

Risk Management

The Art and Science of Financial Modeling

Part 1

Tuesday, July 20, 2021
12:25 pm-1:40 pm

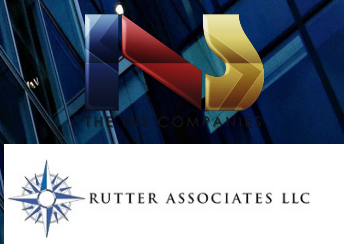
Part 2

Tuesday, July 20, 2021
2:10 pm-3:00 pm



INS Companies:
Richard Foster, Financial Regulation Manager
Annette Knief, Managing Director
Cheryl Plozicka, Financial Regulation Senior Manager
Kelly Willison, Financial Senior Manager

Rutter Associates, LLC:
Bob Selvaggio, Ph.D.



Session Agenda



Part 1



What is financial risk?



What is Financial Risk Management



Key Financial Risks and Key Metrics

Part 2



Models for Risk and Valuation



Questions

Session Presenters



Richard Foster
Financial Regulation
Manager



Annette Knief
Managing Director



Bob Selvaggio, Ph.D.
Co-Owner and President
Head of Analytics
Rutter Associates, LLC



Kelly Willison
Financial Senior
Manager



Cheryl Plozicka
Financial Regulation
Senior Manager



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Session 1

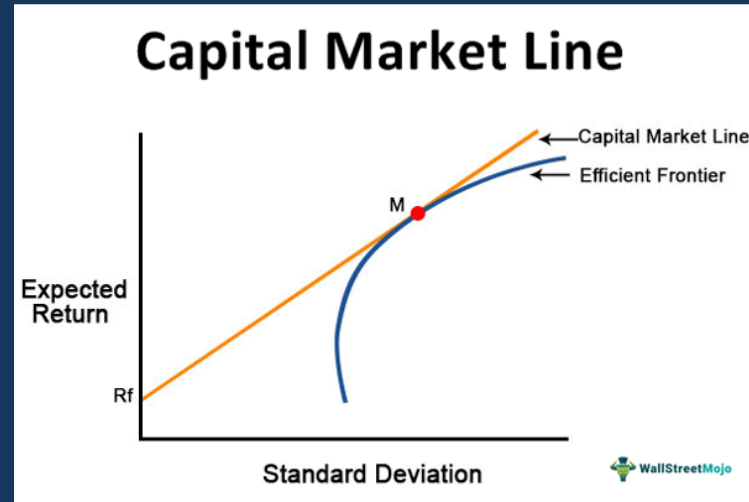
1st Code 683

What is Financial Risk?

- Financial Risk is the quantifiable probability of a result different from the expected performance of a financial asset (or liability). We will focus on the asset side of the balance sheet, but liability items such as Variable Annuities have substantial associated financial risk.
- Financial Risk is accepted to earn a premium above the returns offered by riskless assets.
- Investors differ in their appetite for financial risk, but rational investors seek to maximize their expected financial asset returns given their individual levels of risk tolerance.

What is Financial Risk?

- Modern portfolio theory provides the tools to maximize risk-adjusted returns in investment portfolios:



- Every choice of asset allocation along the CML has the same “maximum” risk adjusted return. Standard optimization calculus allows finding the various allocations that map that line.

Source: <https://www.wallstreetmojo.com/capital-market-line/>

What is Financial Risk?

- But such allocation is not a “set it and forget it” exercise – risks evolve over time and emerge constantly.
- Financial “Risk” is not the same as Financial “Uncertainty” and this is an important distinction when thinking about “models”.

Economist Frank Knight first explained in 1921 that risk applies to situations where we do not know the outcome of a given situation but can accurately measure the odds. Uncertainty, on the other hand, applies to situations where we cannot know all the information we need in order to set accurate odds in the first place.

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What is Financial Risk Management?

Financial Risk Management is NOT:

- The Art and Science of Minimizing Risk
- Something done only by CROs and their Quant “Geeks”

Financial Risk Management IS:

- The Art and Science of Maintaining Levels of Risk Consistent with an Institution’s Risk Tolerance and Optimizing the Risk-Return Tradeoff given an Institution’s Risk Appetite

What is Financial Risk Management?

Risk appetite is the amount and type of risk that an organization is prepared to pursue, retain or take. Risk appetite statements should be linked to/consistent with the underwriting and investment goals of the company.

Risk tolerance is the quantified acceptable level of variation around a particular set of risk-based objectives. It's a measurement of exactly how much of a loss an organization is willing to experience given their existing assets and the other risks it currently faces. Risk tolerance is often expressed as limits to potential loss of capital relative to shareholders' equity over a given period, downside limits to RBC ratios, or maintenance of an NRSRO rating. Specific stress test limits for credit, market, operational and other risks are specified as well as loss limits against probabilistic tail losses. Many firms are now including tolerances to climate risk as well.

What is Financial Risk Management?

