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# Optimal Risk-Sharing Contracts: A Behavioral Perspective

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**Copenhagen  
Business School**  
HANDELSHØJSKOLEN





# Purpose of this Talk

- > Provide a crash course in behavioral economics.
- > No definite answers provided in this talk.
- > Present thought-provoking ideas as an *entrée* for this conference.
- > Review of optimal risk-sharing schemes under different behavioral assumptions
- > Marginal discussion of Moral Hazard, Adverse Selection and Fraud
  - Very important issues for contract design but not part of this talk



# Key Messages

- People make decisions under risk and uncertainty in different ways
  - This has an impact on the type of insurance contract/scheme people like the most



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- > The poor have ways to cope with risks
  - Mutual insurance schemes
  - Intricate web of risk managing



# Key Messages

- > People make decisions under risk and uncertainty in different ways
  - This has an impact on the type of insurance contract/scheme people like the most
- > The poor have ways to cope with risks
  - Mutual insurance schemes
  - Intricate web of risk managing
- > The challenge of microinsurance is to find its place in the universe of risk managing strategies the poor use.



# Outline

## > Behavioral Economics 101

- Behavioral assumptions of decision-making under uncertainty

## > Optimal Risk-Sharing Contracts

- A mutual insurance theorem
- Classical theory of insurance demand
- Integrated risk management
- Ambiguity, Uncertainty and Multivariate Risks

## > Conclusions



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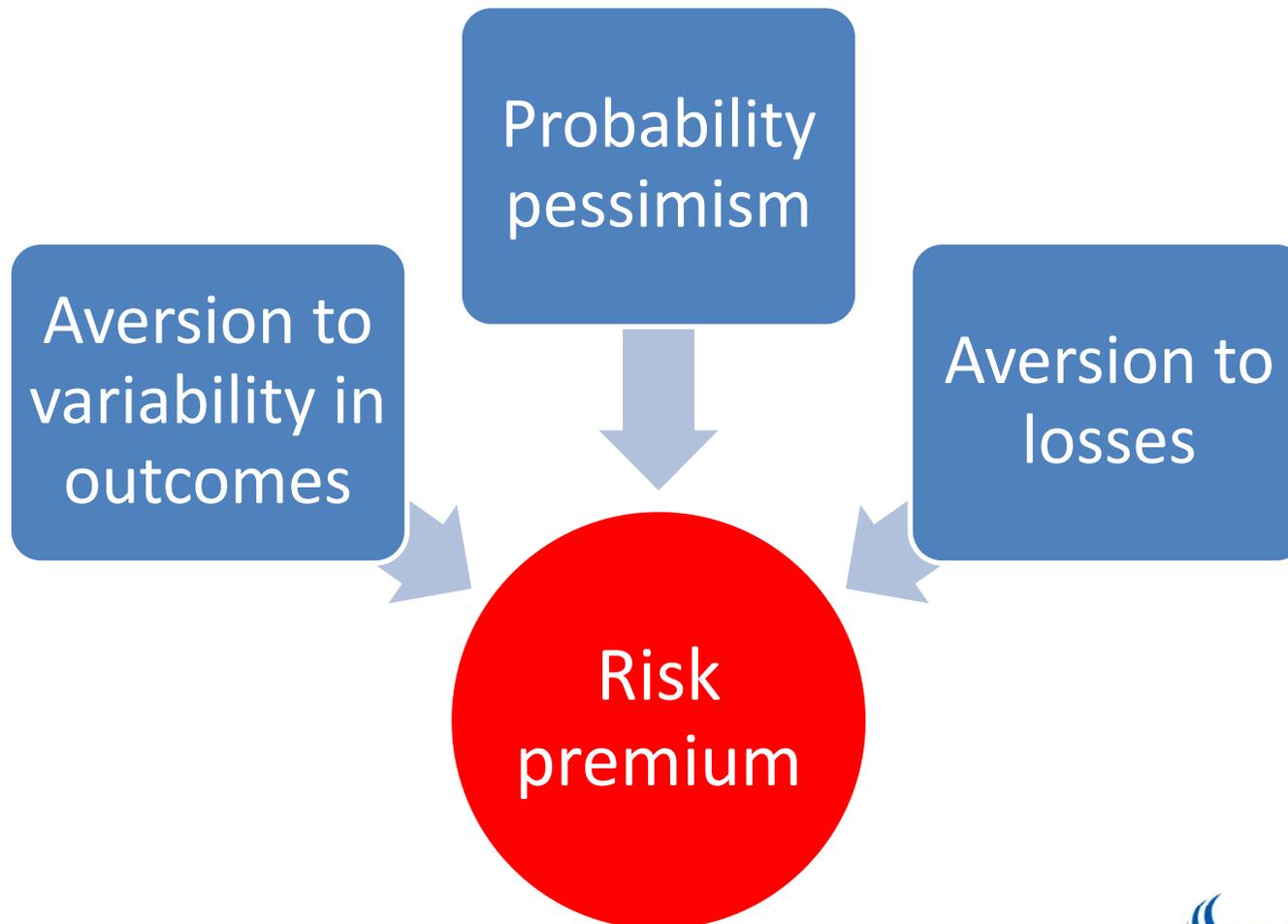


