RUTTER ASSOCIATES LLC

Reviewing Insurance Company Investment Portfolios

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by

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Investment Risk

Investment risk is the possibility that investment returns will fall short of expectations. This can occur due to changes in market conditions or to failures of people and processes.

Investment risk-taking needs to be managed or optimized and not minimized; efficient risk-taking is an input required to produce investment returns (a riskless portfolio will earn a risk-free rate, e.g., a Treasury yield, and will generally not be an adequate outcome for a profit maximizing firm).

Risk and expected return are to be balanced in order to achieve a desired probability of achieving corporate goals, and these include both earnings spread over liability costs and a balanced ALM book (i.e., investing with an eye toward offsetting the interest rate, currency, and other risks embedded in the liability side of the balance sheet).

Most insurance company CIOs with whom we have worked consider themselves *liability-driven investors*.

A Modest Sample of the Skill Sets We Commonly Observe in the Office of the CIO

- Fixed Income Analysis
- Equity Analysis
- Foreign Exchange Analysis
- Complex Structured Product Analysis
- Commercial Mortgage Loan Pricing and Risk Analysis
- Corporate Finance/Valuation
- Risk Management
- Asset and/or Risk Allocation
- Information Technology
- Accounting
- Macroeconomics
- Asset/Liability Management
- Financial Engineering and Analysis of Exotic Derivatives for Hedging, Asset Replication or Income Generation.

This list is reflective of the centrality of the mission of the CIO in the Insurance Industry.

Documentation for Review

- Risk Appetite Statement:
  - E.g., how much investment risk is authorized and how is it quantified?
  - E.g., if CIO hedges liabilities, what percent of market risk must be hedged?

- Policies and Procedures/Investment Guidelines:
  - Mission Statement
  - Asset allocation (or risk allocation) and ALM limits
  - Limits on Privately Placed Securities and Loans
  - Derivative Usage Guidelines
  - Benchmarks and Targets
  - Risk Management Processes

- Validation Studies for All Critical Models: Models have become more important in the low interest rate environment as yield enhancement is sought with increased complexity of structure and optionality and privately placed investment assets for which price discovery is minimal.

- Regular reports to Executive and Board Investment and Risk Committees.

- Daily, Weekly, Monthly, Quarterly Risk Reports and to Whom Distributed.

- Organizational Charts and Bios/CVs of Investment Personnel.

Operational Risk
(People, Processes and Systems)

- Are proper Policies and Procedures, Investment Guidelines and Derivative Usage documents in place?
- Are risks and returns monitored and reported in a thorough and timely manner by qualified, independent personnel and to appropriate Executive and Board committees?
- Are risks and returns quantified by market-accepted standards?
- Do investment and risk personnel fully understand risk/return profiles and valuation of assets (both those that publically traded and private assets) and derivatives?
- Are investment management and risk management compensation schemes consistent with incentivizing desired behaviors and outcomes?
- Does independent risk management maintain an onsite presence?
- Are investment management and risk management systems (internal and vendor-driven) adequate for the tasks to which they are put?

Operational Risk
Sample Taxonomy

- Fraud
- Fat Finger Errors
- Investment Suitability
- “Key Man” Risk (e.g. succession plan for CIO?)
- Compliance/Sanctions and Embargos
- Rogues Gallery:
  - Orange County Treasurer RMBS 1994 ($1.6b loss as rates rose)
  - Barings Rogue Trader $1.25b 1995
  - Societe Generale $1.7b due to unauthorized trades of a junior trader 2008
  - UBS $2.3b due to unauthorized trades of a junior trader 2011

Market Risk

Market risk encompasses the risk of financial loss resulting from movements in market prices. Market risk is rated based upon, but not limited to, an assessment of the following evaluation factors:

- **The sensitivity of earnings or economic value to adverse changes in interest rates, volatilities, correlations, foreign exchange rates, commodity prices, or equity prices.**

- The ability of management to identify, measure, monitor, and control exposure to market risk given the institution's size, complexity, and risk profile.

- The nature **and complexity** of market risk exposure arising from non-trading positions.

- Where appropriate, the nature and complexity of market risk exposure arising from trading and foreign operations.

