RPP II - The Risk Premium Project (RPP) Update

Martin Eling
Institute of Insurance Science
University of Ulm, Germany

Hato Schmeiser
Institute of Insurance Economics
Univ. of St. Gallen, Switzerland

Casualty Actuarial Society
Annual Meeting, Washington
Session C-8
November 8, 2010

Outline

1. Motivation
2. Search and Evaluation Strategy
3. Results
   - 3.1. Update of the bibliography from Phase I of RPP I
   - 3.2. Revision of RPP I conclusions
   - 3.3. Recommendation of additional empirical studies

The Risk Premium Project (RPP) represents an extensive, thorough and up-to-date analysis of the theory and empirics of risk assessment for property-casualty insurance

1. Motivation: Background

- History of RPP:
  1. Initiated with call for research by COTOR in 1999
  2. RPP I in 2000 (138 references, five conclusions, future research)
  3. Two empirical studies funded by COTOR → Cummins and Phillips (2005); Cummins, Lin, and Phillips (2009)
- Developments in the last decade: Substantial number of new topics (Op. risk, behavioral insurance, market consistent valuation, solvency,…)
- Aims of RPP II:
  1. Update of the bibliography from Phase I of RPP I
  2. Revision of RPP I conclusions
  3. Recommendation of additional empirical studies

1. Motivation: Research Design and Key Results

- Literature review contains 963 references
- Opinions of 51 colleagues were integrated via a questionnaire
- Main Results:
  - Convergence of opinions, additional factors discussed, financial crisis
  - RPP II Report, RPP II website (www.casact.org/rpp2) incl. searchable database
- Design of the review part:

Step	Thematic Category	See pages	
1	Review of pricing literature (asset pricing, insurance pricing)	pp. 26-32	Goal 1 of RPP II
2	Review of surplus allocation literature	pp. 32-34	
3	Review of new fields (operational risk, catastrophe risk, …)	pp. 34-35	
4	Revision of RPP I conclusion	pp. 36-39	Goal 2 of RPP II
5	Derivation of five new conclusions	pp. 39-43	
6	Derivation of five areas of future research	pp. 45-49	Goal 3 of RPP II

2. Search and Evaluation Strategy: RPP I Review

- 138 papers and books in seven categories
- 5 key conclusions:
  1. Convergence of financial and actuarial approaches (non-syst. risk matters)
  2. Systematic risk adjustment necessary by-line (reflecting cash-flow pattern)
  3. CAPM is inadequate, extensions are better, no research for insurance
  4. Myers/Read (2001) is a consistent way to allocate the costs of capital
  5. Default risk must be recognized in pricing

2. Search and Evaluation Strategy: RPP I Review

– Two important empirical studies funded by COTOR

1. Cummins and Phillips (2005):

   a) Cost of capital using the Fama-French model higher than CAPM

   b) Significant differences across lines

2. Cummins, Lin, and Phillips (2009): Price of insurance…

   a) is inversely related to insurer insolvency risk (Phillips, et al. 1998)

   b) is related to the amount of capital allocated to lines of insurance (Froot and Stein, 1998; Myers and Read 2001, Zanjani 2002)

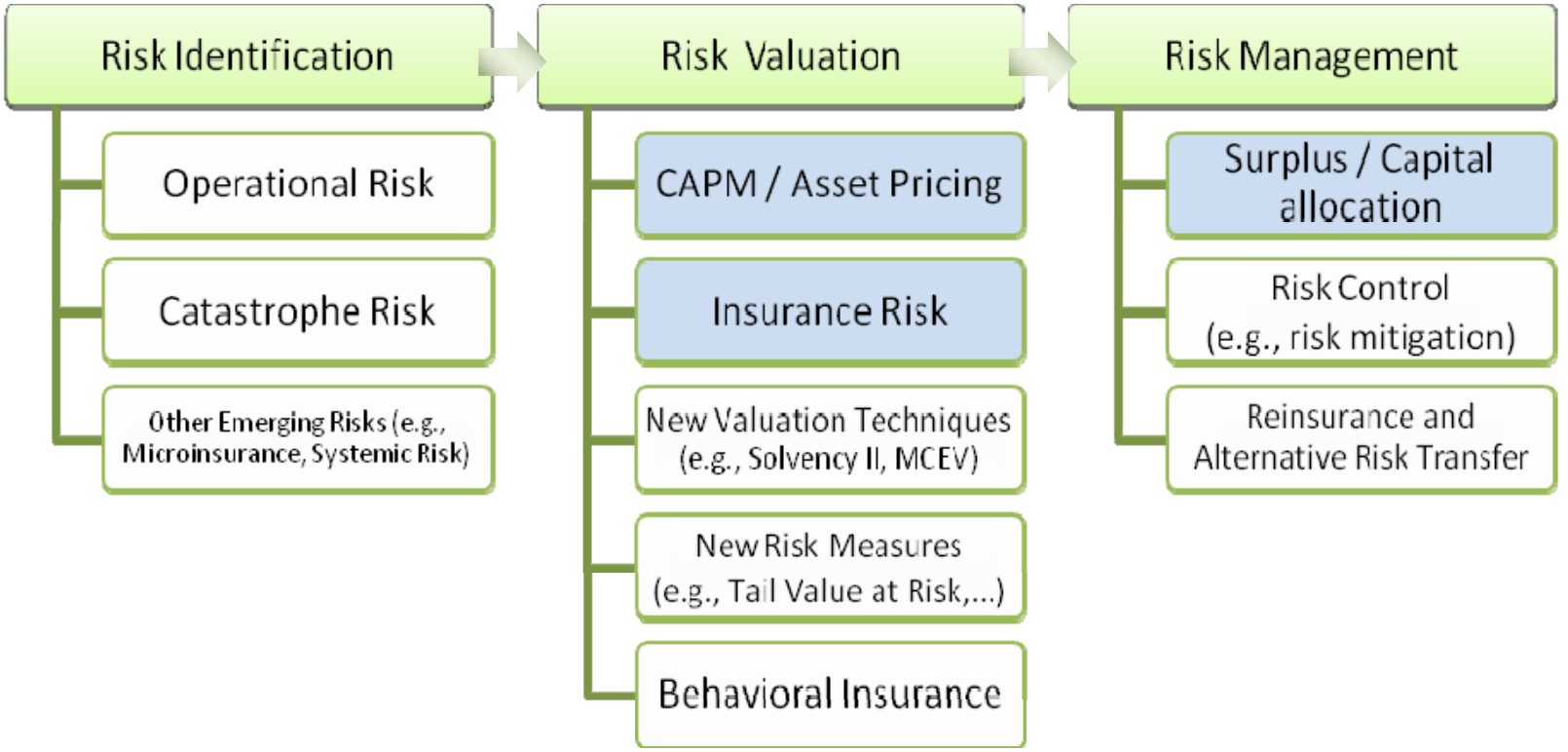
   c) reflects the asymmetries of return distributions (Froot 2007)

