Management of Operational Risk

Control and Mitigation

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PLAN

- Op Risk Management
  - A framework for control
  - Quick portrayal of op risks
  - Optimal control with risk/reward trade off
- Op Risk Mitigation Alternatives
  - Insurance
  - Op Risk bonds
- Conclusions

THE NEW ECONOMICS

- Experts put the total cost of implementing Basle II op risk proposals by 2005 at $100bn. That is about the total cost of op risk losses over the last 10 years including the direct costs of the 9/11 strike.
- In addition there will be on going costs for operating the new system and cost of capital which would exceed $10bn per year
- Will we get value for money? Only if op risks were grossly underestimated or might increase dramatically in the future. Arguments to that effect are:
  - Greater **automation** and concentration of op risks
  - **New technologies** (e-banking,…)
  - Greater **complexity** of financial products

A SIMPLE PROGRAMME

1. Build a framework to assess Op Risks that will satisfy the regulator as well as management
2. Screen out negligible risks
3. Examine risk/reward trade off for significant risks. Optimise
4. Seek insurance or alternative risk transfers for potentially large losses

FRAMEWORK

- All but very small institutions will be **required** to put in place op risk monitoring and control procedures including
  - **Loss database**
  - **op risk management responsibilities**
  - **independent audit**
- Such procedures already exist in most banks for managing and covering a large number of traditional risks, but the spotlight turned on by the regulator has revealed a **piecemeal** approach in many places

  Hence the need for greater **consistency**

REGULATORY CONSTRAINTS

Regulators impose:

- **Categories** of risks and definitions (albeit vague) of losses to be taken into account
- **Calculations** of capital charges for OR according to set rules (Standardised Approach) or internal models subject to both qualitative and quantitative standards (AMAs) and, ultimately, regulatory approval

Rules are still being developed for:

- Calibration of external data
- Recognition of op risk transfers (outsourcing) and coverage (insurance)

MANAGEMENT OBJECTIVES

- Build up a better understanding of the economics of op risk by developing **causal models** leading to alternative strategies that may improve the risk/ reward balance
- **Identify** and **focus** attention on the most critical risks
- Rationalise **insurance** and **outsourcing** decisions
- Obtain a more comprehensive view of risk adjusted returns for various activities in order to **optimise resource allocation**

QUICK PORTRAYAL OP RISKS

Op risks frequencies and severities can be combined into expected and unexpected losses. As a first cut, the standard deviation of losses can be taken as a measure of the latter

Displays of expected and unexpected losses for various categories of op risks can be used to sort them into 3 main categories to:

- **Ignore** as negligible
- **Examine** for optimal control
- **Transfer out** (outsourcing, insurance, securitisation)

BASIC STATISTICAL MODEL

For each op risk category assume that:

- The number of loss events, N, and their severities, L, are independent
- N is Poisson distributed (independent arrivals) with mean frequency μ_N (equal to the variance)
- L has a mean μ_L equal to its standard deviation (as with an exponential distribution)

Then:

- the Expected Loss is **EL =** $\mu_N \cdot \mu_L$
- the Unexpected Loss is **UL =** $(2\,\mu_N)^{1/2}\,\mu_L$

AMENDMENT TO BASIC MODEL

- If the arrival of loss events is not believed to be Poisson (e.g, the variance of the number of losses over non-overlapping uniform time intervals is not close to the average number per interval). Or,
- If severities are not believed to be exponentially distributed (e.g, the standard deviation of severities is not close to the average severity).

We would still have **EL =** $\mu_N \cdot \mu_L$ as before but UL would be such that $UL^2 = \mu_N . var(L) + var(N) . \mu_L^2$ which might still be close to **UL =** $(k\,\mu_N)^{1/2}\,\mu_L$ but with k different from 2

CALCULATION OF FULL LOSS DBN

- The previous calculations give **means** and **standard deviations** of losses per risk category based on the same statistics for loss frequencies and severities
- **Full loss distributions** could be obtained by making specific distributional assumptions about frequencies and severities or simply using empirical distributions. In both cases, the full loss distribution can be approximated by simulations (or analytically in some rare cases).

