Extending ERM To Multi-Employer Pension Plans

Doug Andrews

April 2006

Why ERM Applies To MEPPs

- Stand-alone legal entities
- With sole responsibility to deliver on benefit promises
- Managed by a board of trustees that has fiduciary responsibility
- From the perspective of the board, the MEPP is an enterprise

Operational Risk Management

- Two proposals to reduce conflict of interest: change governance structure and purchase annuities on retired lives
- Trustees should have an up-to-date risk map that identifies related risks
- The risk map will identify each risk, assign responsibility and reporting schedule, indicate potential severity
- Trustees should have a report on financial position including projections

Proposed Governance Changes

- Approval panel appointed by constituencies
- Nominating committee proposes candidates for the board
- Initial and ongoing education and training program for board members
- 6 to 8 board members for 3 year terms
- Board members should be appropriately compensated

Pension Benefit Protection Funds

- Should be available to MEPPs with premiums set following actuarial principles
- MEPPs should be categorized based on how the liability for participating employers is pooled
- Separate risk classification into underfunding and solvency risk
- Protected benefit levels should be set
- Asset allocation should be a risk factor

Scenario Analysis Should Examine

- Pattern of contributions and contribution rate
- Rate of increase in future liabilities
- Correlations between contribution inflow, benefit payouts and investment returns
- Financial status of participating employers

Flexible Pension Promises

- Trustees would set a long term “ultimate” benefit level expected to be maintained regardless of financial position
- Benefit increases granted on ad hoc basis
- Clear communication that increases not guaranteed and could be eliminated at any time with appropriate notice
- Termination benefits based on ultimate level

Reasons To Annuitize

- Longevity risk cannot be hedged or diversified but can be insured
- It is prudent to transfer risks when an appropriate method is available
- Awkward fiduciary situation if retiree pensions which could have been provided in full must be decreased
- Certain issues of conflict of interest are reduced

Some Investment Implications

- Retiree pensions should be annuitized
- The ultimate level of benefits should be suitably matched by relatively risk-free investments
- Risky assets as required for target benefits
- Diversification benefits, correlation effects and liquidity should be considered
- Industry of MEPP and life-cycle of participating employers should be incorporated in policy
- Pooling of assets among MEPPs may enable specialized investments

OTPP Example

- Asset types: equity, fixed income and inflation sensitive
- Governance structure emphasizes focus on returns, independence, professional board
- Active management
- Proprietary risk management system
- Culture which is nurturing, innovative, pedagogical, and which keeps egos in check

Principles For A MEPP Risk Accord

- MEPPs should have a process for mapping risks, identifying vulnerabilities, and prioritizing risk management actions
- MEPPs should have a process for assessing financial adequacy and a strategy for maintaining financial position
- Regulators should evaluate assessments and strategies
- Regulators should establish a protection benefit fund for MEPPs and revise legislation that impedes sound risk management processes

Summary of Recommendations

- Restructure the method of appointment of trustees with the objective of having a paid professional board with appropriate expertise
- Maintain an up-to-date risk map and prioritize actions to manage risk
- Receive timely reports on financial status including sensitivity analysis
- Adopt a flexible-pension-promise design with ad hoc increases and low-risk investment policy for ultimate benefits

Recommendations Continued

- Purchase annuities in respect of retired lives
- Coordinate activities to gain access to a wider range of investment opportunities
- Regulators should ensure that a pension benefit protection fund is in place
- Adopt an accord to be followed in the management and regulation of MEPPs

ERM for Value

Jeremy Gold

ERM Symposium
Session 5 - Scientific
Chicago - April 25, 2006

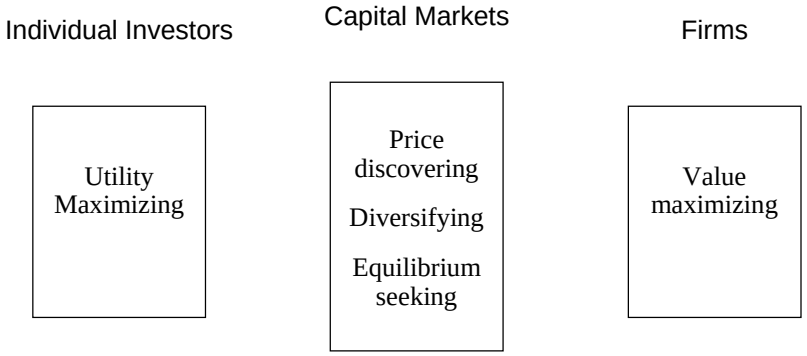
Headlines

- Risk management:
  - it's not about risk and reward
  - it's about value
- Corporations can add value by shorting the market