2. Search and Evaluation Strategy

Phase	Step
1	Definition of the search strategy
2	Implementation of the search strategy (data collection, quantitative part)
3	Evaluation of search results (including qualitative evaluation)
4	Involvement of the research community; revision and search based on comments of colleagues/on conferences
5	Report
6	Delivery and revision of draft report
7	Final report

2. Search and Evaluation Strategy

– Definition of the search strategy - Thematic Categories:



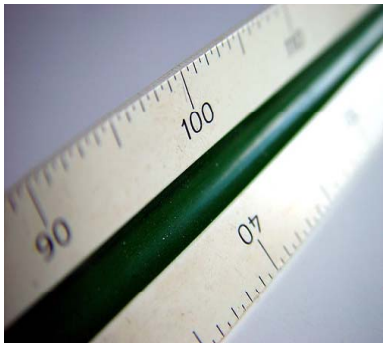
2. Search and Evaluation Strategy

– Implementation of Search Strategy

Thematic Category	Principal advances	Important papers in this field	Main messages	Future Research
Operational Risk	Advance 1	Name of Paper 1	Message 1	Challenge 1
	Advance 2	Name of Paper 2	Message 2	Challenge 2
	Advance 3	Name of Paper 3	Message 3	Challenge 3
Catastrophes	Advance 1	Name of Paper 1	Message 1	Challenge 1
	Advance 2	Name of Paper 2	Message 2	Challenge 2
	Advance 3	Name of Paper 3	Message 3	Challenge 3
…	…	…	…	…

– Development of the RPP II website

– Involvement of research community via questionnaire



3. Results: Aim 1 – Update of the bibliography

- Literature review on eleven thematic categories…

  → See RPP II webpage (www.casact.org/rpp2)

  → RPP II Results

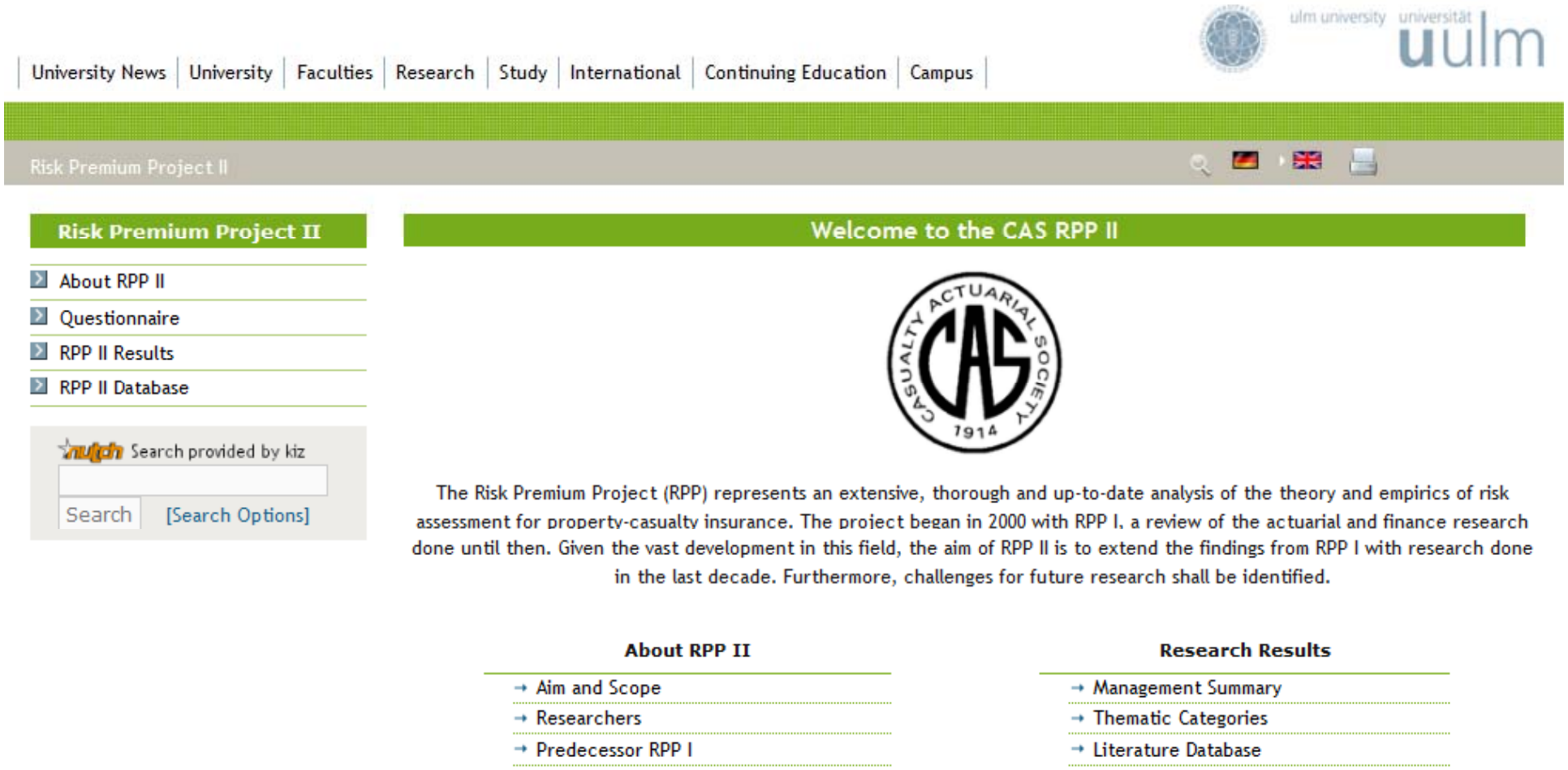
  - Management Summary
  - Results for Thematic Categories

  → RPP II Database (references available upon request)