Market Risk: Metrics and Tools

Sensitivity Measures:

- Duration (and DV01)
- Convexity
- Delta
- Gamma
- Rho
- Vega

Risk Measures:

- Value at Risk (VaR) and Stress VaR
- Earnings at Risk (EAR)
- Expected Shortfall (Tail Risk/Conditional Measure)
- Stress Testing

How are risk and sensitivity measures different?

Market Risk: Sample of Common Stress Tests (source: RiskMetrics RiskManager)

HISTORICAL	PREDICTIVE (SCENARIO)	PREDICTIVE (SENSITIVITY)	RISK TYPE	MODEL PARAMETER
Lehman Crisis (9/8/08-10/27/08)	Asian Crisis 1997	DAX +1%	Credit Spreads +1bp	Implied Volatility
Tech Wreck (4/7/00-4/14/00)	Black Monday 1987	FTSE100 +1%	Credit Spreads -1bp	Recovery Rate
Gulf War 2 (3/1/03-3/21/03)	Black Week 2008	JPM EMBI +1%	Parallel +65bp	Amortization Rate
Bond Rally (5/1/03-6/13/03)	China Hard Landing 2015	Hang Seng +1%	Parallel -65bp	Implied Risk Curve
Bond Sell-off (6/14/03-7/31/03)	Eurozone Break-up 2015	MSCI ACWI +1%	Volatility +10%	CDO Compound Corr
Equity Rally (10/10/02-11/27/02)	Fall 2008	Peak +	Volatility -10%	CDO Base Corr
Equity Sell-off (8/23/02-10/09/02)	Gulf War 1990	Peak -		Issuer OAS
	Mexican Crisis 1995	Twist +		Idiosyncratic OAS
	Rate Rise 1994	Twist -		Hazard Rate
	Russian Deval 1998	USD Flattener		EMC ADCO
	Sept 11	USD Steepener		SABR Model
	WaMu Collapse 2008			
	G8 Equity 1M Worst			

Credit Risk

Credit risk arises from the potential that a borrower or counterparty will fail to perform on an obligation.

Key Products: Credit risky assets such as non-agency mortgages, commercial mortgages, other non-agency ABS, corporate/municipal/sovereign debt, **OTC derivatives**

Key Indicators:

- Credit Ratings (Internal, Rating Agency, Regulatory)
- Credit Spreads
- Debt Service Coverage projections, LTV projections etc.

Key Factors:

- Default Probability
- Exposure at Default
- Loss Given Default

Key Risk Metrics:

- Credit VaR
- Credit Stress Analysis

Model Risk

The possibility of a financial loss, incorrect business decisions, misstatement of external financial disclosures, or damage to the company's reputation arising from:

- Errors in model design and development — data, theory, statistical analysis, assumptions, or computer code underlying a model
- Misspecification, faulty estimation of econometric coefficients
- Misapplication by model users
- Use of substandard frameworks
- Errors in data inputs and assumptions
- Errors in model execution.

Model Risk: Case Study of GMWB Underpricing

Milevsky, M. and T.S. Salisbury, *Financial valuation of Guaranteed Minimum Withdrawal Benefits*, **Insurance: Mathematics and Economics**, Volume 38, Issue 1, 24 February 2006, Pages 21–38

"Our main result is that the No Arbitrage hedging cost of a GMWB ranges from 73 to 160 basis points of assets. In contrast, most products in the market only charge 30–45 basis points. Although we suggest a number of behavioral reasons for the apparent under-pricing of this feature in a typically overpriced VA market, ***we conclude by arguing that current pricing is not sustainable and that GMWB fees will eventually have to increase or product design will have to change in order to avoid blatant arbitrage opportunities."***

Model Risk: Key Models of Rutter Associates' Focus on Investment Portfolio

- Valuation and Risk Assessment of Level II Derivatives (models required, all market inputs observable) and Level III Derivatives (models required, inputs that are both unobservable and significant to the overall fair value measurement).
- Residential Mortgage Prepay, Default, Recovery.
- Commercial Mortgage Default and Recovery.
- Corporate Bond Default and Recovery.
- Term Structure of Interest Rate models applied to fixed income products.
- Waterfall/Reverse Engineering models for structured products.
- Frameworks for Due Diligence on Private Issues.
- Value at Risk, Credit Value at Risk, Expected Life of Portfolio Loss, Earnings at Risk, Expected Shortfall, GAP, net interest income simulation, Stress Tests and other Risk Management Models.