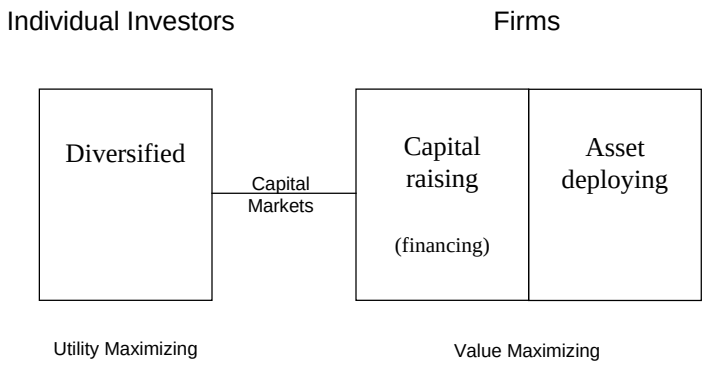
Outline

- Corporate framework and definitions
- Projects and NPV
- Pricing risk
- Project portfolio
- Disposing of risk
- Financial firms and pension plans

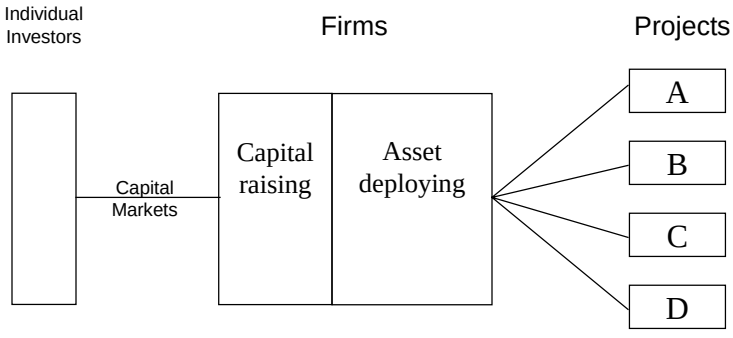
Corporate framework and definitions



Corporate framework and definitions



Projects and NPV



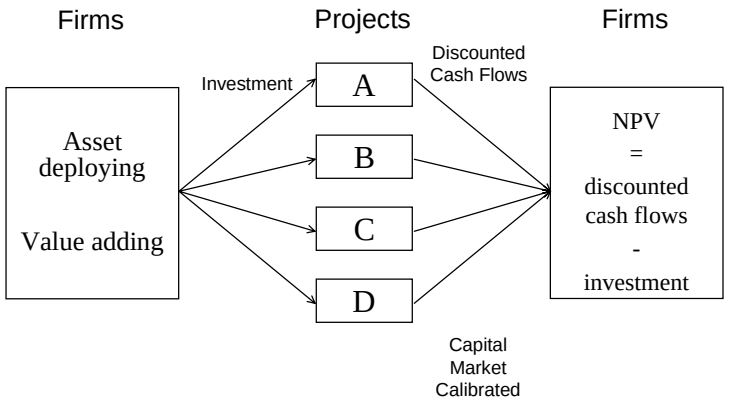
Projects and NPV

- Projects are real investments by firms
- Firms add value by selecting, investing in, managing projects.
- Industrial firms raise capital by issuing generic securities that are deployed in value-adding asset-side projects
- Financial firms reverse:
  - projects consist of designing products:
    - for policyholders
    - depositors, or
    - (for pension funds) employees
  - these firms add value on the liability side — their assets are generic and usually are not a source of added value.

Projects and NPV

- Projects require investment and result in cash flows
- Project (i) net present value (NPV_i)
  - defined as the discounted cash flows (using market rates for similarly risky flows) less the required investment.
- Discount rate from an asset pricing model.
  - Example the CAPM.
  - Other models may be used.
  - Rate reflects systemic (non-diversifiable) risk (aka β)
  - Does not reflect diversifiable risk.

Projects and NPV



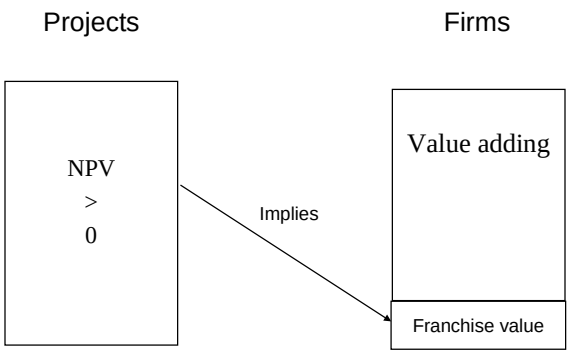
Projects and NPV

- Firms exist to add value
- Perfect competitive equilibrium => all project NPV = 0
- Too perfect, markets aim at (but do not reach) equilibrium.
- Project: make and sell carbonated, flavored, sugar-water.
  - manufacturing costs are competitive
  - products barely differentiable.
- Why can Coke and Pepsi charge more than Brand X.

Projects and NPV

- Coke (Pepsi too) has competitive advantage over Brand X
  - Brand recognition
  - Distribution
- Unit costs pretty similar, unit price much higher for Coke than for X.
- Thinking of the unit as a project (or a gazillion units, if you insist), we appear to have added value, i.e., NPV > 0.