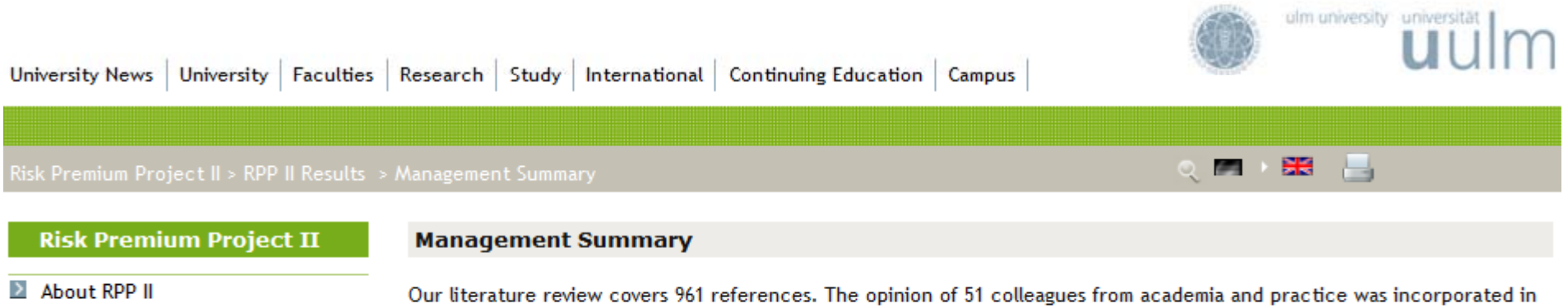
- Based upon literature review and on results of a…

  → Questionnaire (51 participants, summary of main findings and comments (RPP II Report, page 23-25))

3. Results: Aim 1 – Update of the bibliography



3. Results: Aim 1 – Update of the bibliography



ulm university universität ulm

University News | University | Faculties | Research | Study | International | Continuing Education | Campus

Risk Premium Project II > RPP II Results > Management Summary

Risk Premium Project II

- About RPP II
- Questionnaire
- RPP II Results
  - Management Summary
  - Thematic Categories
  - Detailed RPP II Report
- RPP II Database

Search provided by kiz

Search [Search Options]

Management Summary

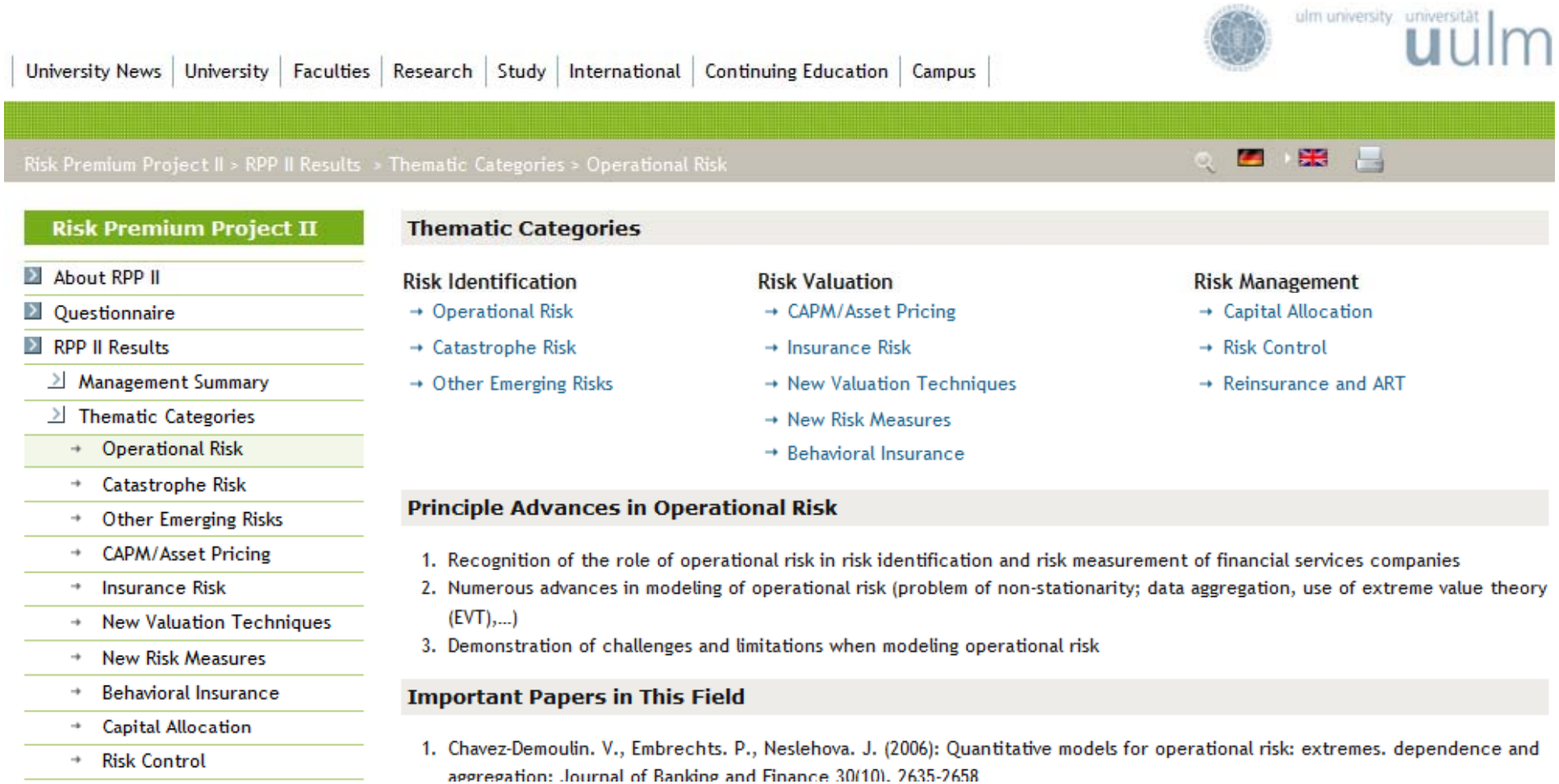
Our literature review covers 961 references. The opinion of 51 colleagues from academia and practice was incorporated in the review document. As a main result we find that actuarial and financial views of how to price risk are still converging, but additional factors have been added to the discussion such as new risk measures, new valuation techniques, behavioral aspects, or emerging risks. In the aftermath of the financial crisis systemic risk, liquidity risks, and implications from the crisis are discussed. Throughout this report the five conclusions from RPP I are revised and five new conclusions are added to the discussion. Furthermore, five areas for future research are identified.

Revision of key conclusions from RPP I

(1) Financial vs. actuarial approaches: There is an ongoing consolidation between financial and actuarial literature with regard to pricing of insurance contracts. Both fields acknowledge the role of systematic and non-systematic risk in the pricing of insurance contracts.

