these needs for a target notional or usage amount and still meet the transaction constraints is termed FITNESS.

Synthetic CLO Portfolio Fitness =

Economic Capital + Regulatory Capital - Penalties for Exceeding Constraints

Genetic Algorithm

Selective Reproduction

We create a collection of potential portfolios (a GENERATION) and measure the fitness of each one.

The higher the fitness of a given portfolio, the more likely it is to be selected in creating the next generation of portfolios.

Portfolio	Economic Capital	Regulatory Capital	Penalties	Fitness
213	$632,000,000	$290,000,000	$165,000,000	$757,000,000
107	$579,000,000	$288,000,000	$150,000,000	$717,000,000
90	$601,000,000	$292,000,000	$180,000,000	$713,000,000
409	$639,000,000	$300,000,000	$229,000,000	$710,000,000
5	$593,000,000	$290,000,000	$205,000,000	$678,000,000
54	$601,000,000	$287,000,000	$211,000,000	$677,000,000

Genetic Algorithm

Diversity

How do we combine two portfolios to create a new portfolio?

First we describe a portfolio as a list of 0s and 1s. Where each position refers to a potential facility and each facility is either included (=1) or excluded (=0) from the portfolio.

Facility 1 Facility 2 Facility 3 Facility 4……

Parent 1 (Generation 7, Portfolio 213): 00101001100101011000110111000 0…….

Parent 2 (Generation 7, Portfolio 107): 11100010101100011100001101010 0…….

CROSSOVER:
Child (Generation 8, Portfolio 1): 00101001101100011100001101010 0…….

MUTATION:
Child (Generation 8, Portfolio 1): 00101001101100011100001111010 0…….

Genetic Algorithm

The Process

1. **Randomly create a collection of portfolios (the first generation) that each produce a positive fitness score subject to very minimal constraints.**

2. **Rank order the fitness of each one of these portfolios**

3. **Select parents (portfolios) based upon the fitness level of each portfolio.**

4. **Use cross-over and mutation to combine selected parents into a new generation of portfolios.**

5. **Increase the difficulty of the constraints (increase the penalties).**

6. **Repeat steps 2 through 5 a desired number of times and store the best 10 results.**

The top portfolios created to date are a result of 800 generations of 400 portfolios or 320,000 positive fitness portfolios. A significant number of negative fitness portfolios (penalties exceed economic and regulatory capital) are excluded upon creation. The typical run time was 24 hours on a very powerful machine.

Genetic Algorithm

The Results

The model was run for each of three separate sets of optimization goals:

Portfolio Maximization Criteria	Fitness	Facilities	Regulatory Capital	Economic Capital	Total Penalties
Economic Capital	$609,807,168	$338	$274,061,297	$715,684,282	$105,877,114
Regulatory Capital	$263,728,818	$334	$300,173,745	$472,851,580	$36,444,927
2 * Regulatory + Economic	$1,049,050,421	$332	$278,984,318	$614,081,230	$122,999,445

Portfolio Maximization Criteria	Moody WARR	Fitch WARR	Diversity Score	Moody Ind 1 Conc
Economic Capital	215.6	7.1	76.2	7.71%
Regulatory Capital	215.6	7.3	75.1	7.85%
2 * Regulatory + Economic	218.7	7.4	74.9	8.16%

Notes

1. The Fitness scores are not comparable across different goals.

2. Our conception of measuring the economic and regulatory capital has changed since these runs were performed. Results today would vary from those above.

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Data and The KMV Model

Description

Database constructed and maintained within Portfolio Management

- **4150 Facilities from US Corporate Bank**
- **Credit quality minimums, tenor limits and excluded obligors from SCP reduce this to under 2000**
- **Data source ACBS, GBS and Tradeline Systems**
- **Indicators for inclusion in existing Cash CLO as well as Synthetic Bank Book**
- **Indicators for legal review status for existing Cash CLO**
- **Information housed at Primary GCI (Global Customer Identifier level)**
- **Commitments at Primary GCI along with usage from both a Cash CLO and Synthetic CLO perspective.**
- **Agency ratings, logic for missing ratings, and internal risk ratings at Primary GCI level**
- **Industry assignments made at family GCI level (all primary GCIs roll up to a family) by choosing the industry for the primary GCI with the most commitment under its family.**
- **Original and current maturities for each facility**

Data and The KMV Model

Risk Information

The KMV Model is used to produce other database risk values.