# Decomposition of Risk Attitudes

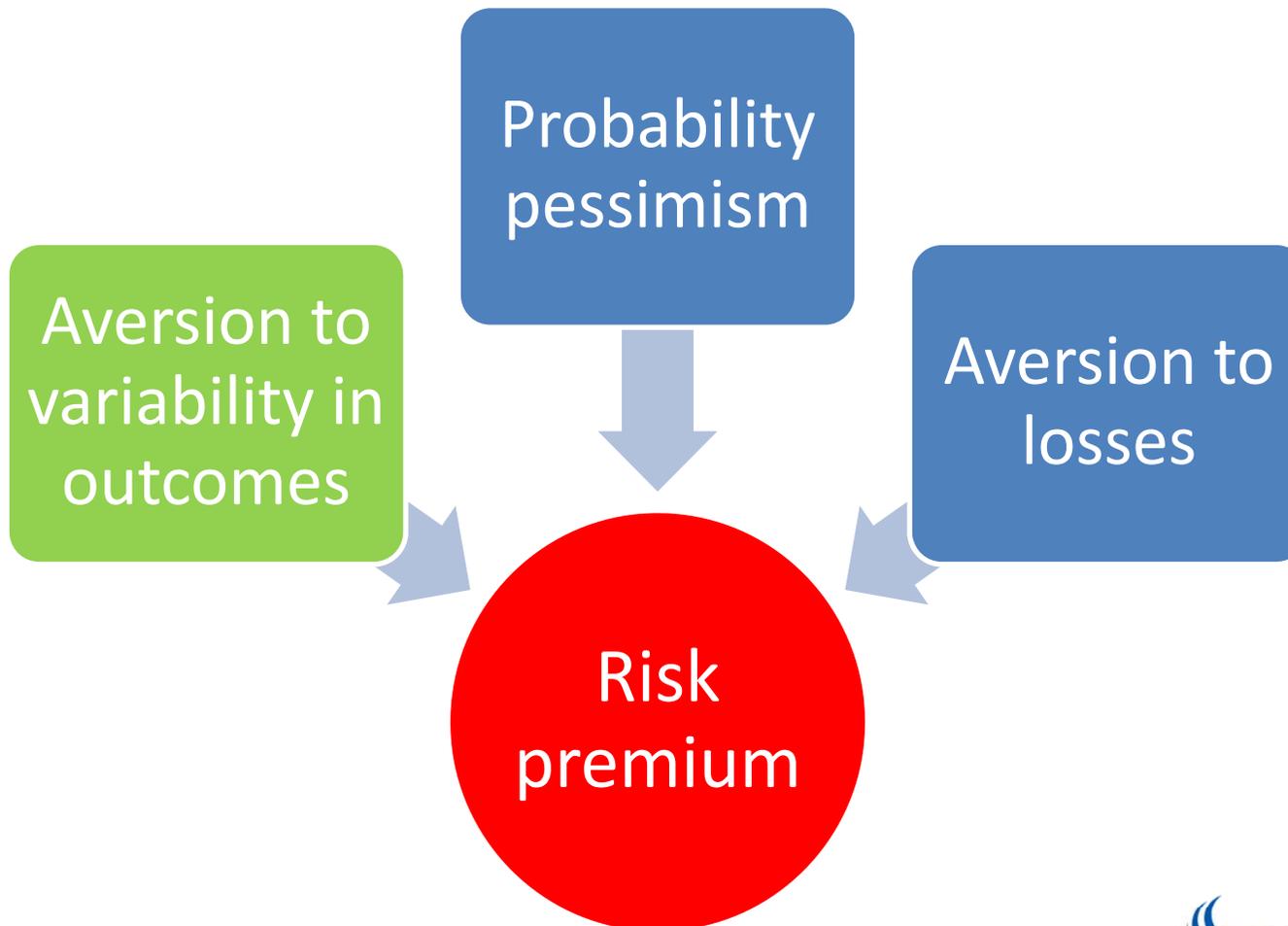


- > We are interested in how people make decisions under risk
- > We can characterize risk attitudes by looking at the risk premium and its decomposition
  - Risk premium: minimum amount of money people would like to get to feel compensated for a risk they are taking
- > Alternative theories about the risk premium
  - Aversion to variability
  - Probability optimism or pessimism
  - Loss aversion