  In both cases the dispersion of the loss distribution (UL) should be corrected (increased) for **statistical errors** (either in the assessment of parameters or the representativeness of the empirical data)

EXPECTED LOSS DIAGRAM

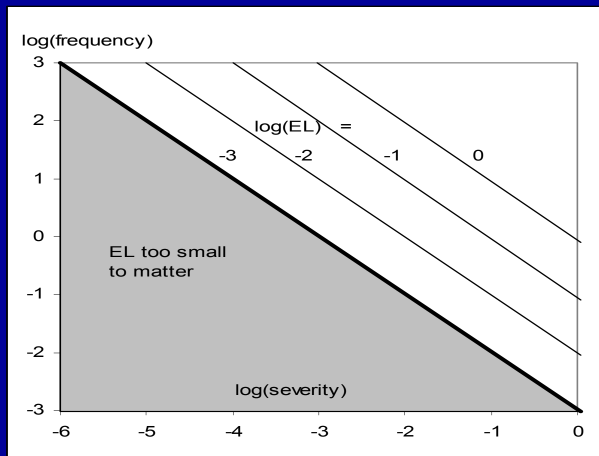
On a log(frequency) versus log(severity) diagram, each loss category can be plotted according to its mean frequency and mean severity. On the following diagram, severity is expressed as a fraction of the qualifying capital of the firm

Equal expected loss (EL) categories lie along diagonal lines with slope –1

For example, categories lying on the main diagonal marked '-3' contribute the same expected loss equal to one thousandth (0.1%) of capital

The most important contributor to EL is the one lying furthest in the top-right direction

EXPECTED LOSSES



Severities and losses are scaled to the economic capital of the firm

CATEGORISATION OF EL

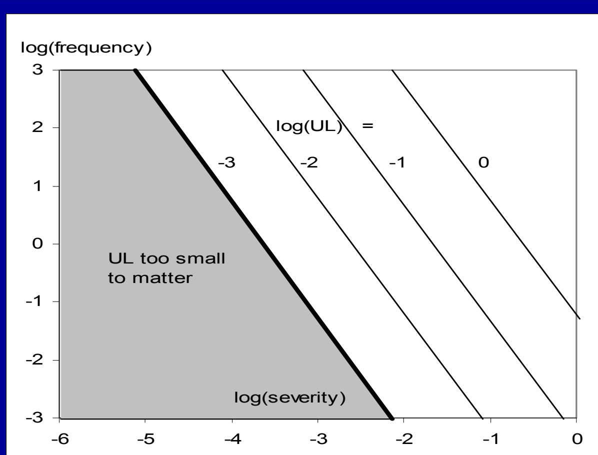
As a rule of thumb:

- **Ignore** as negligible from an EL point of view
  - Any category falling below the main diagonal (grey area)
  - Any category 100 times smaller than the main contributor
- **Examine carefully** any category contributing an EL greater than 5% of capital. Are there offsetting profits, or have provisions been made? If not, can the EL be reduced or should the related activities be abandoned?

UNEXPECTED LOSS DIAGRAM

- On the same log(frequency) versus log(severity) diagram, equal UL categories lie along lines with slope –2 (basic model) or lines of similar slope
- Assuming Op risk capital requirements set at the 99.9% quantile or about 3 standard deviations from the mean, each line can be indexed with the corresponding capital charge. Capital requirements are shown on the next diagram as a fraction of qualifying capital on a log scale
- For example, categories lying on the line marked '-3' require one thousandth (0.1%) of capital
- Again, the main contributor is on the top right

UNEXPECTED LOSSES



Severities and losses are scaled to the economic capital of the firm

CATEGORISATION OF UL

As a rule of thumb:

- **Ignore** as negligible from a capital point of view -
  - Any category falling below the main diagonal (grey area)
  - Any category 10 times smaller than the main contributor
- **Examine carefully** any category where average severity or required capital is greater than 10% of current capital. These risks should either be reduced significantly or transferred out.

 17

WHAT IS LEFT?

1. Most **high frequency, low impact** op risks will be **ignored** as not significant
2. A middle range of risks will have to be examined to determine whether better controls or a better way of doing business could be designed to achieve an adequate **risk/ reward balance**.
3. **Dependencies** between these risks should be assessed before calculating capital requirements
4. Some low frequency high impact risks will need to be **transferred out**

 18

ILLUSTRATIONS

For a bank with $10bn capital, 3 risks with same EL =$200m

- **Execution risks**: N = 200, L = $1m. Check how EL is accounted for but ignore capital requirement of $60m; it must be negligible compared to other risks
- **Improper market practice**: N = 2, L = $100m. Check accounting of EL; check cost of better controls against capital requirement of $600m
- **Rogue trader**: N=0.1, L = $2bn. Reduce the risk with better controls or seek insurance. Damages could be fatal. A capital requirement at the 99.9% confidence interval would account for 2 events or more than $4bn?

BALANCING RISK vs REWARDS

- Op risk management strategies seek to **balance** the costs of additional controls or safer procedures against a reduction in op risks. This is not different in principle to choosing a hedging strategy for market or credit risk
- Note that **all risk types** must be considered simultaneously, as often the reduction in one risk type is at the expense of an increase in another type
- Some risk control strategies may appear intuitively better than the status quo but in general some **quantitative criterion** is needed to balance risks and rewards consistently

A QUANTITATIVE TRADE-OFF

Utility theory(*) offers a simple, systematic method for choosing between risky alternatives: Choose the alternative with maximum expected utility.