Projects and NPV



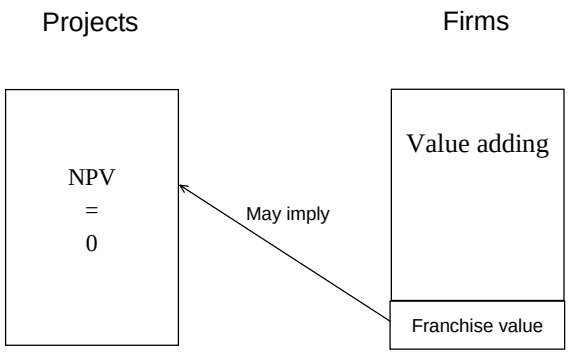
Projects and NPV

- For purpose of this analysis, however ...
  - We define project value from the shareholder perspective.
  - Superior unit price for Coke is no surprise
    - price of Coke stock already anticipates it
    - higher stock price reflects the existing franchise value from brand recognition, distribution, etc.
  - Coke must deliver returns to shareholders merely to justify the franchise value already in the stock.
  - So we adjust the NPV to reflect the required return on franchise value.

Projects and NPV

- "Cost of capital" is ambiguous
  - we might say that the return on franchise value is built into Coke's cost of capital
  - thus the project (making & selling a unit) has an NPV = 0
  - we start with a zero NPV for the unsurprising project.
- Value is only added after accounting for required returns on franchise value. We modify the chart.

Projects and NPV



Projects and NPV

- Project risk — the following distinction may strike you as semantic. I think it reflects an important mindset:
  - Risks are not taken to pursue reward
  - Projects are undertaken in pursuit of rewards
  - Risks are attached

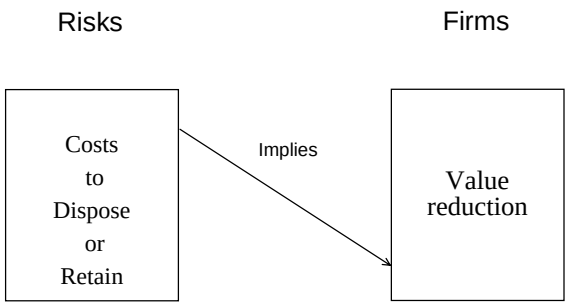
Pricing risk

- A firm needs to price risk two ways:
  - The disposition value is the cost to get rid of the risk
    - hedging
    - insurance
    - operationally
  - The retention value is the impact that the risk has on financial distress costs

Pricing risk

- Financial distress encompasses many concepts and costs, including:
  - bankruptcy
  - increasing capital costs
  - under investment
  - principal agent problems
  - some tax effects, etc.

Pricing risk



Pricing risk

- The project value (NPV_i) developed earlier reflects market pricing of systemic risk and the role of franchise value but only applies to a firm entirely free of financial distress.
- Project value (restated) = $NPV - \mathbf{min(}\text{disposal}, \text{retention}\mathbf{)}$
- But risk retention cost not determinable at the project level.
- Enterprise risk management tells us that we must recognize risk retention as a portfolio of risks.
- We must maximize firm value by maximizing project values in the context of a portfolio of projects and risks.

Project portfolio

- Further, every project can have several types of risk and we want to minimize the cost of each type.
- Project value (restated) = $NPV_i - \mathbf{min}(d_{ij}, \tilde{r}_{ij})$
- where i designates the project and j the type of risk;
  - d_{ij} is the cost to dispose of risk j for project i;
  - $\tilde{r}_{ij}$ is marginal cost of retaining a portfolio of risks.

Project portfolio

- Project values, the choice of which projects to invest in, and even the choice to retain or dispose of a particular risk depends on the debt/equity level we may use for financing.
- We can bring the amount of borrowing into the picture by treating borrowing as a project; call it project 0.
- In order to maximize shareholder value we will, for every project and type of risk, choose disposal or retention and the fraction (w_i) of starting shareholder value to deploy.

Project portfolio

- Our borrowing "project 0" will have a non-positive weight $(w_0 \le 0)$ and a value: $NPV_0 - \tilde{r}_0$
- Taxes make $NPV_0 > 0$
- All other project weights are non-negative: $i > 0 \Rightarrow w_i \ge 0$
- Total project weight is unity: $\sum_{i=0} w_i = 1$

Project portfolio

- Shareholder value may now be represented as the sum of NPV's for projects net of the risk cost:
  - $SV = FV - w_0(npv_0 - \tilde{r}_0) + \sum_{i=1} w_i(npv_i - \sum_j \min(d_{ij}, \tilde{r}_{ij}))$
  - where $-w_0 \ge 0$ implies that borrowing is done if it adds value
  - and $\tilde{r}_{ij}$ must be evaluated as a marginal component of the total financial distress cost (FD) reflected in the portfolio of retained risks.
- Want to maximize SV.