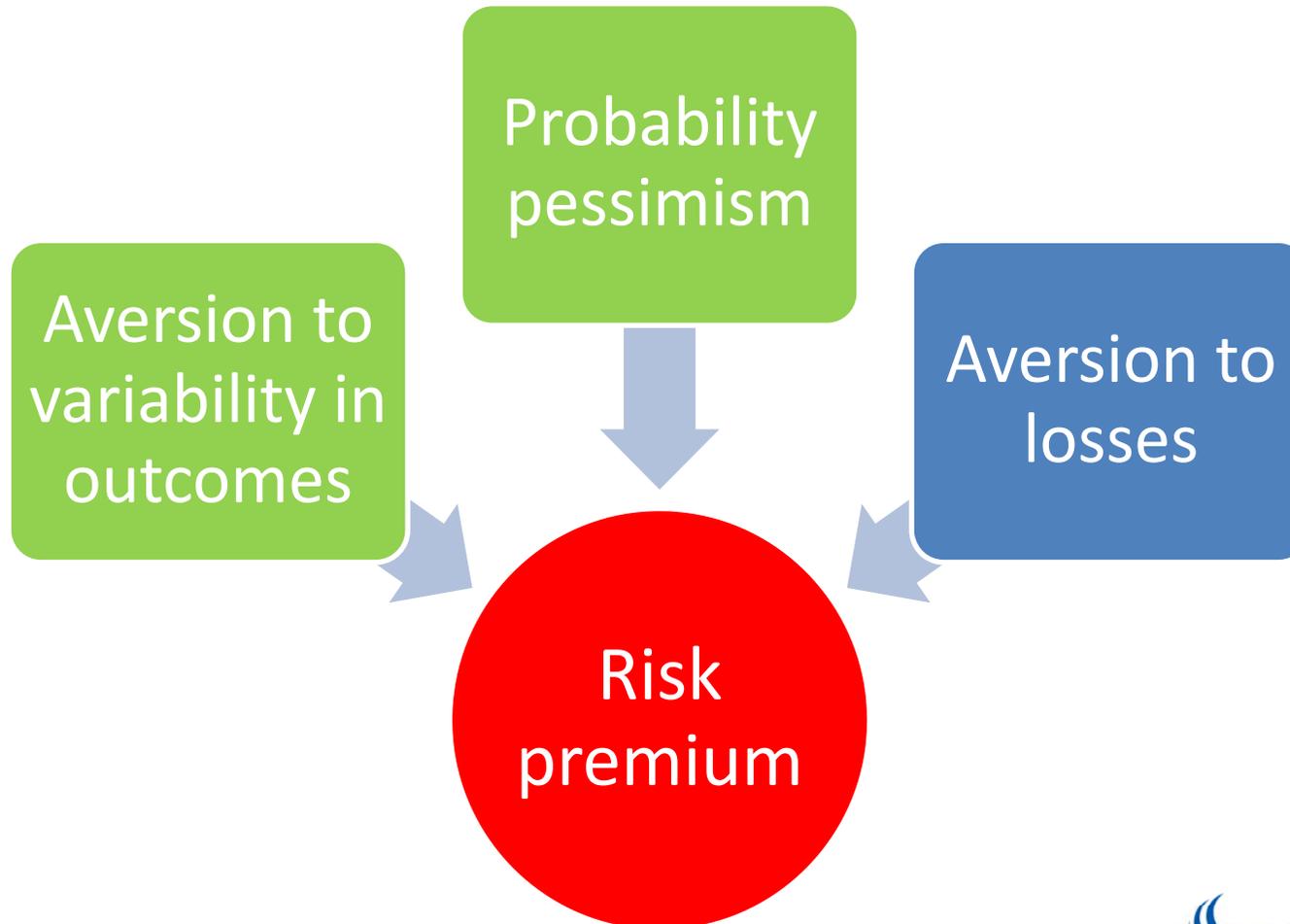
# Risk attitudes are multi-dimensional



