

Biennial Convention 2007

Adventures in Risk

23-26 September 2007 • Christchurch, New Zealand



Institute of Actuaries of Australia



ERM-II's Research Activities and Future Plans for Research and the Organization

Findings of the Lyon workshop on
“Economic Capital and
Diversification Effect at Group
Level”

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About the 1st ERM-II research workshop in Lyon

- Hosted by the *Institut de Science Financière et d'Assurances* (ISFA), University of Lyon, France, on June 7th, 2007.
- Funded by ERM-II and ISFA
- 100+ participants from all around the world
- Good balance between academics and practitioners.
- 8 talks + a brainstorming session in small group



Economic capital and diversification effect at group level: outline of today's talk

- Speakers and their main points
- Main ideas/questions that arose in discussions
- Plans for future research



Speakers

- **Shaun Wang** (Georgia State Univ.* & ERMII)
- **Alexander McNeil** (Heriot-Watt Univ.*)
- **Steve Kou** (Columbia Univ.*)
- **Pauline Barrieu** (London School of Economics)
- **Pablo Koch-Medina** (Managing Director, Risk Management, Swiss Re)
- **Max Bézard** (Head of Group Capital Management, BNP Paribas)
- **Guillaume Gorge** (P&C Chief Risk Officer, AXA)
- **Gary Venter** (Columbia Univ.* & Guy Carpenter)

* ERM-II member University



Main points of Shaun Wang: Correlation modeling and correlation parameters for Economic Capital Calculations.

- Introductory talk
- Review of some correlation models and tail correlation measures
- Practical issues associated with Solvency II and Company Internal Economic Capital Models
- Correlation
 - between risk factors,
 - between lines of business,
 - and across geographic regions.



Main points of Alexander McNeil: Mixture models of dependent risks.

- Introduction and features of mixture models
- Mixture models for random vectors may be useful in risk modeling because :
 - by mixing underlying distributions with tractable forms (Normal, independent component models, Uniform on simplices), one can introduce features (like additional dependence and asymmetry) in simple, intuitive ways without completely sacrificing tractability.
 - Besides, simulation is easy, so those models are useful in a Monte Carlo context.
 - The latent structure introduced by the unobserved mixing variable(s) has a factor interpretation. Models may often be estimated by using statistical techniques for models with latent structure.



Main points of Steve Kou: What Is a Good Risk Measure: Bridging the Gaps between Data, Coherent Risk Measures, and Insurance Risk Measures.

- Two main axiomatically based risk measures are
 - the coherent risk measure, which assumes subadditivity for random variables,
 - and the insurance risk measure, which assumes additivity for comonotonic random variables.
- Steve proposed a new, data-based risk measure, called natural risk statistic. This risk measure is characterized by a new set of axioms that
 - require comonotonic subadditivity instead of subadditivity
 - provide an axiomatic justification for Value-at-Risk (VaR),
 - include Tail Conditional Median (TCM), which is more robust than Tail Conditional Expectation (TCE),
 - and may incorporate scenario analysis.



Main points of Pauline Barrieu: General Pareto optimal allocations and applications to multi-period risks.

- Pauline considered the problem of Pareto optimal allocation in a general framework, involving preference functionals defined on a general real vector space.
- The optimization problem is equivalent to a modified sup-convolution of the different agents' preference functionals.
- The results were applied to a multi-period setting and some further characterization of Pareto optimality for an allocation was obtained for expected utility for processes.
- As the Market-Value Margin for one risk in Solvency II is often deduced from the price that one would ask to incorporate this risk in his portfolio, these questions on risk transfers are hidden but of primary importance. Some of the next steps to better study practical issues were identified as
 - having more than two agents,
 - dealing with continuous-time models,
 - and inferring the preference functional from existing transactions.



Pablo Koch-Medina's action points: When is diversification a benefit?