(2) Fair value of the insurance premium: Theoretical models as well as empirical tests have confirmed that given the real-world market imperfections, the price of insurance should be a function of the (1) expected cash flow with adjustments for systematic risk, (2) production costs (i.e. expenses), (3) default risk, and (4) frictional capital costs. By-line adjustments should be integrated depending on the cash flow pattern of the liabilities.

3. Results: Aim 1 – Update of the bibliography



University News | University | Faculties | Research | Study | International | Continuing Education | Campus

ulm university universität uulm

Risk Premium Project II > RPP II Results > Thematic Categories > Operational Risk

Risk Premium Project II

- About RPP II
- Questionnaire
- RPP II Results
  - Management Summary
  - Thematic Categories
    - Operational Risk
    - Catastrophe Risk
    - Other Emerging Risks
    - CAPM/Asset Pricing
    - Insurance Risk
    - New Valuation Techniques
    - New Risk Measures
    - Behavioral Insurance
    - Capital Allocation
    - Risk Control

Thematic Categories

Risk Identification	Risk Valuation	Risk Management
→ Operational Risk	→ CAPM/Asset Pricing	→ Capital Allocation
→ Catastrophe Risk	→ Insurance Risk	→ Risk Control
→ Other Emerging Risks	→ New Valuation Techniques	→ Reinsurance and ART
	→ New Risk Measures	
	→ Behavioral Insurance	

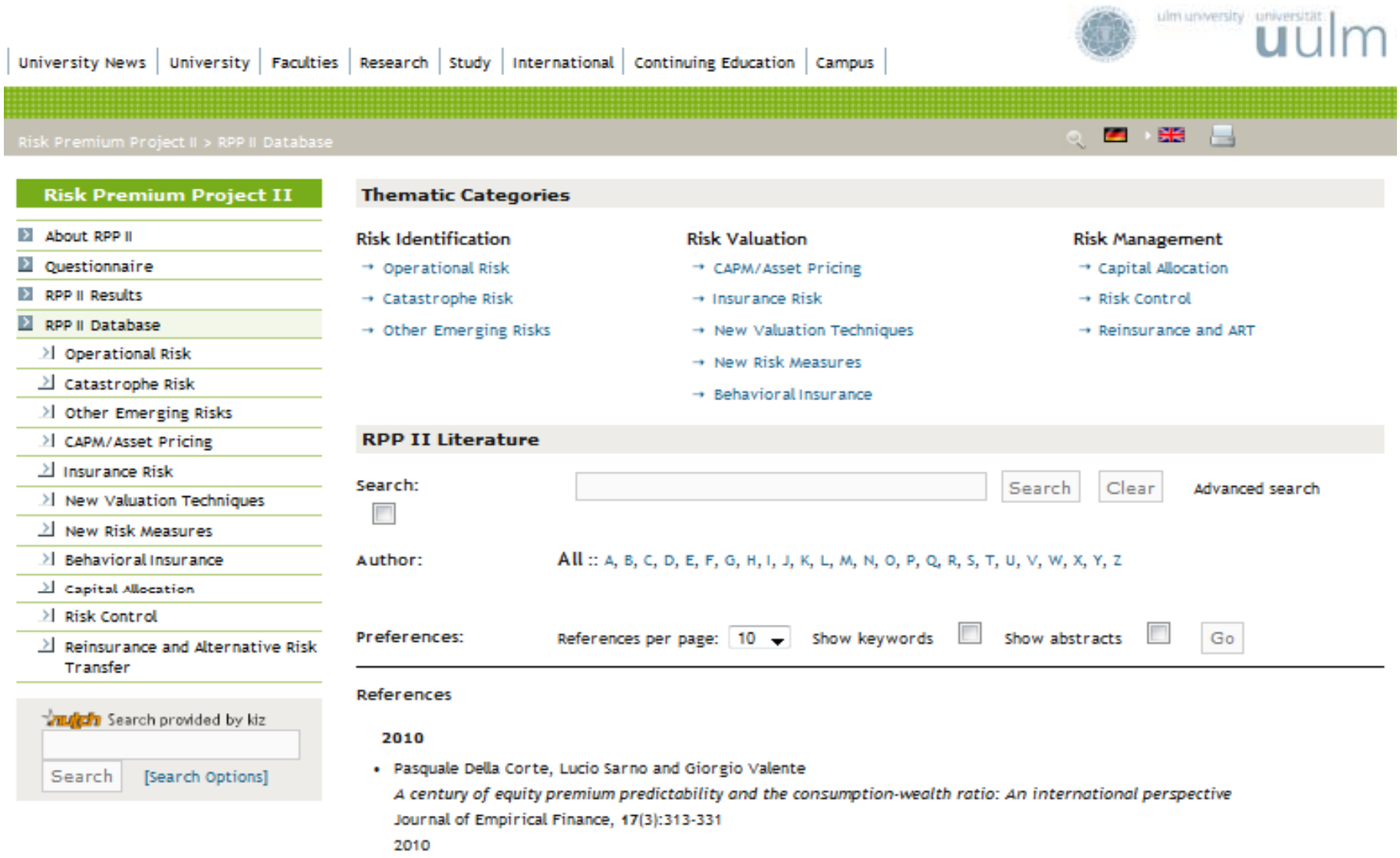
Principle Advances in Operational Risk

1. Recognition of the role of operational risk in risk identification and risk measurement of financial services companies
2. Numerous advances in modeling of operational risk (problem of non-stationarity; data aggregation, use of extreme value theory (EVT),...)
3. Demonstration of challenges and limitations when modeling operational risk

Important Papers in This Field

1. Chavez-Demoulin. V., Embrechts. P., Neslehova. J. (2006): Quantitative models for operational risk: extremes. dependence and aggregation: Journal of Banking and Finance 30(10). 2635-2658

3. Results: Aim 1 – Update of the bibliography



University News | University | Faculties | Research | Study | International | Continuing Education | Campus

ulm university universität uulm

Risk Premium Project II > RPP II Database

Risk Premium Project II

- About RPP II
- Questionnaire
- RPP II Results
- RPP II Database
  - Operational Risk
  - Catastrophe Risk
  - Other Emerging Risks
  - CAPM/Asset Pricing
  - Insurance Risk
  - New Valuation Techniques
  - New Risk Measures
  - Behavioral Insurance
  - Capital Allocation
  - Risk Control
  - Reinsurance and Alternative Risk Transfer