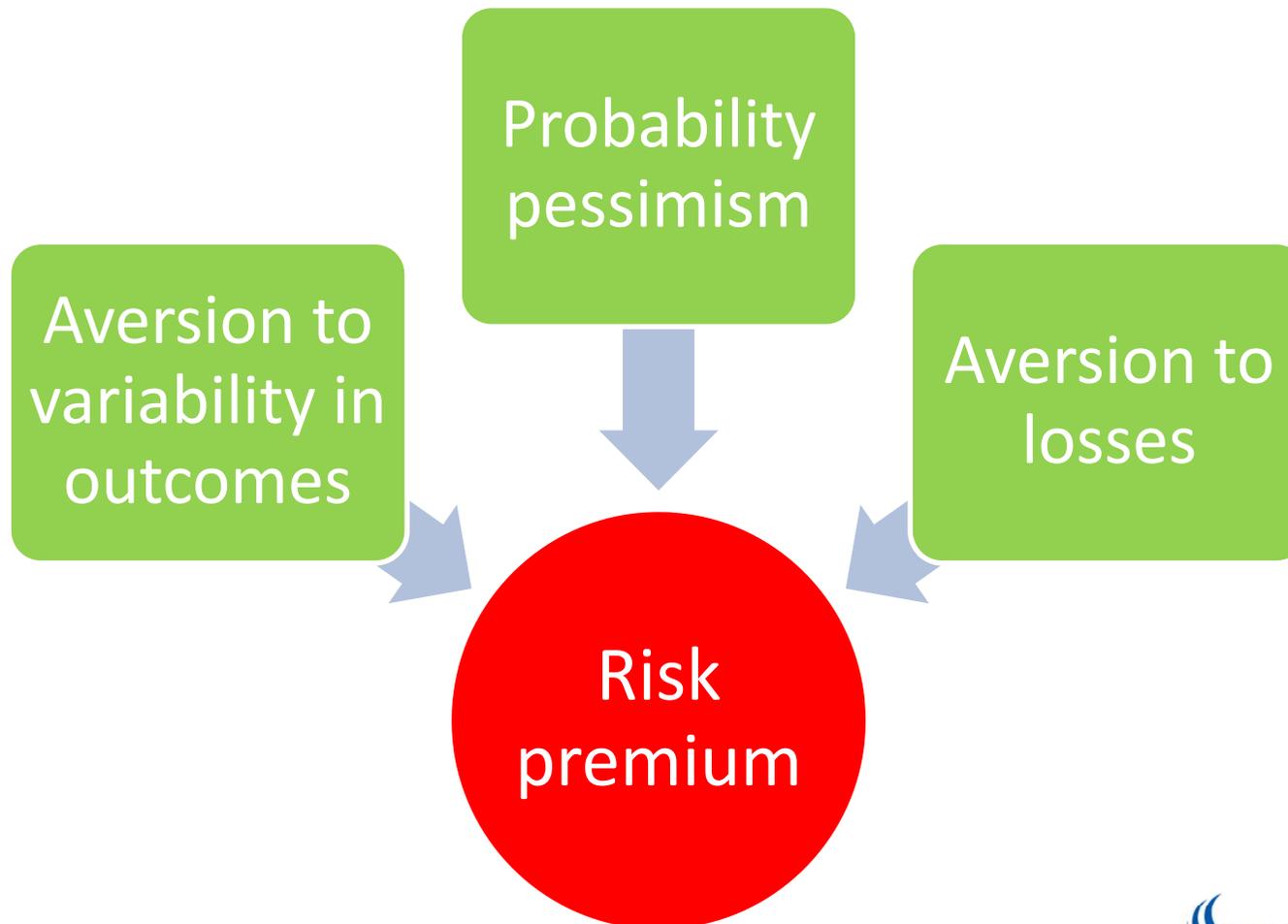
# Expected utility theory (EUT)