- spend more effort in modeling of dependencies and calibration/specification of dependency models
- investigate how insurers can best realise diversification through intra-group transactions
- establish societal costs of regulatory barriers to diversification and identify regulatory environments minimizing them (e.g. equal treatment of all policyholders)
- investigate how the adequacy of transferability of funds should be measured and ensured (e.g. liquidity test, etc)
- investigate evidence for existence of risk premium for insurance risks
- investigate how to quantify frictional costs and what the drivers of frictional costs are
- investigate how allocation of capital costs can serve decentralisation
- investigate incentive created by different allocation methods



Max Bézard's questions to be addressed:

Setting the bridge between strategic planning, risk profile measures and economic capital.

- How to link a value based management approach with economic capital?
- Does economic capital need to reflect bank's risk aversion rather than regulators' one?
- Are there some risks that should not be covered through capital?
- What is the appropriate notion of time horizon / risk schedule (ie multiperiod notion) for risk measures and capital need?
- How to make sure to identify and leverage on correlation and diversification effects?
- Is there anything else than catastrophic events to be taken into account in economic capital?



Main points of Guillaume Gorge: Practical issues raised by evaluating diversification.

- The complex correlation impact, often under-estimated by practitioners, was in practice probably the main risk driver of an insurance company.
- Strong differences between correlations at short and long term horizons
- Difficulties to go market-consistent, in particular for illiquid assets.
- Some of his suggestions would be either
 - to make them liquid thanks to securitization,
 - to measure frictional cost and price illiquidity, with a need to understand financial distress as one should include an additional capital,
 - or to model the way pricing is done, in the spirit of Pauline's work.
- Time-diversification should be taken into account, particularly for long-term risks which are often treated as short-term ones
- Can we really separate the operational risk element from the “pure” insurance risk ? There is a lack of an explicit market price in the insurance business.



Main points of Gary Venter: Risk-adjusted profitability.

- For companies that want to allocate capital, Gary prescribed to use marginal decomposition, preferably with a risk measure based on transformed probabilities of underlying events.
- An alternative to capital allocation (for measuring risk-adjusted profit) could be to charge each business unit for its right to access the capital of the company (consuming capital).
- Each business unit has the option to use capital when premiums plus investment income on premiums run out (company provides stop-loss reinsurance at break-even).
- Gary discussed the problems associated with the valuation of this option.
- His conclusions were that
 - marginal decomposition with co-measures improves allocation exercise,
 - the choice of a risk measure can make result more meaningful,
 - capital consumption removes some arbitrary choices and artificial notions of allocation,
 - market value of risk is what is needed in each method but we do not really know how!



Main points that arose during the brainstorming session

- Need for a framework to facilitate discussions on value creation and recognition between individuals from different backgrounds jointly developed by a group of practitioners and academics.
- This framework will enhance our understanding of issues in economic capital, fair value and group diversification.
- A large financial institution has to deal with multiple definitions of economic capital and valuation systems, coming from different concerns.



Main points that arose during the brainstorming session

- How to harmonize the treatment of risks of different time horizons in a market-consistent way?
- Given the fact that insurers need to hold capital year over year to support long-term risks, there is a need for a framework that
 - reflects time-correlation and diversification for long-tailed risks (e.g. liability or longevity)
 - and produces a 1-year equivalent measurement.



Main points that arose during the brainstorming session

- Interplays between liquidity, market value and long-term value.
- Valuation of a deposit, and series of deposits, as in a life policy.
- Measuring the degree of liquidity and how to incorporate potential future changes that could impact liquidity ?
- More generally, how to deal with illiquidity (by a risk transfer), or how to price illiquidity?



Main points that arose during the brainstorming session

- Correlation is of first order importance for risk aggregation and risk capital assessment.
- It is also a complex issue, as stochastic dependence between multiple risks often features asymmetrical characteristics
- The discussion on benchmarks included questions like:
 - How does one justify a balance between judgment and more rigorous analytical approaches?
 - How to factor in correlations for low probability events and/or scenarios that haven't occurred?
 - Given the fact that correlations are usually under-estimated for extreme events, should one use an actuarial approach or an economic/causality approach?
 - How to balance adherence to a benchmark (that might be provided by ERMII in the future) with internal judgment?
 - How to calibrate this benchmark?