Project portfolio

- We define a "plan" as a vector of weights:

$$\mathbf{w} = \{w_i\}, \sum_{i=0} w_i = 1, i > 0 \Rightarrow w_i \geq 0, w_0 \leq 0$$

  - together with a series of risk management choices:

$$\mathbf{min}(d_{ij}, \tilde{r}_{ij}), \forall j, i > 0$$

- To develop these choices we look at:
  - risk disposal costs
  - risk retention costs at the portfolio level:

$$\tilde{F}d = \tilde{r}_0 + \sum_{i,j} (w_i \tilde{r}_{ij} \mid d_{ij} > \tilde{r}_{ij})$$

- We find the plan that maximizes SV

Disposing of Risks

- The Banana — The CRO sees a banana peel on the floor, picks it up and throws it in the garbage. Operational risk management can add to NPV.
- Capital markets hedge — After correlating all the risks in our retained risk portfolio, we see that we can reduce some retained risk costs ($\tilde{r}_{ij}$) by executing a swap that exchanges one market instrument for another. Because, ignoring minor transaction costs, such a swap is "free" since it has no effect on NPV, we execute it.

Disposing of Risks

- **A remarkable capital markets hedge!**
  - Systemic risk β is irreducible in the market portfolio
    - asset pricing models assert that this implies an equity risk premium.
  - Because β reflects common market factors
    - majority of projects and firms in most industries will be "long" β.
  - As with our other market hedges, β may be shorted free.
    - S&P futures contract is one simple way to do this.
  - β is likely to exacerbate financial distress in most firms.

Disposing of Risks

- **A remarkable capital markets hedge!**
  - For any one firm, shorting β will have no effect on NPV and will increase SV to the extent that it reduces the cost of retained risks.
  - Thus many firms following the discipline outlined herein will conclude that they should reduce firm β.
  - This suggests further research:
    - what if many firms tried this?
    - what would the new equilibrium look like.
    - what (seemingly very high) equity risk premium would allow the market to clear?

Disposing of Risks

- **A remarkable capital markets hedge!**
  - Further support for the short-β strategy comes in the form of new research presented in a paper by Almeida and Philippon at NYU.
  - Previous researchers have discounted financial distress costs within firms either at the risk free rate or at the firm's own weighted average cost of capital (WACC) which invariably exceeds the risk free rate.
  - Almeida and Philippon argue that discounting should be done with a rate below risk free because financial distress is negatively correlated with the market portfolio. When the overall market declines, financial distress costs in most firms increase.

Disposing of Risks

- **A remarkable capital markets hedge!**
  - Financial distress has negative β! Since firms are short financial distress, they are long extra β attributable to their own financial distress. This adds to our earlier rationale for firms to short β.
- And now back to our regularly scheduled programming.

Disposing of Risks

- Insurable risk — pure finance theory says we need never insure risks because shareholder diversification effectively spreads such risk over the entire capital markets.
- Nonetheless, even when insuring a risk is costly (i.e., $d_{ij} > 0$), we will insure in accordance with our general rule if disposal is cheaper than retention.
- Because insurance is a transfer of risk to another firm within the capital markets, we might ask why this would be cost effective?
  - We rent the insurer's balance sheet, capital, and expertise.
  - We inherit a slice of the insurer's financial distress cost.
  - Sometimes this is cost effective, sometimes not.

Financial firms and pension plans

- Financial firms seek value-added projects on the liability side.
  - products attract funds below the cost of market instruments.
- Banks offer below market returns on deposits.
  - depositors exchange for other banking services and conveniences.
- Insurance companies offer below market returns on policies.
  - insurers pool risks more efficiently than individuals
  - homeowner prefers paying his fire insurance premium to taking the risk on losing his entire home; will pay more than expected loss.
  - with a large pool of risk averse homeowners, an insurer can pool the risk and thus manufacture the coverage with a profit.

Financial firms and pension plans

- Many banks and insurers believe they also add value on the asset side of their balance sheets.
  - Financial theory says that this may be true but that this amounts to a second business — investment management.
  - Academics are not inclined to believe that the majority of firms can add value by beating the market.
  - If the source of value in the insurance industry comes from risk management, product design, and policy acquisition, we may see more investment outsourcing
    - a mirror image of the mortgage finance industry where many banks originate loans, leaving capital raising to the capital markets.

Financial firms and pension plans

- Defined benefit pension plans make fixed promises and invest in risky assets “for the long run.” In recent years, finance theory has nearly demolished the idea that this adds value.
- At a crossroads in pension finance.
  - illusory free lunch discredited
  - sponsors are focusing on the risks and many are fleeing.
- DB’s can add value through workforce management:
  - attracting, retaining, motivating and exiting employees efficiently.
  - today’s sponsor community appears skeptical.