# Rank dependent utility (RDU)



# Cumulative prospect theory (CPT)



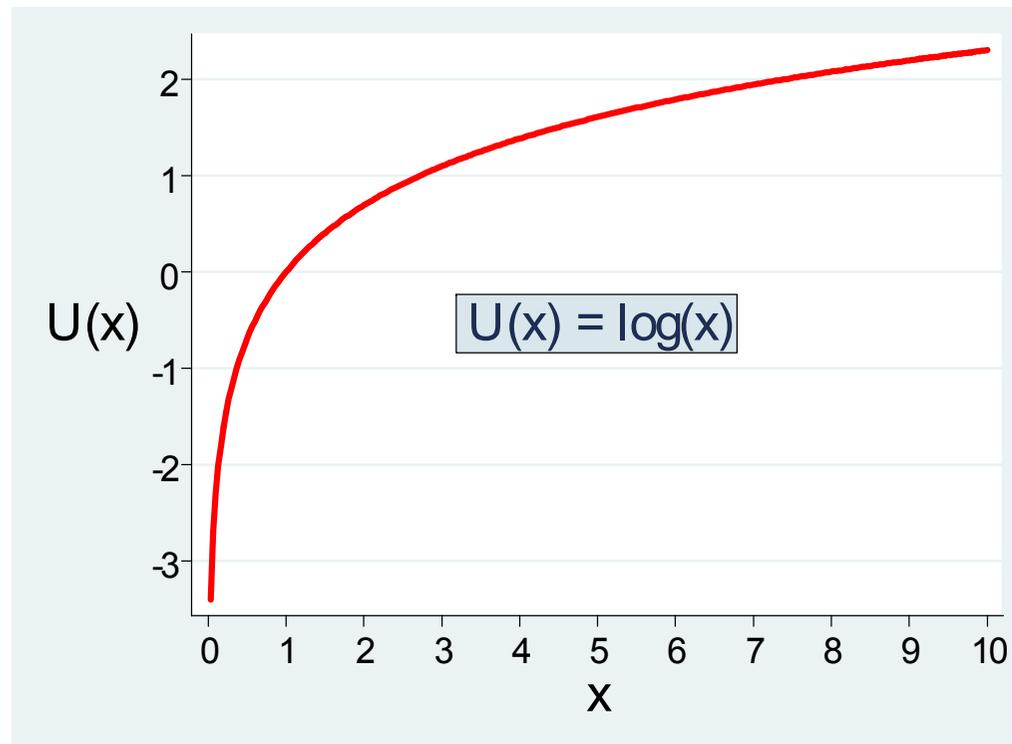


# Theories of risk attitudes

Psychological pathway to risk premium	Expected utility theory		
Aversion to variance			
Probability pessimism or optimism			
Loss aversion in utilities			
Loss aversion in probabilities			

# Diminishing MU and risk attitudes in EUT

- > MU (eventually) gets smaller as  $x$  gets bigger
- > So  $\partial^2 U / \partial x^2 < 0$