Search provided by kiz

Search [Search Options]

Thematic Categories

Risk Identification	Risk Valuation	Risk Management
→ Operational Risk	→ CAPM/Asset Pricing	→ Capital Allocation
→ Catastrophe Risk	→ Insurance Risk	→ Risk Control
→ Other Emerging Risks	→ New Valuation Techniques	→ Reinsurance and ART
	→ New Risk Measures	
	→ Behavioral Insurance	

RPP II Literature

Search: Search Clear Advanced search

Author: All :: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z

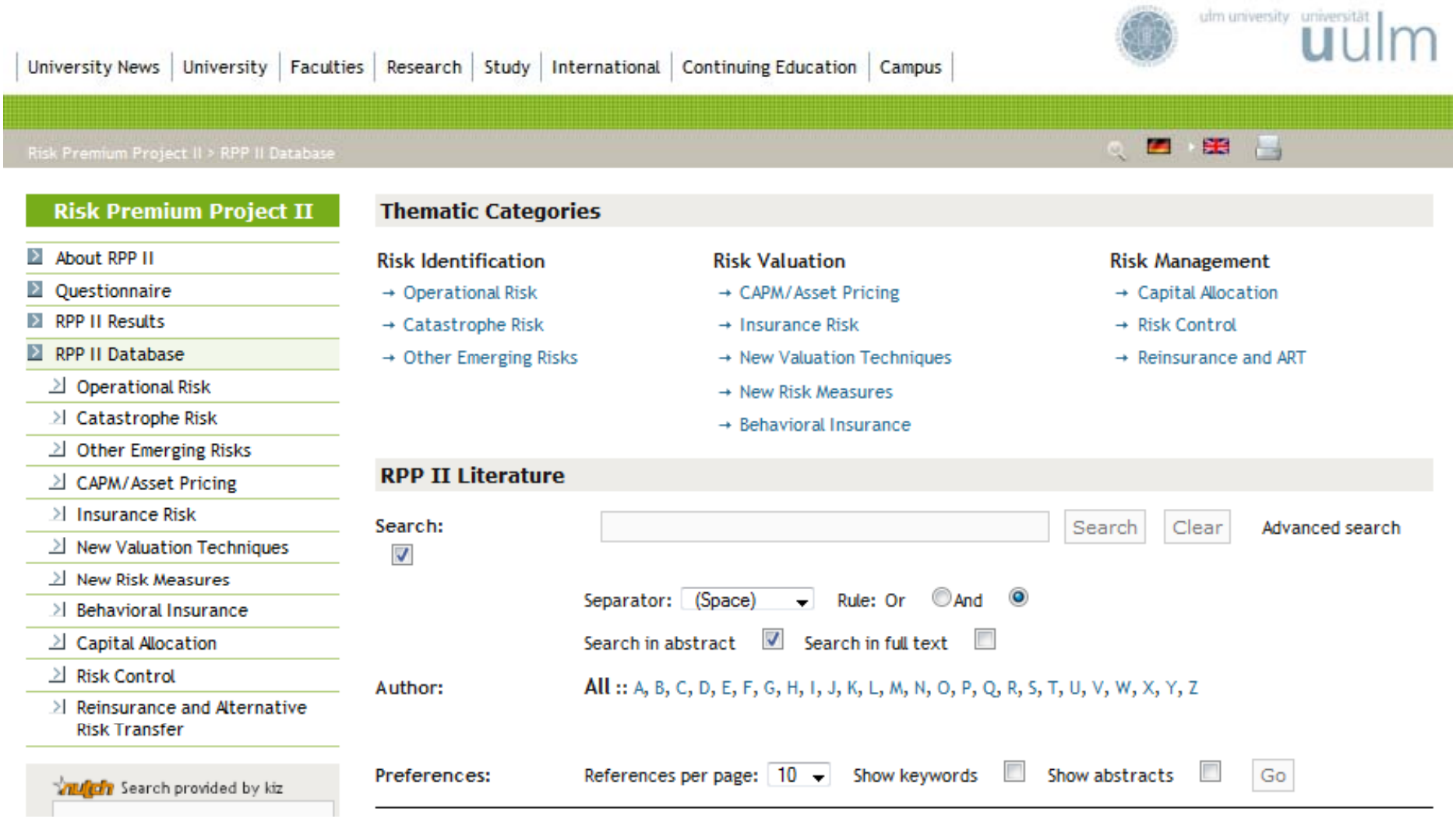
Preferences: References per page: 10 Show keywords Show abstracts Go