Asset-Liability Management Risk

The risk of loss due to risk parameter mismatches across the balance sheet.

- If derivatives are used by the Chief Investment Officer to hedge optionality in variable annuities, are delta, gamma, rho and vega monitored and hedged within established guidelines?
- On the enterprise level, do the assets in the Investment Portfolio mitigate or amplify aggregate interest rate and other market risks generated by the liability portfolio?
- Gauges include option "Greeks", Interest Rate "GAP" (e.g. floating rate assets – floating rate liabilities), Duration ***and Convexity*** of Economic Value of Portfolio Equity (Assets-Liabilities).

Liquidity Risk

The inability to meet liabilities as they arise due to insufficient cash on hand (funding liquidity) and/or the inability to liquidate assets sufficiently quickly and without catastrophically adverse price effects when required (asset liquidity).

CIO typically concerned with Asset Liquidity, not Funding Liquidity (unless the CIO is also the Treasurer).

- Asset Liquidity can be/should be captured in VaR Horizon.
- Timing of **asse**t cash inflows needs to be coordinated with timing of **liability** outflows. Important to understand liquidity risk by visualizing forecasted exposures under a multitude of scenarios and thus preparing for liquidity shortfalls that may otherwise have been unforeseen (i.e., **Liquidity Stress Testing**).
- Many insurance companies simply assign NO LIQUIDITY credit to structured products and private placements.
- Important to incorporate *collateral planning* into Liquidity plans.

Two Examples of Liquidity Risk Catastrophes

Insufficient Funding Liquidity Example:

- "Ultra-prime mortgage lender Thornburg Mortgage Inc. said on Monday that it had failed to meet $270 million in margin calls received since just last week." (2008)
- "Fitch said it was also concerned about Thornburg's lack of alternative sources of funding, and therefore increased reliance on repurchase agreement financing, given that the firm no longer has access to the commercial paper and asset-backed securitization markets." (2007)

Insufficient Asset Liquidity Example (2008):

- On September 15, 2008 credit rating agencies downgraded AIG to below AA-levels because of its increasing inability to meet collateral demands as well as because of its growing RMBS losses. Following the downgrade counterparties demanded $14.5 billion to be posted as additional collateral as triggers were breached. The value of AIG assets exceeded the face value of liabilities, but AIG could not liquidate assets fast enough to satisfy collateral calls and was therefore insolvent not due to negative equity, but rather due to illiquidity. The US Government bailed them out on September 16. AIG survived, but insolvency was costly.

Derivative Usage

Valuation

- Are adequate models in place to value Level II and Level III derivatives?
- Are adequate data available on a daily basis to value all derivatives?

Counterparty Credit Risk for OTC Derivatives

- What collateral agreements are in place?
- How are collateral requirements monitored and managed?
- How is residual counterparty credit risk (if any) measured?

Hedging

- How is hedge effectiveness gauged? How often?
- What accounts are being hedged?
- Are models adequate to value the accounts being hedged?
- What sensitivities are targeted? Delta? Gamma? Rho? Vega?

Derivative Usage (cont'd)

Asset Replication (e.g. Treasuries + CDS in lieu of corporate bond)

Income Generation (e.g. covered call writing)

No SPECULATION (or, euphemistically, "investment")

- Derivatives Commonly Encountered Include:
  - Total Return Swaps
  - Swaptions
  - Credit Default Swaps
  - Variance Swaps
  - Options on Variance Swaps
  - Index Options and Futures (purchased and written puts and calls)
  - Equity Index put spreads (buy at the money, sell out of the money)
  - Interest Rate Futures
  - Interest Rate Caps and Floors
- Valuation techniques go well beyond Black-Scholes formula and may involve Monte Carlo analyses.

Case Study of A Complex Structured Product: Secured Note

A ***Secured Note*** is comprised of equity and selected debt tranches of a unique leveraged loan Collateralized Loan Obligation (or CLO), repackaged into a single security. Some of the individual tranches are below investment grade, and some above, and the specific tranches and par amounts of each are combined to achieve an investment grade rating for the Secured Note.