Financial Risk Management IS:

- The Responsibility of the CEO and Board of Directors who define Risk Appetite and Tolerance.
- The Responsibility of the Business Unit Leaders, the “first line of defense”.
- The Responsibility of the Office of the CRO, the “second line of defense”.
- The Responsibility of the Audit Team, the “third line of defense”.

What is Financial Risk Management?

Financial Risk Management is a shared responsibility:

- The first line of defense is the business staff who “own” the risks (and to some extent the rewards) associated with the business process, function, or activity for which they are responsible.
- The second line of defense is the associated oversight areas for the risk. This includes the office of the Chief Risk Officer, Financial Control, Compliance, and the Chief Actuary (if that role has no first-line P&L responsibility). These functions must not have reporting lines into the first line of defense.
- The third line of defense is the internal and external audit groups that provide independent assurance over the risk.

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Session 1

Key Financial Risks And Associated Metrics

Key Financial Risks



Market Risk is the risk of financial loss resulting from movements in:

- Market prices
- Foreign exchange and interest rates
- Volatilities, and
- Correlations.

Asset-Liability risk is a subset of market risk and until the 1980s ALM pretty much defined market risk management.

Source: Source: market-finance-stock-market-falling-prices-wallpaper-preview.jpg (728x297) (wallpaperflare.com)

Key Financial Risks



Credit Risk is the risk of financial loss resulting from a borrower or counterparty's failure to perform on an obligation.

Examples include:

- Bond defaults and downgrades (although “market” downgrades via spread widenings are often viewed as market risk events)
- OTC derivative counterparty failures
- Collateral shortfalls

Credit Risk is oftentimes the most significant financial risk an insurer faces and the most significant driver of risk-based capital.

Source: 46462473222_57a6618ba2_b.jpg (1024x741) (staticflickr.com)

Key Financial Risks



Liquidity Risk is the risk of financial loss from the inability to liquidate assets sufficiently quickly and without catastrophically adverse price effects (fire sale pricing) when required.

Examples include:

Thornburg Mortgage. *The Santa Fe, New Mexico-based company had specialized in making mortgages larger than \$417,000 to borrowers with good credit. Thornburg has struggled with liquidity problems since the summer of 2007, when the value of mortgages on its balance sheet (which served as collateral for loans) began to fall, and later suffered a series of margin calls from its creditors.*

Key Financial Risks

Thornburg Mortgage only wrote “pristine” jumbo mortgage loans with high FICOs and low LTVs. The company was not writing Alt-A or Subprime mortgages.

Their failure was a function of asset illiquidity leading to funding illiquidity.

Their funding lines (lifelines) disappeared, and their assets were ultimately sold at fire sale prices.

Asset liquidity risk is generally managed through asset diversification, limits on private investment and other less-liquid assets, and by incorporating liquidity considerations in VaR metrics by adding the expected costs of unwinding positions in a stressed market (next section).



Key Financial Risks

Operational Risk is the risk of financial loss from failures of people, processes, and systems (e.g., fraud, “key man” risk, fat finger errors, cyber-attacks)

- Operational risk is measured and minimized subject to cost/benefit constraints. There is no positive return to operational risk, only returns to reducing it.
- Databases for statistical risk assessments of operational risk are still rare, but probabilistic statements about operational losses are often made for purposes of economic capital attribution.
- Generally, Key Risk Indicators (KRIs) and self-assessments of these are used to monitor and encourage reduction of operational risk.



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Key Financial Risks

Model Risk is the risk of financial loss 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



Source: [financial-crisis-544944_960_720.jpg \(960×678\) \(pixabay.com\)](https://www.pixabay.com/photo/2015/01/27/544944/960_720.jpg)

Key Financial Risks

Model Risk's Continued



- Use of substandard frameworks
- Errors in data inputs and assumptions
- Errors in model execution

Model Risk leads to faulty valuation of financial assets that require model-based pricing (Level 2 and Level 3 assets) and to faulty risk assessments based on model-driven risk metrics.

Source: [financial-crisis-544944_960_720.jpg \(960x678\) \(pixabay.com\)](https://www.pixabay.com/photo/2015/01/14/544944/960/720/financial-crisis-544944_960_720.jpg)

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk



We start our discussion of risk metrics with a nod to the importance of Model Risk Management which we will pick up in Session 2, because so many of the key risk metrics used by financial institutions (that we will discuss below) are based on models.

The infamous “London Whale” episode in which JPMorgan/Chase lost over \$6 billion was due in large part to the use of a faulty “Synthetic Credit Value at Risk” model that was insufficiently documented and validated. The episode cost Ina Drew her job and Jamie Dimon \$11.5mm in 2012 compensation.

Source: financial-crisis-544944_960_720.jpg (960×678) (pixabay.com)

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Market Risk: Value at Risk

Value at Risk (or “VaR”) is a model-based estimate of the loss an institution will exceed due to unexpected changes in prices, rates, volatilities, correlations, etc. over a given horizon at a specified level of probability. This leads to statements such as “we are positioned to lose \$10mm or more with less than 1% probability in any 10-day period” or “our 99 percentile 10-day VaR is \$10mm”.