References

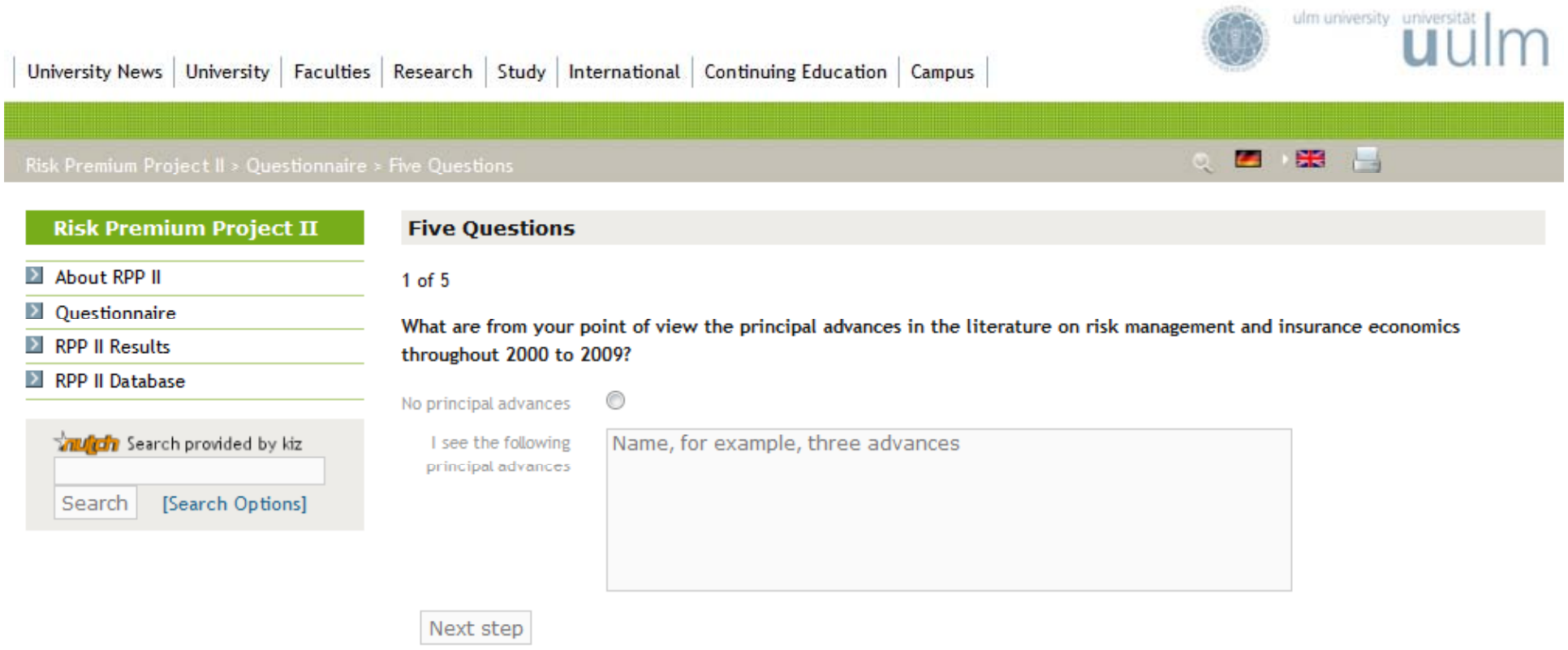
2010

- Pasquale Della Corte, Lucio Sarno and Giorgio Valente
  A century of equity premium predictability and the consumption-wealth ratio: An international perspective
  Journal of Empirical Finance, 17(3):313-331
  2010

3. Results: Aim 1 – Update of the bibliography



3. Results: Aim 1 – Update of the bibliography



3. Results: Aim 2 – Revision of RPP I conclusions

- Review of pricing literature (asset pricing, insurance pricing)

  → RPP II Report, page 28
- Review of surplus allocation literature

  → RPP II Report, page 33
- Review of new fields (operational risk, catastrophe risk, …)

  → RPP II Report, page 35

3. Results: Aim 2 – Revision of RPP I conclusions

Pricing until 1999

Time

Pricing in Financial Economics
=> only systematic risk is relevant

- Capital Asset Pricing Model (CAPM)
  - Fama/French
  - Full Information Beta Approach
  - Rubinstein-Leland Approach
- Arbitrage Pricing Theory (APT)
  - Fundamental Theorem of Asset Pricing
  - No Arbitrage Principle

Pricing in Actuarial Science
=> syst. and unsyst. risk is relevant

- Net Premium Principles
  - Expectation principle
  - Variance Principle
  - Standard Deviation Principle
  - Semi-Variance Principle
- Utility Based Approaches
- Quantile Principle
- Esscher Principle

1999

2000

3. Results: Aim 2 – Revision of RPP I conclusions

Pricing 2000-2009

Time

1999

2000

1) Combine financial and actuarial pricing/integrate both perspectives, e.g., *Embrechts (2000)*
2) New pricing approaches:
   A) Assumption of non-normality, e.g., *Kozik and Larson (2001)*
   B) Incorporation of liquidity, e.g., *Acharya and Pedersen (2005)*
   C) Non-hedgeable insurance risk, insolvency risk, capital allocation, and negatively skewed returns, e.g., *Froot (2007)*
   D) Approaches from regulation and accounting, e.g., *MCEV, Solvency II*
3) Empirical applications in property-casualty insurance, e.g., *Cummins and Phillips, 2005*
4) Other aspects relevant for pricing such as behavioral insurance (e.g., *Kunreuther and Pauly, 2006*)

2009

2010

3. Results: Aim 2 – Revision of RPP I conclusions
Pricing – Theoretical and Empirical Results

Time

1999

2000

- **Theoretical contributions:** Froot and Stein (1998), Phillips, Cummins, and Allen (1998), Zanjani (2002), Froot (2007), Ibragimov, Jaffee, and Walden (2010)

  → The overall prediction of these papers is that prices of illiquid and imperfectly hedgeable intermediated risk products should depend upon the a) firm's capital structure, b) the correlation of the risks with the firm's other projects, c) their marginal effects on the firm's insolvency risk, and d) asymmetries of return distributions

- **Empirical contributions:** Cummins and Phillips (2005), Wen et al. (2008), Cummins, Lin, and Phillips (2009)

  → In general, empirical tests support the theoretical predictions

2009

2010

3. Results: Aim 2 – Revision of RPP I conclusions

Surplus/Capital Allocation

Proportional	CAPM	Marginal Capital Allocation (Merton and Perold, 1993) (Myers and Read, 2001)