Main points that arose during the brainstorming session

- About diversification effect assessment, the following questions arose:
- Should diversification at the group level have an impact on pricing at the local business unit level?
- How would one treat marginal costs vs. fixed costs, and how might they be allocated to new business and/or ventures?
- Another aspect was the concept that the subsidiary implicitly had an “option” on the firm’s capital, and this option should have a cost.
 - How would one calculate this cost?
 - And would this be allocated?
 - Should the estimated cost be considered in the pricing of local policies?
 - How would one make this case to a regulator?
 - Would the cost be modified by changes in the liquidity of the parent organization?
- Practitioners making rate filings and/or completing solvency calculations are concerned with these practical issues.



ERMII future research activities

- ERM-II working group will follow up on these research topics and welcomes any contribution from academics and practitioners.
- ERMII could well develop subjects for research papers and formalize an RFP process, provide grants, etc., to develop a larger body of ERM research.
- This is one of the ideas we envision to implement to follow up on the ERMII Research Workshop to be held at Columbia University.



ERMII future research activities

- ERMII might be able to sponsor some sort of survey to capture relevant data from interested organizations (perhaps the CRO Forum, for example) that would be of value
 - to researchers
 - and then subsequently the research findings to the practitioners to reinforce issues with regulators on items like diversification.
- Data could be collected anonymously.
- This effort would clearly need a committee of research oriented individuals to develop the data requirements, working with some volunteer companies regarding availability.



Details, material and feedback

- Slides and more details may be obtained on the conference's website:

<http://isfaserveur.univ-lyon1.fr/ermii-research-workshop/>

and on ERMII's website: <http://www.ermii.org>

- If you have any feedback or comment, please contact Wayne Fisher, Executive Director of ERMII: wayne.fisher@zurich.com.

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ERM-II's Research Activities and Future Plans for Research and the Organization

“Economic Capital and
Diversification Effect at Group Level”:
link with some Solvency II issues

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Solvency II timeline

- Currently: 3rd Quantitative Impact Study (QIS3)
- Results of QIS3 to be published in November 07
- Directive Draft published
- Guidance for internal models
- Calibration of standard formula
- Development of internal or partial internal models
- Risk transfers (securitization by AXA of part of its motor liability risk)



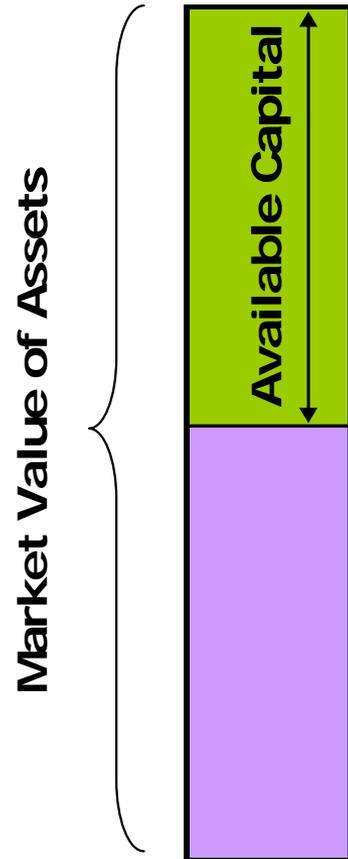
Solvency II, Pillar I.