All it requires is the unavoidable task of expressing quantitatively the firm's risk attitude (the costs and uncertainties of alternative strategies having been already assessed)

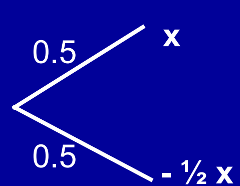
Risk attitude can be inferred from choices in a few simple but risky situations

(*) J. von Neuman and O. Morgenstern (1944)

QUANTIFICATION OF RISK ATTITUDE

ILLUSTRATION

1) Consider an activity where the firm would have equal chances of winning x% of capital or losing – ½ x%. How big can x be before the company would consider the project too risky?



QUANTIFICATION OF RISK ATTITUDE

Considering two more hypothetical risky situations may suffice to complete a rough quantification of risk attitude. For example:

2) A potential loss, y, is perceived to have a probability of 10%? How big would the loss y have to be to accept to insure it for an insurance premium of ½ x

3) A new venture may return 50% of total capital if it works, but nothing if it fails. There is a buyer at x. At which minimum probability of success, p, would the the firm refuse to sell at x?

CONSTRUCTION OF UTILITY CURVE

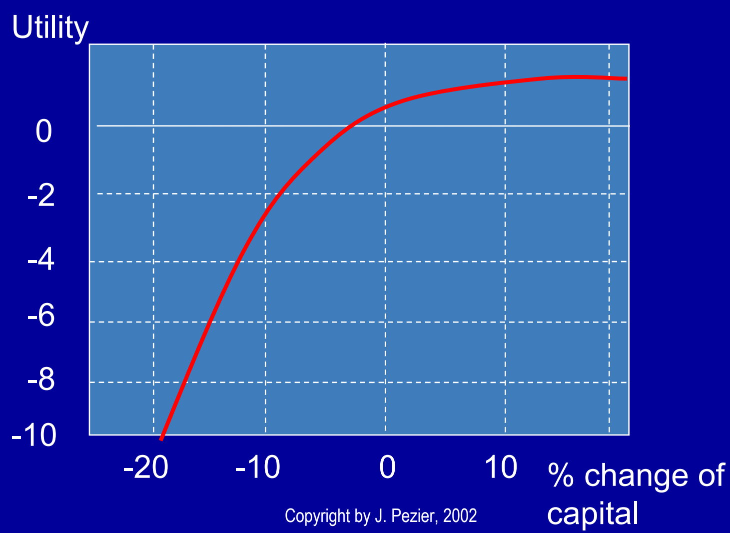
Answers x, y and p to the three previous questions are sufficient to construct a 5 points utility curve. For example, suppose the answers are 10, -20 and 0.67%.

Without loss of generality (utility curves are equivalent within a positive linear transformation), set u(0) = 0 and u(10) = 1; then, equating expected utilities:

1. u(0) = .5(u(10) + u(-5))   u(-5) = -1
2. -1 = 0.9 u(0) + 0.1 u(-20)   u(-20) = -10
3. 1 = 0.33 u(0) + 0.67 u(25)   u(25) =1.5

A smooth curve can be drawn through these 5 points

UTILITY CURVE



COMMENTS ON UTILITY

- The purpose of drawing a utility curve is to improve **consistency** in decision making under uncertainty
- At first, the encoding of risk attitude may produce a cloud of points rather than a neat curve. **Discussions** should ensue to verify and narrow down views
- Some features, like a kink at the current wealth level (status quo bias) will appear as **undesirable**
- Other features, such as constant sign curvature, will appear as **highly desirable** (to avoid being arbitraged against)

UTILITY AND RISK POLICY

- A utility curve expresses the firm's risk attitude; it may be proposed by risk managers but it should be **agreed** at the highest management level (Board)
- There should be only **one curve** for a firm. Different curves in different units would create internal arbitrage opportunities, i.e., inconsistencies
- That there should be one curve follows from elementary considerations (e.g. transitivity of preferences) but there is **no 'right' curve**. It is simply a key defining element of the risk policy of a firm

CURVATURE AS RISK AVERSION

- The **curvature** of the utility curve describes risk attitude. A degree of downward curvature reflects a degree of risk aversion
- Indeed, consider a small risky prospect X. The cash amount having same utility as the expected utility of X, or **Certain Equivalent Q** is such that, to leading order in x:

$$u(0) + u'(0)Q = u(0) + u'(0)E[X] + 1/2\ u''(0)\ \mathrm{var}[X]$$

hence, $\mathbf{Q = E[X] + \frac{1}{2}\,(u''(0)/u'(0))\ var[X]}$

$u''(0)/u'(0)$ is the local curvature; when it is negative, the certain equivalent is equal to the expected value reduced by a risk premium proportional to the local curvature multiplied by the variance of the risky opportunity