Time

1999

2000

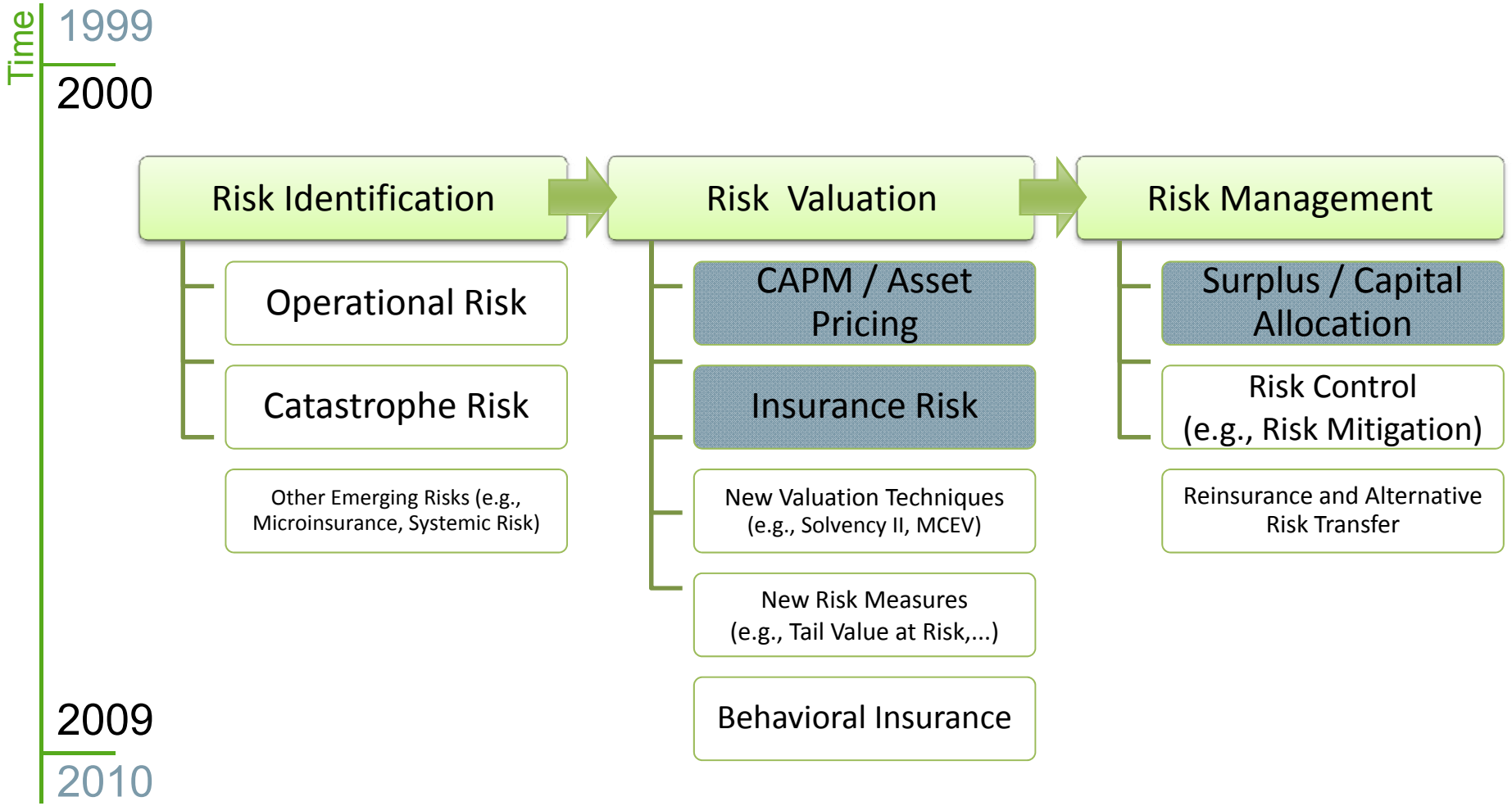
2009

2010

1) **21 New Approaches:** Taflin (2000), Denault (2001), Myers and Read (2001), Zanjani (2002), Wang (2002), Panjer (2002), Fischer (2003), Goovaerts, Kaas, and Dhaene (2003), Tsanakas (2004), Perold (2005), Sherris (2006), Erel, Myers, and Read (2007), Sherris and van der Hoek (2007), Stoughton and Zechner (2007), Furman and Zitikis (2008b), Bargès, Cossette, and Marceau (2009),Kim and Hardy (2009), Landsman (2009), Tsanakas (2009), Ibragimov, Jaffee, and Walden (2010), Zanjani (2010)
2) **Integration of different approaches/perspectives**
   - Wang (2000): New distortion function connects traditional actuarial standard deviation principle, CAPM, and option-pricing theory
   - Panjer (2002): CAPM and Tail Value at Risk
   - Wang (2002): Euler and covariance as special cases of Myers/Read (2001)
3) **Other aspects:**
   - Critique on Myers and Read (2001)
   - Denault (2001) and Kalkbrenner (2005) introduce axiomatic approaches to capital allocation

3. Results: Aim 2 – Revision of RPP I conclusions

New Fields 2000-2009



3. Results: Aim 2 – Revision of RPP I conclusions

New Fields 2000-2009 (cont.)

Time

1999

2000

1. Operational risk: Recognition in risk identification and measurement; advances in modeling, but also many challenges when modeling op. risk
2. Catastrophe risk: Analysis of market development/coverage; valuation of cat insurance; analysis of limitations and impediments of cat. insurance markets
3. Other emerging risks: New emerging risks such as terror, climate change, microinsurance; public vs. private sector; systemic risk
4. New valuation techniques: Development of new models from different perspectives; trend towards market-consistent valuation; critical discussion
5. New risk measures: Rapid expansion of number of risk measures; axioms; internal vs. external risk measures
6. Behavioral insurance: Prospect theory matters, first step in constructing a theory of insurance decision-making
7. Risk control: Better understanding of the interaction between insurance and risk mitigation; risk-based premiums and ex post public disaster assistance
8. Reinsurance and ART: Analysis of market development; Risk management with ART instruments; Analysis of basis risk and moral hazard

2009

2010

3. Results: Aim 2 – Revision of RPP I conclusions

Key Conclusion 1

1. <u>Financial vs. actuarial approaches:</u>
   - Ongoing consolidation between financial and actuarial literature
   - Both fields acknowledge the role of systematic and non-syst. risk in pricing

Theoretical insights

- The paper by Froot and Stein (1998) on risk management and capital budgeting for financial institutions has been very influential for the insurance literature. Froot (2007) models an insurance specific extension of the Froot and Stein (1998) paper that incorporates unsystematic risk.
- The model by Zanjani (2002) and recent work by Ibragimovic, Jaffee, and Walden (2010) also incorporate non-systematic risk.

Empirical insights

- Empirical tests of the theoretical pricing models include the work by Cummins and Phillips (2005), Wen et al. (2008), and Cummins, Lin, and Phillips (2009).
- The results by Cummins, Lin, and Phillips (2009) are especially important, because they confirm the predictions of various theoretical models: The price of insurance is related to insolvency risk and the covariability of losses across lines of insurance. It also reflects reflect negative asymmetries of return distributions.

3. Results: Aim 2 – Revision of RPP I conclusions

Key Conclusion 2

2. Fair value of the insurance premium:
   - Theoretical models and empirical tests have confirmed that given the real-world market imperfections, the price of insurance should be a function of the (1) expected cash flow with adjustments for systematic risk, (2) production costs (i.e. expenses) (3) default risk, and (4) frictional capital costs.
   - By-line adjustments should be integrated depending on the cash flow pattern of the liabilities.

Theoretical insights

- Zanjani (2002, p. 284) shows that price differences across market segments can be explained by differences in marginal capital requirements.
- Froot´s (2007) three-factor model includes a factor for the correlation of a given risk with the firm's other non-traded risks (the "firm-wide" risk factor).
- In the model by Ibragimovic, Jaffee, and Walden (2010) the equilibrium ratios of premiums to expected claims vary across insurance lines. In addition, capital and related costs are allocated across lines in proportion to each line's share of a digital default option on the insurer.

Empirical insights

- Cummins and Phillips (2005) and Cummins, Lin, and Phillips (2009), and Shim (2006) all empirically document by-line differences.