Financial and Capital Requirements

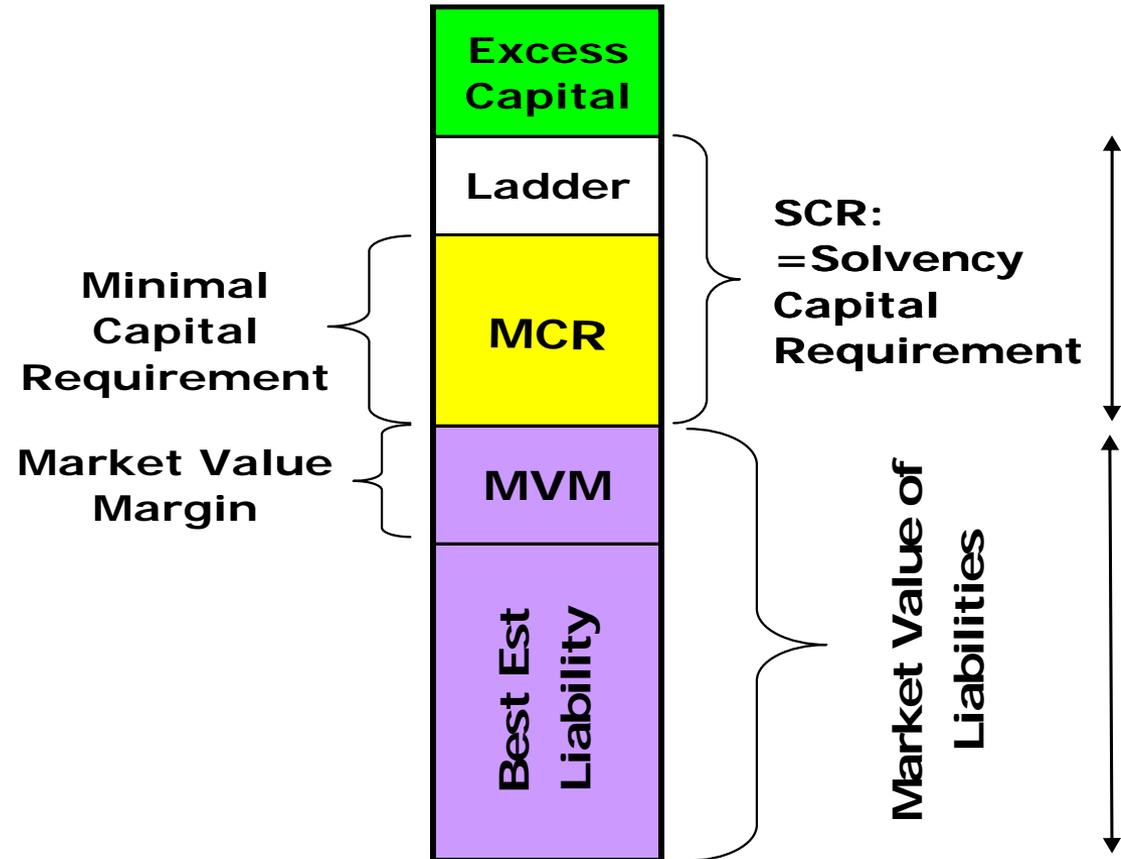
- Principle based, rather than rule-based
- Economic value based approach
- 1-year time horizon, however, valuation reflects future multi-year time horizon
- Diversification across risks and risk mitigation
- Encourage development of internal risk model



Assets



Liabilities





Calibration of the standard formula

- Standard formula based on
 - a 1-year 99.5%-Value-at-Risk
 - for a lognormal distribution
 - for the overall risk of a certain module (e.g. Non-Life Underwriting Risk (NLuw))
- However, for lines of business (LoBs), the lognormal assumption is not made.
- Method:
 - compute the standard error of the risk associated to each LoB
 - Combine these standard errors thanks to a pseudo-correlation given by CEIOPS (QIS 3 parameters)
 - Obtain the standard error for the global risk of NLuw
 - Obtain the SCR for NLuw from the Value-at-Risk of a lognormal r.v. with the corresponding standard error.
- These coefficients do not take tail correlation into account.
- The formula is made to be simple and sub-additive, but not to model accurately stochastic dependence between risks of different LoBs.