Financial firms and pension plans

- DB's are liability-side projects
  - add value through benefit design,
  - not through clever asset allocation and management.
- DB's could be a laboratory for risk management.
  - matching the promises with fixed income securities
    - reduces risk.
    - increases tax effectiveness.
- Tepper-Black arbitrage demonstrates that investing in taxable fixed income increases shareholder value when compared with investing in equities.

Financial firms and pension plans

- Gold (2001)* demonstrates that DB pension plans can add value by shorting β.
  - e.g., cash balance plans that promised equity returns to participants while investing in taxable fixed income.
- Combined with the remarkable capital markets hedge described earlier, the added shareholder value derived from the tax arbitrage implies that firms should use their pension plans as the location of first choice for a value-adding β-shorting strategy!
- Er, Q.E.D.?

* http://library.soa.org/library/monographs/retirement_systems/M-RS02-3/M-RS02-3_I.pdf

ERM for Value

Jeremy Gold

ERM Symposium

Session 5 - Scientific

Chicago - April 25, 2006

GUY CARPENTER

Applying Actuarial Techniques in Operational Risk Modeling ERM Symposium

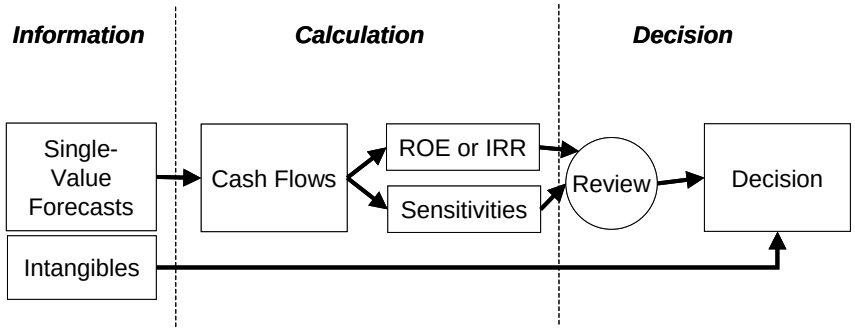
Don Mango, Guy Carpenter & Co.

Overview

- This session is woefully inadequate to do anything more than highlight the material in the paper.
- If interested, read the paper!!
- Many operational risks are insured by property-casualty insurers.
- Actuarial techniques have already been proposed as best practice in operational risk modeling.
- I will provide practical assistance in risk-return preferences, cost-benefit tradeoffs, and allocation of the cost of risk mitigation.

Evolution of Decision Making

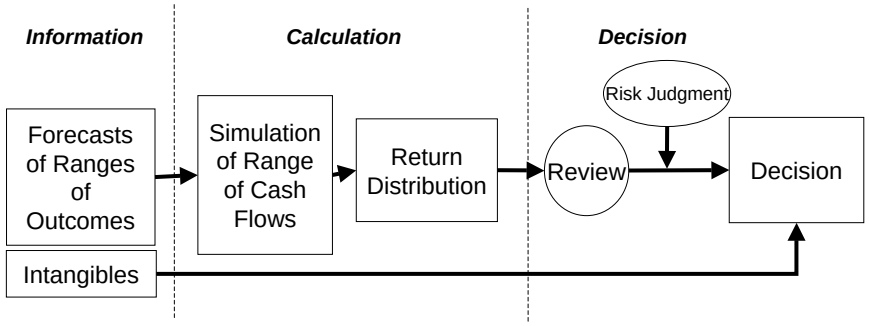
#1: Deterministic Project Analysis



- **Carl Spetzler**, "The Development of a Corporate Risk Policy for Capital Investment Decisions," *IEEE Transactions on Systems Science and Cybernetics*, Sept 1968

Next Step: Risk Analysis

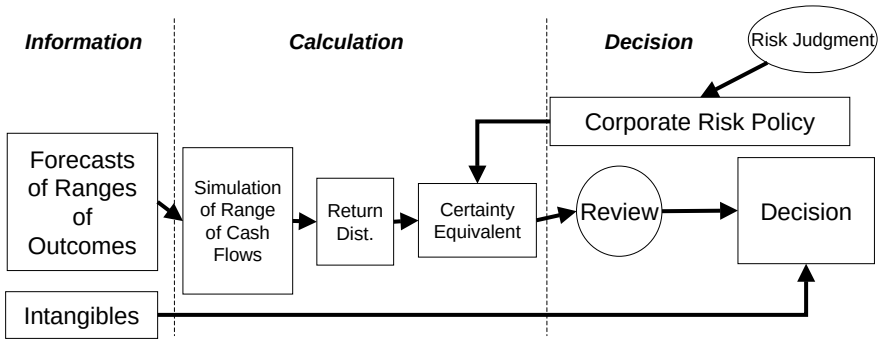
#2: Risk Analysis



- Similar to DFA or Monte Carlo processes
- Uncertainty in variables is quantified
  - Only info which is impossible/too costly to quantify remains intangible
- Judging the acceptability of alternatives ("Risk Judgment") is intuitive and specific to the decision maker