If \$10mm is above the VaR limit, decision makers can hedge or take other action such as rebalancings to bring that VaR down.

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Market Risk: Value at Risk

“**Expected Tail Loss**” is a VaR variant and measures the expected loss given that the 99-percentile event has occurred.

Institutions typically set tolerance limits for VaR; some for expected tail loss.

The three key modelling approaches are historical look-back, Monte-Carlo, and Parametric. We will briefly discuss each.

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Market Risk: “The Greeks”

Delta, Gamma, Rho, Vega (Duration, DV01, Convexity):

No probability assessments here but understanding financial asset sensitivities to small changes in prices, rates and volatilities is important for hedging, especially in the case of life insurers, hedging Variable Annuities.

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Credit Risk: Credit VaR

By assigning (model-based!) default probabilities, recovery rates in the event of default, and default or asset-value correlations to the credits in a portfolio and performing Monte Carlo analysis, risk managers can make statements such as “we are 99% confident that our credit losses in the coming year will not exceed \$100mm”. This is Credit VaR or CVaR.

If decision makers think \$100mm is too large a CVaR or if a CVaR limit is being exceeded, they can hedge or alter their portfolios to bring that CVaR down.

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Economic Capital: Putting Market, Credit and Operational Risk Together

Insurers use Economic Capital to inform their internal views of resources needed to maintain a given credit rating and to support risk-based decision making. It is a measure of required protection against unexpected future losses at a selected confidence level.

Let's suppose an insurer is targeting an AA rating (i.e., 99.97%-ile 1-year solvency standard) and is exposed to Market Risk, Credit Risk and Operational Risk. The planning horizon is 1 year.

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Economic Capital: Putting Market, Credit and Operational Risk Together

One common approach would have the Company calculating its one-year 99.97 percentile VaR for Market Risk, Credit Risk and Operational Risk as well as correlations among the three and combining these into a single total VaR:

$$\begin{aligned} \text{VaR}(\text{total}) = & [\text{VaR}_M^2 + \text{VaR}_C^2 + \text{VaR}_O^2 \\ & + 2\text{VaR}_M \text{VaR}_C \text{Corr}(M, C) + 2\text{VaR}_M \text{VaR}_O \text{Corr}(M, O) \\ & + 2\text{VaR}_C \text{VaR}_O \text{Corr}(C, O)]^{1/2} \end{aligned}$$

Economic Capital = VaR(total) – Expected Credit and Operational Losses

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Market and Credit Risk: Stress testing

Probabilistic Risk Assessments and Limits based on these are important but are not sufficient. Institutions should be doing robust stress-testing. This involves “replaying” the market shocks that characterize historical stress incidents or simulating hypothetical stress scenarios. A good set of scenarios used by many institutions as suggested by RiskMetrics is the following slide.

Institutions should also be considering hypothetical “reverse stress tests” that are aimed at finding situations that cause financial distress.

The Key Risk Metrics for Measuring, Managing and Limiting Financial Risk

Market and Credit Risk: Stress testing

Scenario	Portfolio P&L	Benchmark P&L
2001 Fed Rate Cut		
2003 Iraq War		
1995 US Dollar Rally		
1999 Brazilian Real Crisis (Peak)		
1994 Mexican Peso Crisis		
1997-1998 Asian Financial Crisis		
1998 LTCM Collapse		
2000 LDC Decline		
1989 - 1990 Nikkel Stock Price Correction		
2007-2009 Subprime and Credit Crisis		
2008 - 2009 Global Financial Crisis		
1987 Market Crash (Aug. to Nov.)		
2007-2008 Equity Slow Grind		
\$200 per Barrel - Oil Supply Shock		
1998 Russian Financial Crisis		
2001 Sept 11		
2006 Emerging Market Crash		
1990 Reunification of Germany		
1973 - 1974 Oil Crisis		
2020-2021 Pandemic		

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Presenter Contacts

Richard Foster
Financial Regulation Manager

The INS Companies
Mobile: 308.430.5377



Email: rfoster@theinscompanies.com

Visit: www.theinscompanies.com

Annette Knief
Managing Director

The INS Companies
Mobile: 913.568.7725



Email: aknief@theinscompanies.com

Visit: www.theinscompanies.com

Cheryl Plozicka

Financial Regulation Senior Manager

The INS Companies
Mobile: 704.640.4776



Email: cplozicka@insris.com

Visit: www.theinscompanies.com

Robert D. Selvaggio, Ph.D.
Co-Owner and President
Head of Analytics

Rutter Associates, LLC
Mobile: 914.500.5373



Email: rselvaggio@rutterassociates.com

Visit: <https://www.rutterassociates.com/>

Kelly Willison

Financial Regulation Senior Manager

The INS Companies
Mobile: 917.535.3378



Email: kwillison@insris.com

Visit: www.theinscompanies.com

Questions