•Desired outputs from the KMV model are economic exposure, expected loss % and risk contribution %

•Most inputs to KMV model are produced by John Walter's Risk Capital and Portfolio Analysis Group

•We run the KMV model and populate the database 4 times

– using both Portfolio Management and Risk Capital assumptions

– using both Cash CLO and Synthetic CLO assumptions

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The KMV Model and Economic Risk

Viewpoints

Three potential perspectives:

1. The bank's official methodology promulgated by Risk Capital and Portfolio Analysis

Consistent methodology applied to the credit risk of all bank activities

2. The approach taken by Portfolio Management

More market oriented approach for large US firms only

3. The optimal approach for the Synthetic CLO transaction

Consistent with parts of each approach above

Each perspective will affect the KMV model's inputs, settings, and results

The KMV Model and Economic Risk

Definition of Risk

Credit Loss may be viewed as the actual loss from default after consideration of recovery as well as mark-to-market change resulting from decline in credit quality in the absence of default.

1. <u>Risk Capital and Portfolio Analysis</u>

Loss in the event of default to the target horizon

2. <u>Portfolio Management</u>

Loss in the event of default or mark-to-market change to the target horizon

3. <u>Synthetic CLO transaction</u>

Loss in the event of default to the target horizon (no transaction compensation for mark-to-market decline)

The KMV Model and Economic Risk

Tenor

Tenor reflects both the horizon over which one wishes to measure risk as well as the maturity of each asset in the portfolio.

1. <u>Risk Capital and Portfolio Analysis</u>

Risk is measured to the one year horizon. Each asset's tenor is reflected as the smaller of actual maturity or one year.

2. <u>Portfolio Management</u>

Risk is measured to the one year horizon. Each assets true tenor is reflected in the model.

3. <u>Synthetic CLO transaction</u>

Risk is measured to the transaction horizon (currently three years). Each asset's true maturity is overwritten with a maturity equivalent to transaction maturity (currently three years).

In the case of an asset with a maturity of less than three years, an assumption of rollover is made. In the case of an asset with greater than three years to maturity, the maturity is reduced to three years to ensure the only risk modeled is the risk of default (not mark-to-market value change).

The KMV Model and Economic Risk

Exposure, Expected Default Likelihood and Loss Given Default

Exposure reflects how much we expect to be outstanding if a default occurs. It is determined by applying a Loss Equivalent (LEQ) factor to the unused amount under a facility and adding this to the current used amount under the same facility.

Expected Default Frequency (EDF) is the probability of default to a given horizon.

Loss Given Default (LGD)is the percentage of each dollar of exposure we will lose after bankruptcy takes place. Equivalently, it is par minus the market price of an instrument after a default event occurs.

1. Risk Capital and Portfolio Analysis

Creates and maintains both LEQ and LGD factors. Creates EDF using a one year horizon and the KMV model. The KMV EDF is constrained by a mixture of KMV model data and Historical S&P default rates which create minimum and maximum boundaries based upon the internal risk rating of the entity.

2. Portfolio Management

Uses LEQ and LGD factors from Risk Capital. Uses KMV EDFs to the one year horizon.

3. Synthetic CLO transaction

Use LEQ and LGD factors from Risk Capital. Use KMV EDFs to the three year horizon.

The KMV Model and Economic Risk

Expected Loss, Unexpected Loss and Capital

Expected Loss is the amount we expect to lose to a given horizon. From default: Exposure * EDF * LGD.

Unexpected Loss is a measure of uncertainty of loss (the standard deviation) also known as risk contribution at the asset level. From default: Exposure *Square Root [EDF*(1-EDF)] * LGD

Capital is the amount we hold to reach a certain level of confidence losses will not bankrupt us as an institution. It is very difficult to calculate (thus the KMV model) and is typically expressed as a multiple of unexpected loss (a number which is not difficult to calculate).

1. Risk Capital and Portfolio Analysis

Expected Loss and Unexpected Loss determined to a one year horizon as a result of default risk only. Uses a 99.97% confidence level, consistent with our AA rating from S&P, to scale unexpected loss to capital. Has produced multipliers by risk rating. GCIB average multiple is 11.4 * unexpected loss

2. Portfolio Management

Expected Loss and Unexpected Loss determined to a one year horizon as a result of both default risk and mark-to-market change. Uses KMV model to measure capital for a given portfolio but uses capital multipliers from Risk Capital to evaluate any given asset.

3. Synthetic CLO transaction

Expected Loss and Unexpected Loss determined to transaction horizon (currently three years) as a result of default risk only. Given that the KMV model is run on all of GCIB facilities prior to asset selection, it is not possible to rely upon KMV for capital measurement of the selected portfolio. Instead, the multipliers from Risk Capital are applied to the risk contribution % from each GCIB asset output as produced by KMV.