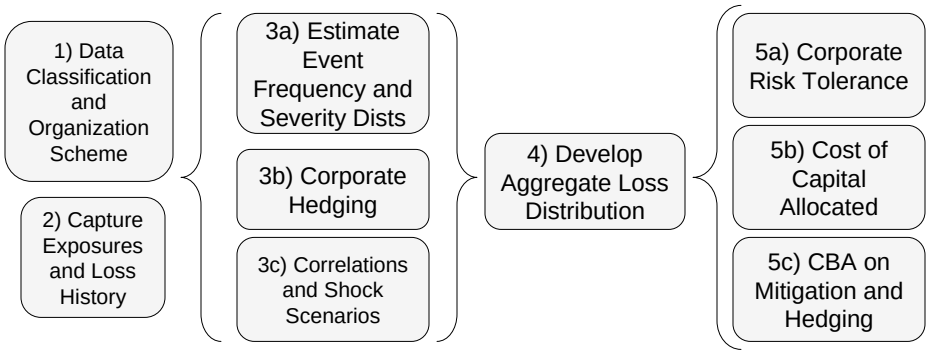
Next Step: Certainty Equivalent

#3: Certainty Equivalent

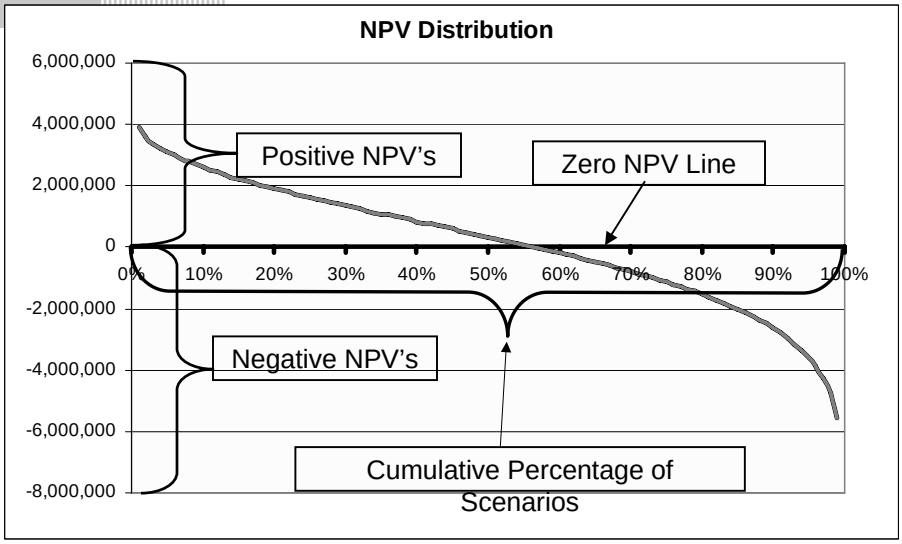


- An extension of Risk Analysis
- Intuitive risk judgment, which is applied in Risk Analysis, is quantified by means of a ***corporate utility function***
- Utility function does not replace judgment, but simply ***formalizes it so it can be applied consistently***

Operational Loss Modeling Framework



Graph of NPV Distribution



Upside and Downside

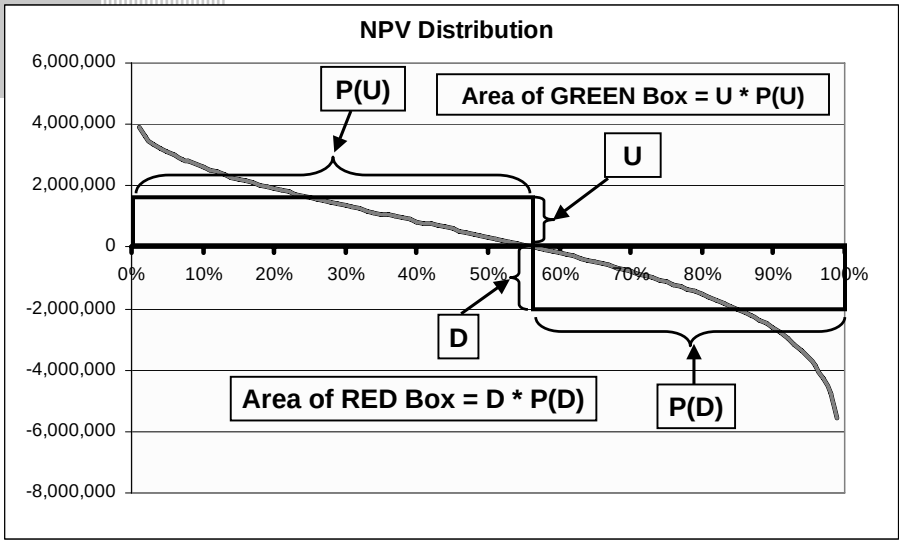
- Upside **U** = weighted average of positive NPV outcomes (like TVaR)
- Downside **D** = weighted average of negative NPV outcomes
- P(Upside) = total probability of positive outcomes
- P(Downside) = total probability of negative outcomes