QIS3 « Correlation Matrix »

I.3.250		PR Worker compens ation	PR Comple mentary health	PR Accident and health/def ault	PR Motor, third party liability	PR Motor, other classes	PR Marine, aviation and transport	PR Fire and other damage to property	PR Third- party liability	PR Credit and suretyshi p	PR Legal expenses	PR Assistanc e
	SCR.NonLife.Corr											
1	PR Worker compensation	100%	50%	50%	25%	25%	25%	25%	50%	25%	50%	25%
2	PR Complementary health	50%	100%	50%	25%	25%	25%	25%	25%	25%	25%	25%
3	PR Accident and health/default	50%	50%	100%	25%	25%	25%	25%	25%	25%	50%	25%
4	PR Motor, third party liability	25%	25%	25%	100%	50%	50%	25%	50%	25%	50%	25%
5	PR Motor, other classes	25%	25%	25%	50%	100%	25%	25%	25%	25%	50%	50%
6	PR Marine, aviation and transport	25%	25%	25%	50%	25%	100%	25%	25%	25%	25%	50%
7	PR Fire and other damage to property	25%	25%	25%	25%	25%	25%	100%	25%	25%	25%	50%
8	PR Third-party liability	50%	25%	25%	50%	25%	25%	25%	100%	50%	50%	25%
9	PR Credit and suretyship	25%	25%	25%	25%	25%	25%	25%	50%	100%	50%	25%
10	PR Legal expenses	50%	25%	50%	50%	50%	25%	25%	50%	50%	100%	25%
11	PR Assistance	25%	25%	25%	25%	50%	50%	50%	25%	25%	25%	100%
12	PR Miscellaneous non-life insurance	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
13	PR NP reins property	25%	25%	25%	25%	25%	25%	50%	25%	25%	25%	50%
14	PR NP reins casualty	25%	25%	25%	25%	25%	25%	25%	50%	50%	50%	25%
15	PR NP reins MAT	25%	25%	25%	25%	25%	50%	50%	25%	25%	25%	25%
1	RE Worker compensation	50%	25%	25%	13%	13%	13%	13%	25%	13%	25%	13%
2	RE Complementary health	25%	50%	25%	13%	13%	13%	13%	13%	13%	13%	13%
3	RE Accident and health/default	25%	25%	50%	13%	13%	13%	13%	13%	13%	25%	13%
4	RE Motor, third party liability	13%	13%	13%	50%	25%	25%	13%	25%	13%	25%	13%
5	RE Motor, other classes	13%	13%	13%	25%	50%	13%	13%	13%	13%	25%	25%
6	RE Marine, aviation and transport	13%	13%	13%	25%	13%	50%	13%	13%	13%	13%	25%
7	RE Fire and other damage to property	13%	13%	13%	13%	13%	13%	50%	13%	13%	13%	25%
8	RE Third-party liability	25%	13%	13%	25%	13%	13%	13%	50%	25%	25%	13%
9	RE Credit and suretyship	13%	13%	13%	13%	13%	13%	13%	25%	50%	25%	13%
10	RE Legal expenses	25%	13%	25%	25%	25%	13%	13%	25%	25%	50%	13%
11	RE Assistance	13%	13%	13%	13%	25%	25%	25%	13%	13%	13%	50%
12	RE Miscellaneous non-life insurance	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
13	RE NP reins property	13%	13%	13%	13%	13%	13%	25%	13%	13%	13%	25%
14	RE NP reins casualty	13%	13%	13%	13%	13%	13%	13%	25%	25%	25%	13%
15	RE NP reins MAT	13%	13%	13%	13%	13%	25%	25%	13%	13%	13%	13%



Internal models or partial internal models

- If an internal model is developed, correlations have to be modeled.
- -> Strong model risk
- Link with Pillar II: the model must be used ! etc...
- Difficulties to compare with standard formula.



Correlation issues in the calibration of the standard formula

- For some risks, how to quantify correlations at the 1-year horizon ?
- How to deal with inflation risk for Non-Life Reserving risk ? How to model correlation with interest rate risk (in a completely different modulus, treated by stress scenarios)?
- Sometimes hard to quantify only the standard error for one marginal risk, or even best estimates, so correlations...



More and more doubts on the 99.5% level

- Level adapted from Basel II. Is it really adapted for the insurance business?
- Past bankruptcy of insurance companies in France and the 99.5% level...
- Statistical difficulties
- Why not a longer time horizon (5-10 years) and a lower quantile level?