The risk profile of the ***Secured Note*** is generally more favorable than that of an equivalently rated tranche of the underlying CLO.

"Typical" Leveraged Loan:

- senior secured corporate loan to a high yield company.
- ranks ahead in capital structure of the company's unsecured high yield bonds
- non-investment grade
- floating-rate debt instrument issued at a spread over LIBOR
- syndicated to multiple lenders in a manner similar to a bond offering

Case Study of A Complex Structured Product: Secured Note

Leveraged Loan CLO:

- Issuer repackages a diversified pool of leveraged loans into a reference collateral portfolio.
- Principal and interest proceeds of the collateral portfolio are subsequently sold to investors in the form of debt securities (*tranches*) with various levels of senior claim on this collateral.
- The typical pool of loans is comprised of 150-300 issuers from upwards of 20 different industries (there are thousands of issuers of leveraged loans worldwide).
- A first-loss *equi*ty tranche holds a claim on excess cash flows after obligations on each debt tranche have been met.
- The issued tranches receive payments via a waterfall that pours cash flows from the underlying collateral pool beginning at the top of the CLO capital structure (the most senior tranches) and then flowing down to the mezzanine tranches and finally to the bottom of the capital structure (junior and then equity tranches).
- The cash flows from the underlying collateral pool are at risk to high default rates and low recoveries especially as the CLO comes to the end of its reinvestment period.

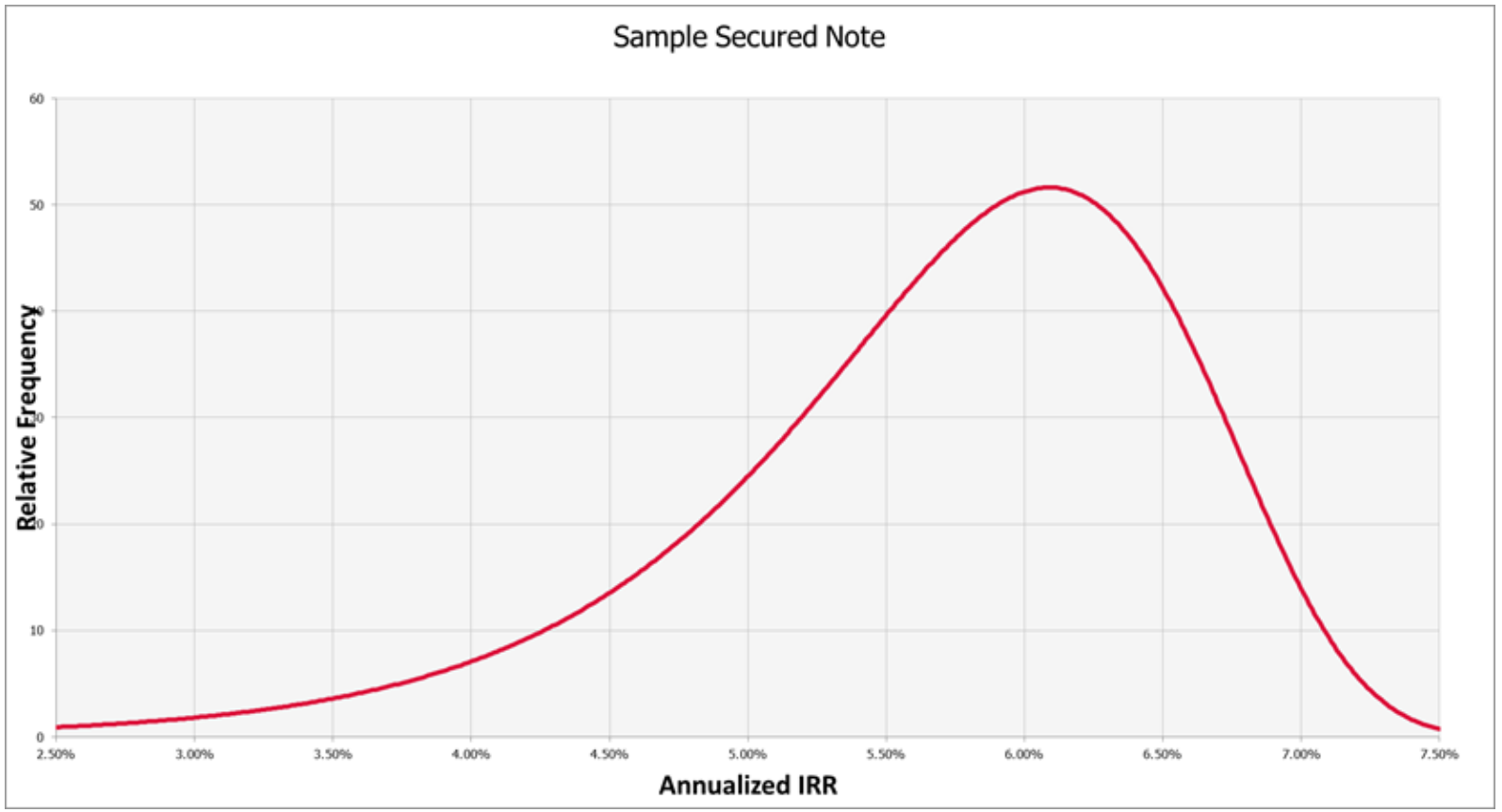
Case Study of A Complex Structured Product: Secured Note