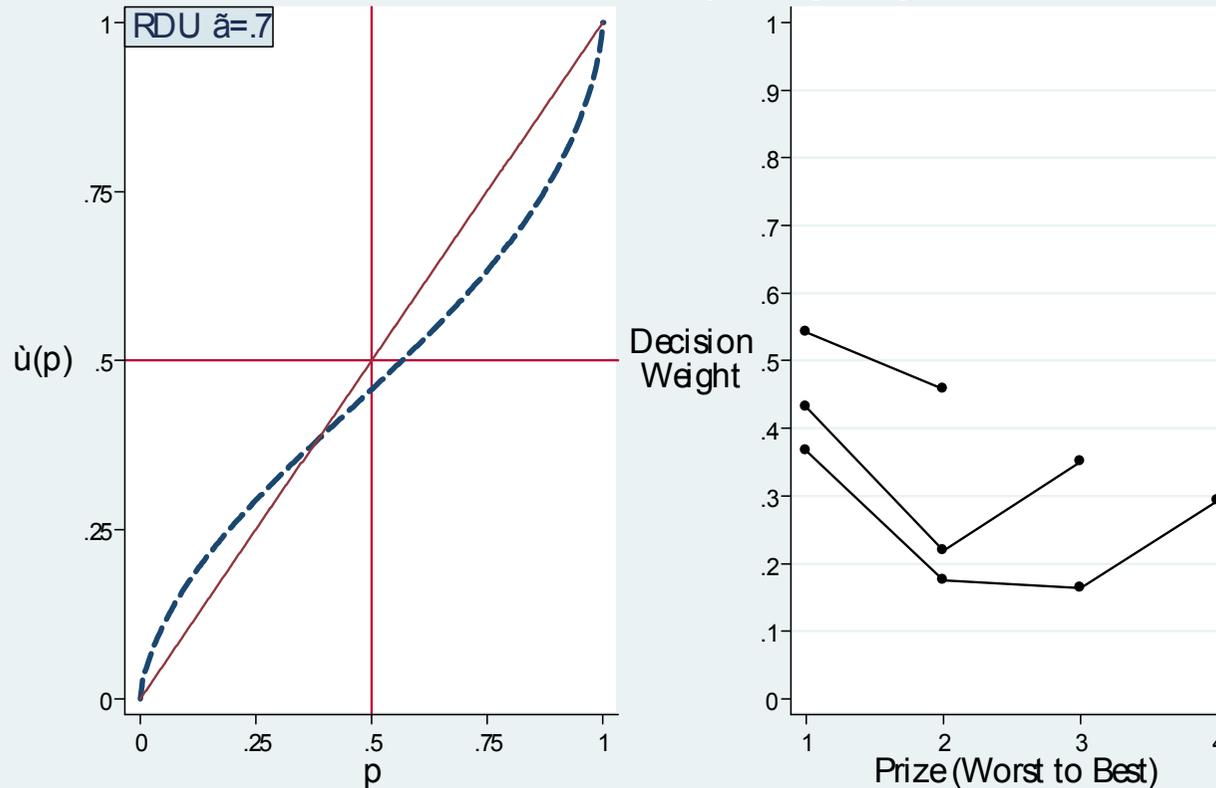


# Theories of risk attitudes

Psychological pathway to risk premium	Expected utility theory	Rank dependent utility	
Aversion to variance	✓	✓	
Probability pessimism or optimism		✓	
Loss aversion in utilities			
Loss aversion in probabilities			

# Overweighting of extremes

Probability Weighting and Decision Weights  
With Inverse-S Shaped Probability Weighting Function