EXPONENTIAL UTILITY AND CARA

- To facilitate the use of a utility curve and further specify its characteristics, one may fit a simple **function** with a single curvature parameter to the empirical distribution, e.g. quadratic, logarithmic, exponential…
- For example, an exponential utility of the form

  $$\mathbf{u(x) = -k.exp(-x/\lambda)} \text{ with } \boldsymbol{\lambda = 10}$$

  fits well the previous empirical curve; λ is known as the **coefficient of risk tolerance**
- The exponential utility function exhibits constant curvature $-1/\lambda$, that is, **constant absolute risk aversion (CARA),** i.e., the risk premium is constant for a given prospect whatever the current level of capital (wealth)

LOCAL RISK TOLERANCE

- Note that the local coefficient of risk tolerance is very close to the answer x to the first encoding question, thus giving an approximate but direct method to gauge risk attitude
- Very few banks have a declared coefficient of risk tolerance but from observation of key decisions, it would seem to lie in a range from **7% to 20% of capital**, or **10% to 30% of gross income**
- If risk tolerance is stable relative to capital:
  - Risk attitude should be reviewed regularly and after any significant change (20%?) in capital
  - An exponential utility function should not be applied to variations beyond the ± 20% range

APPLICATION TO OP RISK CONTROL

Alternative risk control strategies impact both the severity and the frequency of losses and introduce their own costs

Q: Which is the best among alternative strategies?

A: Choose the strategy that maximises expected utility or, as a first approximation, on a loss scale **L**:

$$\textbf{Min}\left\{ \textbf{E[L] + (1/2}\ \lambda) \textbf{ Var[L]} \right\}$$

Where **L** should include all direct and indirect costs and losses (including the cost of regulatory capital)

ILLUSTRATION

Consider strategies that would be expected to halve the number of loss events in the three previous illustrations. Each would halve the expected cost, thus saving an expected $100m, and they would reduce the uncertainty by 1/√2 thus bringing the following additional savings:

Risk Category	Capital Reduction	Saving on Cap @ 13%	Risk Premium Saving	Total Saving
Execution	18	2.3	0.2	2.5
Improper Practice	176	23	20	43
Rogue Trader	(?)0	(?)0	200	200

COMMENTS ON ILLUSTRATION

1. For relatively high frequency, low impact loss categories, the effect of better controls on risk reduction are negligible. The optimisation is down to a comparison of **expected costs**
2. For mid frequency, mid impact categories, risk reduction is of similar magnitude to expected loss reduction because of both risk **premium reduction** and **savings on capital charges**
3. For rare, very high impact events, **risk reduction** and therefore **risk attitude** becomes more important than expected loss reduction. Any form of risk reduction, transfer or cover should be studied

THE CASE FOR INSURANCE

- There is a **trade-off** for insurable risks between insurance and prevention
- The imposition of capital charges to Op-Risks introduces a new economic element in this trade-off that may **favour an insurance solution for significant risks IF there is a corresponding reduction in capital charges.**
- On the other hand, if an insurance contract does **not qualify** for a reduction in capital charges, the new regulation will provide **strong incentive not to insure** small to medium risks
- Insurance companies currently enjoy a somewhat paradoxical capital treatment; they should eventually be subject to similar capital charges as banks for similar risks

THE CASE FOR INSURANCE

The economics of insuring are simple. For the total cover of a risk:

Benefits =	Cost (Insurance premium) =
Expected cost	Expected cost
+ Cost of cap savings	+ Cost of reserves
+ Risk Premium	+ Profit margin

Where:

- Cost of cap savings = 13% x 3 (Standard Dev) or 0.4(Standard Dev) with a typical 13% cost of capital
- Risk Premium is small for small to medium risks
- Cost of reserves is currently small

One is left wit comparing 0.4(St Dev) with Profit Margin

THE CASE FOR OR BONDS

Main difficulties with insurance cover are:

- The limited scope of insurance contracts (named perils, definitions, conditions, exclusions, causal link with loss)
- The lengthy and uncertain claim process (discovery process, proof of loss, investigation of loss,negotiation, settlement)

And therefore **traditional insurance may not qualify** for capital charge reductions. New types of contracts must be designed (e.g. Swiss Re)

Alternatively, OR bonds are being promoted. They offer investors risks that are **uncorrelated** with the market. Resources are immediately available to the issuer, although restitution is a possibility. But investors are shy of new risks they do not fully understand and require a **hefty premium**

CONCLUSIONS

- New regulations are introducing **new incentives** for reducing operational risks
- Management should focus their attention on **key risks** , measure them and understand **causal factors**
- Alternative strategies, including better controls, outsourcing and insurance, should be evaluated on the basis of a **clear risk/reward trade-off**
- New types of insurance contracts are needed to provide a reduction in capital charges; there will be a disincentive to continue with traditional insurance
- It is still early days for OR bonds and derivatives.

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