NOTE: Mean = U*P(U) + D*P(D)

Reward-to-Risk Ration or R2R = [P(U) * U] / [P(D) * D]

Combines measures of Reward (positive outcomes) and Risk (negative outcomes)

- Measures risk by ***downside*** = returns below tolerance threshold
  - This definition of R2R uses a threshold of **zero return**



R2R = Area of GREEN Box / Area of RED Box

Guy Carpenter

Consider More Robust Metrics Like R2R

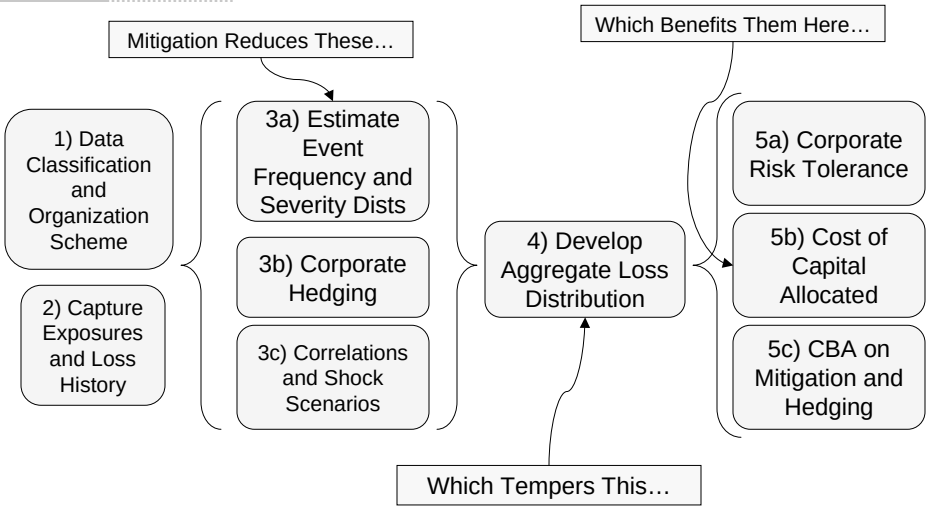
Figure 6
TVaR Sensitivity Testing

10000 Trials
LogNormal Variates

Mu	***10.087***	***10.082***	***10.075***	
Sigma	**0.28**	**0.30**	**0.32**	
Mean	**$ 25,000.00**	**$ 25,000.00**	**$ 25,000.00**	
VaR 99.9%	$ 54,405.73	$ 62,044.20	$ 64,704.18	
TVaR 99.9%	$ 56,919.36	$ 64,645.66	$ 70,933.27	
Capital	$ 31,919.36	$ 39,645.66	$ 45,933.27	*=TVaR - Mean*
Diff	***-19.5%***		***15.9%***	
VaR 95%	$ 37,918.88	$ 39,498.30	$ 40,253.85	
TVaR 95%	$ 42,565.05	$ 45,223.47	$ 46,270.23	
Capital	$ 17,565.05	$ 20,223.47	$ 21,270.23	*=TVaR - Mean*
Diff	***-13.1%***		***5.2%***	
R2R	1.258	1.268	1.325	
Diff	***-0.8%***		***4.5%***	

Guy Carpenter

Operational Loss Modeling & Mitigation



Guy Carpenter

Figure 7
Operational Risk Cost Assessment Example
Standalone BU Mitigation Reward

Scenario	Starting Loss BU #1	Excess Loss	Corporate Position	Mitigated Loss* BU #1	Excess Loss*	Corporate Position*
1	$ 56.00	$ -	$ 19.67	$ 56.00	$ -	$ 16.50
2	$ 24.00	$ -	$ 19.67	$ 24.00	$ -	$ 16.50
3	$ 13.00	$ -	$ 19.67	$ 13.00	$ -	$ 16.50
4	$ 55.00	$ -	$ 19.67	$ 55.00	$ -	$ 16.50
5	$ 89.00	$ (28.50)	$ (8.83)	***$ 80.00***	$ (23.00)	$ (6.50)
6	$ 77.00	$ (16.50)	$ 3.17	$ 77.00	$ (20.00)	$ (3.50)
7	$ 27.00	$ -	$ 19.67	$ 27.00	$ -	$ 16.50
8	$ 78.00	$ (17.50)	$ 2.17	$ 78.00	$ (21.00)	$ (4.50)
9	$ 90.00	$ (29.50)	$ (9.83)	***$ 80.00***	$ (23.00)	$ (6.50)
10	$ 96.00	$ (35.50)	$ (15.83)	***$ 80.00***	$ (23.00)	$ (6.50)