3. Results: Aim 2 – Revision of RPP I conclusions

Key Conclusion 3

3. General finance:
   - Accepted that the CAPM cannot adequately price financial contracts
   - Asset pricing models were systematically expanded to account for new aspects, e.g., liquidity risk or behavioral aspects
   - Empirical validation is still ongoing

(Empirical) insights from finance literature

- Fama and French (1993) factors (SMB, HML)
- Momentum factor (Carhart, 1998)
- Full Information beta (Kaplan and Peterson, 1998)
- Rubinstein-Leland model (Leland, 1999)
- Skewness and other higher moments (Harvey and Siddique, 2000)
- Liquidity (Liu, 2006)
- Information and pricing (Easley and O´Hara, 2004)
- Behavioral aspects and pricing (Daniel, Hirshleifer, and Subrahmanyam, 2001)
- Time-varying risk aversion and consumption based models (Campbell and Cochrane, 1999)
- Jump models (Carr et al., 2002)

(Empirical) insights for insurance companies

- Cummins and Phillips (2005) on Fama and French (1993) and full Information beta approach
- Wen et al. (2008) on Rubinstein-Leland
- Cummins, Lin, and Phillips (2009) confirm the role of unsystematic risk (by-line adjustments, default risk, higher moments)

3. Results: Aim 2 – Revision of RPP I conclusions

Key Conclusion 4

4. Capital allocation:
   - Capital allocation is still controversially discussed in literature
   - More than 20 new approaches were proposed in recent literature and critically reviewed in the light of economic and mathematical principles
   - Some authors consider the Myers and Read (2001) model as a benchmark model, while others believe that this model is inaccurate
   - Capital allocation remains a field of active discussion in academia and practice

RPP I

- Myers/Read (2001) was mentioned as theoretically consistent way to allocate the costs of holding equity capital to individual lines of insurance

RPP II

- Mildenhall (2006) and Gründl/Schmeiser (2007) argue that Myers/Read (2001) is inappropriate
- More than 20 new allocation approaches were discussed in literature
- Remains a field of active discussion in the future

3. Results: Aim 2 – Revision of RPP I conclusions

Key Conclusion 5

5. Risk transfer:
   - Various papers have theoretically and empirically confirmed the assertion that default risk is recognized in pricing risk transfer to the policyholder

Theoretical insights

- The model by Phillips, Cummins, and Allen (1998) predicts that in an efficient and competitive insurance market the price of insurance is inversely related to firm default risk. Empirically, they show that the inverse relationship is stronger for long-tail lines of business than for short-tail lines, suggesting that the default premium increases with the length of the payout phase.
- In Zanjani´s (2002) model 1) solvency matters to consumers, 2) capital is costly to hold, and 3) the average loss is uncertain. This implies a product-quality tradeoff. The more capital, the higher are the costs and the lower is the default risk (and vice versa). Diversification across markets helps to reduce the uncertainty of losses.

Empirical insights

- Sommer (1996), Grace, Klein, and Kleindorfer (2001), Grace et al. (2003), and Epermanis and Harrington (2006) all provide evidence consistent with the hypothesis that insurers suffer from reduced demand when credit ratings fall (see Froot, 2007).
- Epermanis and Harrington (2001) analyze abnormal premium growth surrounding changes in financial strength ratings for a large panel of property/casualty insurers and find significant premium declines in the year of and the year following rating downgrades.
- Cummins and Phillips (2005), Wen et al. (2008), and Cummins, Lin, and Phillips (2009) empirically confirm that the price of insurance is related to insolvency risk.

3. Results: Aim 2 – Extension of RPP I conclusions

6. Use of market consistent valuation techniques:
   - Practitioners are increasingly using these techniques (e.g. Solvency II)
   - New valuation techniques reflect the theoretical conclusions on the price of insurance (see e.g. conclusion 2)
7. Increasing importance of enterprise risk management involving classical techniques as well as new product categories:
   - Market consistent valuation calls for holistic risk management
   - Increasing role of both classical risk management techniques (e.g., risk mitigation) as well as new means (e.g., reinsurance and ART)
8. New risk measures and new risk categories:
   - Success of quantile based risk measures (value at risk, expected shortfall) and generalizations of these (spectral, distortion)
   - New risk categories (operational risk) have been introduced in academic literature and their limitations are discussed; new aspects such as systemic risk

3. Results: Aim 2 – Extension of RPP I conclusions

9. Emergence of behavioral insurance:
   - First steps have been taken towards a new area of literature that may bridge the gap between theoretical models and real world outcomes
   - Many researches address default risk and complement findings of theoretical models
10. Reinsurance and alternative risk transfer:
   - Convergence of (re-) insurance and capital markets through ART
   - Market for ART is, however, still behind the expected capacity
   - Literature analyzes reasons for market failures (e.g., diversification trap) and alternative product innovations (e.g. hybrid cat bonds) to increase volume of the ART market

3. Results: Aim 3 – Recommendation of additional studies

1. Pricing and cost of capital:
   a) The classical CAPM is not sufficient to estimate costs of capital and Fama and French and Rubinstein-Leland are better models for this purpose
   b) However, more research has been done on financial economics in recent years, with unclear implications for pricing of insurance. Are there other factors that we need to take into consideration, such as liquidity risk, credit risk, operational risk, or behavioral aspects such as time varying risk aversion?
   c) A systematic analysis of asset pricing theories in an insurance context could thus constitute a major empirical research agenda.
2. Capital Allocation:
   a) Dozens of capital allocation approaches are discussed in literature and adding another one will be of very limited value.
   b) It might be more helpful to empirically validate the usefulness of different capital allocation approaches.
   c) Some authors see the Myers and Read (2001) approach as a best practice; others think that this model is inaccurate.

3. Results: Aim 3 – Recommendation of additional studies

3. ERM, modeling of risk, and dependencies:
   a) What is the value added by ERM?
   b) Empirical evidence for modeling of dependencies
   c) Empirical research with respect to the robustness of risk measures
   d) Consistency in risk management
4. Financial crisis and systemic risk:
   a) Does existing regulation accelerate a crisis?
   b) What is the role of insurers in the highly connected financial services industry?
   c) Is an insurance run possible or not?
5. Analysis of new insurance markets and products:
   a) How can we eliminate the market failure in ART?
   b) What is the capacity of the ART market?
   c) Emerging insurance markets are future growth markets, but we still do not know enough about insurance business in these markets

THANK YOU VERY MUCH FOR YOUR ATTENTION! QUESTIONS? COMMENTS?