Analytics Required to Analyze Secured Note

- Models for default probabilities and recovery rates of each leveraged loan in the collateral pool and a simulation engine to drive scenarios.
- Model for default correlation among loans in the collateral pool.
- Model or assumptions about loan prepayments.
- Model of cash flow "waterfall" for CLO structure that simulates cash flows for each CLO tranche from senior (AAA) to equity (unrated). Aggregate cash flow depends on loan spreads and loan performance. There are a number of "rules of the game" for CLOs that can lead to diversion of cash flows among tranches including overcollateralization tests and interest coverage tests. These need to be modeled properly.
- Model to aggregate cash flows from tranches selected for Secured Note into a single security.

Case Study of A Complex Structured Product: Secured Note

Example of Rutter Associates Analytical Results (10,000 Monte Carlo Simulations)



Secured Note	Sharpe Ratio	Sortino Ratio	Mean IRR
	4.016	3.264	5.72%

Bio

Bob Selvaggio joined Rutter Associates as Partner and Head of Analytics in 2010. Prior to joining Rutter Associates, Dr. Selvaggio was Senior Vice President and Head of Risk Analysis in Fidelity Investment's Institutional Products Group. At Fidelity he oversaw Capital Markets risk, potential counterparty exposure, CVA and risk adjusted performance measurement. Prior to joining Fidelity, Dr. Selvaggio was Managing Director and Head of Capital Planning and Risk Analysis of Ambac Financial Group, Inc. responsible for portfolio credit and market risk analysis, economic and rating agency capital attribution and allocation, and risk-adjusted performance measurement. Prior to joining Ambac, Dr. Selvaggio served as a financial economist at Thomson McKinnon Securities, and then held a number of positions at The Chase Manhattan Bank including Senior Asset/Liability Analyst, Head of Fixed Income and Mortgage Research, and Managing Director of Treasury Analytics.

While at Chase Manhattan Bob served for six years as adjunct associate professor of economics at Hunter College teaching graduate courses in corporate finance, financial economics, macroeconomics and microeconomics, and supervising master's theses. Bob recently authored "Three Lessons of and since the Financial Crisis" in the Summer 2017 Journal of Structured Finance and contributed a lecture transcript to Simkins et al, "Economic Value of OTC Derivatives used by Non Financial Firms", Journal of Applied Finance, No. 2, 2014.

Bob has lectured on financial economics at the Wharton School of the University of Pennsylvania, NYU Courant and Georgetown University. Dr. Selvaggio is currently an adjunct assistant professor of advanced financial risk management at NYU and a Master instructor of Taekwondo free fighting. Bob is a member of the American Economic Association and National Association of Business Economists, and is a BAI Certified Risk Professional in Credit and Treasury/ALM. A graduate of the University of Pennsylvania, Dr. Selvaggio holds a Ph.D. in Economics from Brown University where he was a University Fellow.