Exp Loss	$ 60.50		Exp Loss*	$ 57.00	
	Premium	**$ 19.67**		**Premium***	**$ 16.50**	*-16.1%*

U	$ 14.81	U*	$ 16.50	*Improved*
D	$ (11.50)	D*	$ (5.50)	*Improved*
P(U)	70.0%	P(U)*	50.0%	
P(D)	30.0%	P(D)*	50.0%	
R2R	**3.00**	**R2R***	**3.00**	***Target = 3.00***

- Corporate takes "unexpected losses" above expected
- Charges the BU a Premium that gives Corporate a R2R = 3.00 on its net (retained) position
- Reduced volatility → reduced Corporate risk → lower premium

Guy Carpenter

Portfolio-Based Cost Assessment Using *Risk X-Ray*

(1) Assess excess loss over mean ***at the company level, not BU level***

(2) Calculate a ***Risk Charge*** by scenario

Mathematical expression of your ***corporate risk preferences***

Figure 8
Operational Risk Cost Assessment Example

	Loss				XS over	Risk	Share of Risk			Allocation		
Scenario	BU #1	BU #2	BU #3	Total	Mean	Charge	BU #1	BU #2	BU #3	BU #1	BU #2	BU #3
1	56	60	8	124	-	-	45.2%	48.4%	6.5%	-	-	-
2	24	21	52	97	-	-	24.7%	21.6%	53.6%	-	-	-
3	13	1	75	89	-	-	14.6%	1.1%	84.3%	-	-	-
4	55	80	22	157	17.80	35.60	35.0%	51.0%	14.0%	12.47	18.14	4.99
5	89	90	39	218	78.80	157.60	40.8%	41.3%	17.9%	64.34	65.06	28.19
6	77	15	55	147	7.80	15.60	52.4%	10.2%	37.4%	8.17	1.59	5.84
7	27	99	3	129	-	-	20.9%	76.7%	2.3%	-	-	-
8	78	47	24	149	9.80	19.60	52.3%	31.5%	16.1%	10.26	6.18	3.16
9	90	18	58	166	26.80	53.60	54.2%	10.8%	34.9%	29.06	5.81	18.73
10	96	12	8	116	-	-	82.8%	10.3%	6.9%	-	-	-
Exp Value	60.50	44.30	34.40	139.20	14.10	28.20						
Std Dev	30.34	35.93	24.95	37.38								
CV	50.1%	81.1%	72.5%	26.9%								

Exp Value	**12.43**	**9.68**	**6.09**
Total	28.20		

(3) Determine % shares for each BU by scenario based on losses for that scenario

(4) = (2) * (3) = $$ allocated cost of capital back to BU by scenario

Guy Carpenter

Figure 9
Operational Risk Cost Assessment Example

Pre-Mitigation (from Figure 8)

Exp Value	60.50	44.30	34.40	139.20	14.10	28.20
Std Dev	30.34	35.93	24.95	37.38		
CV	50.1%	81.1%	72.5%	26.9%		

Exp Value	**12.43**	**9.68**	**6.09**
Total	28.20		

Reflecting BU #2 Mitigation Efforts

	Loss				XS over	Risk	Share of Risk			Allocation		
Scenario	BU #1	BU #2	BU #3	Total	Mean	Charge	BU #1	BU #2	BU #3	BU #1	BU #2	BU #3
1	56	60	8	124	-	-	45.2%	48.4%	6.5%	-	-	-
2	24	21	52	97	-	-	24.7%	21.6%	53.6%	-	-	-
3	13	1	75	89	-	-	14.6%	1.1%	84.3%	-	-	-
4	55	***80***	22	157	17.80	35.60	35.0%	51.0%	14.0%	12.47	18.14	4.99
5	89	***80***	39	208	68.80	137.60	42.8%	38.5%	18.8%	58.88	52.92	25.80
6	77	15	55	147	7.80	15.60	52.4%	10.2%	37.4%	8.17	1.59	5.84
7	27	***80***	3	110	-	-	24.5%	72.7%	2.7%	-	-	-
8	78	47	24	149	9.80	19.60	52.3%	31.5%	16.1%	10.26	6.18	3.16
9	90	18	58	166	26.80	53.60	54.2%	10.8%	34.9%	29.06	5.81	18.73
10	96	12	8	116	-	-	82.8%	10.3%	6.9%	-	-	-
Exp Value	60.50	***41.40***	34.40	136.30	13.10	26.20						
Std Dev	30.34	***31.63***	24.95	36.15								
CV	50.1%	***76.4%***	72.5%	26.5%								

Exp Value	**11.88**	**8.46**	**5.85**
Reduction %	**-4.4%**	**-12.5%**	**-3.9%**

- **Compare expected values of allocated costs of capital:**
  - **Everyone benefits from the reduction in aggregate risk**
  - **BU #2 benefits the most**

Guy Carpenter

Thank You

Questions?