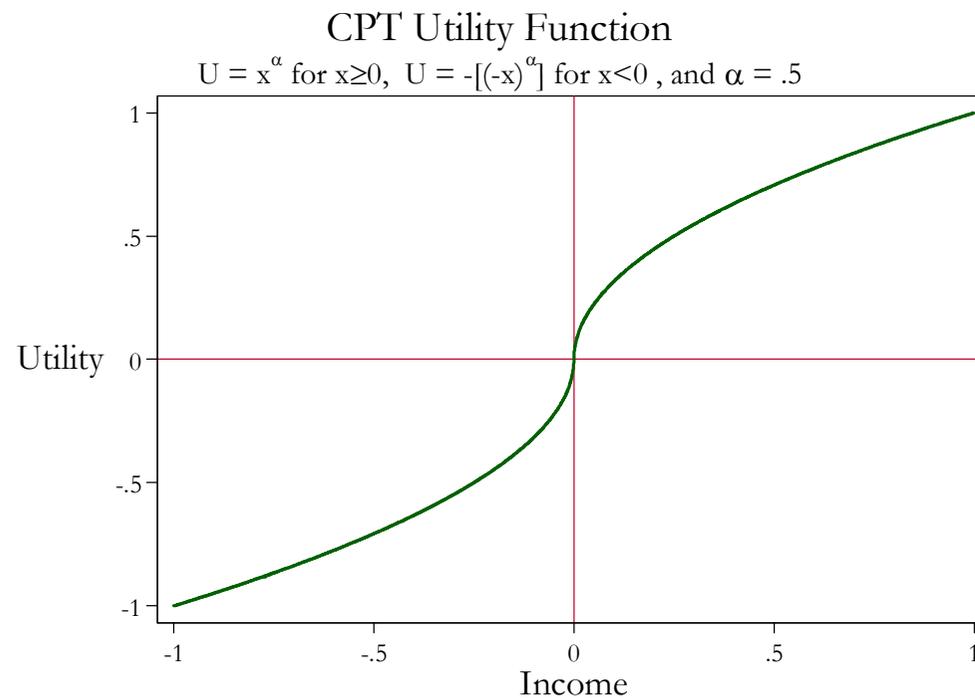


# Theories of risk attitudes

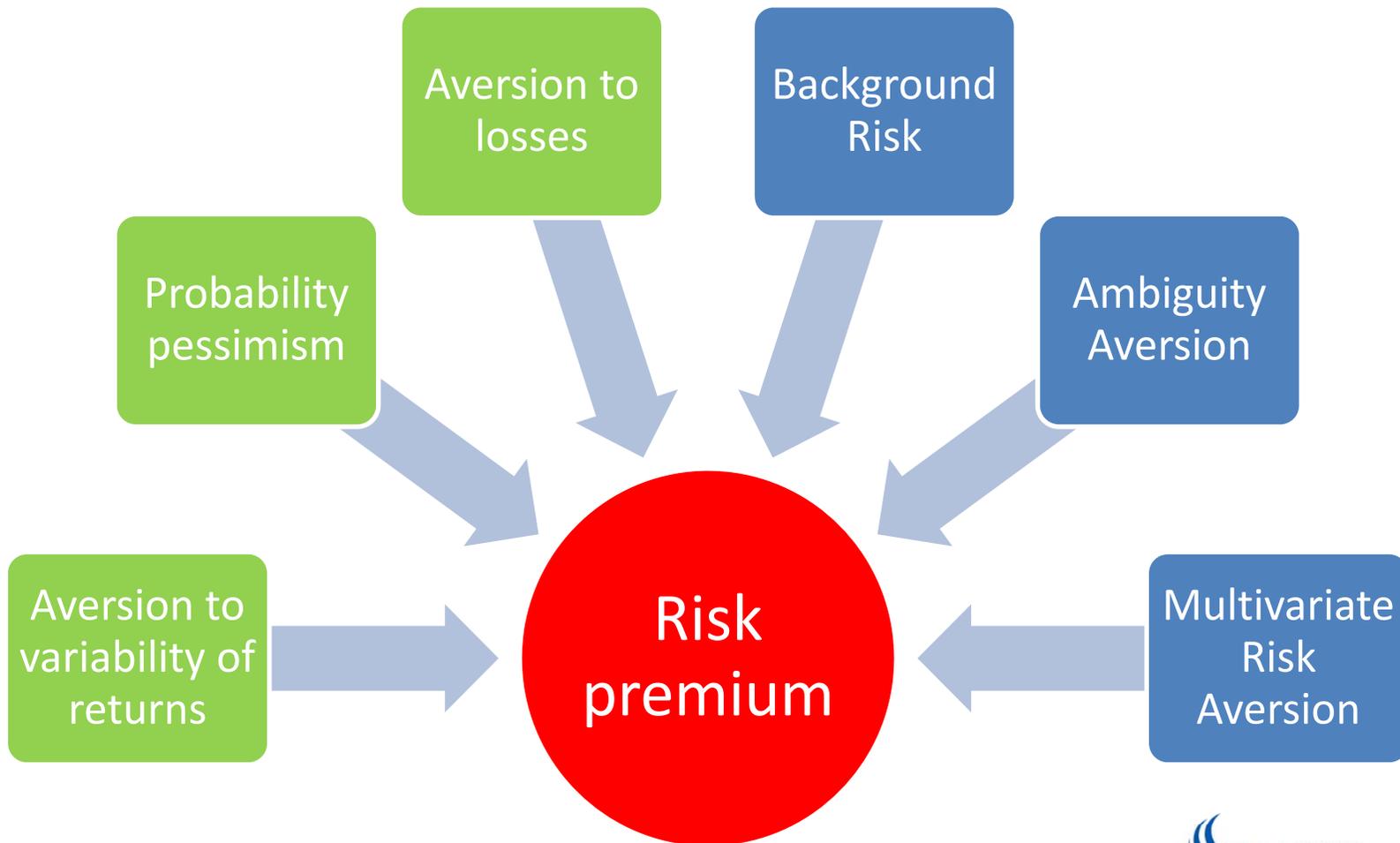
Psychological pathway to risk premium	Expected utility theory	Rank dependent utility	Prospect theory
Aversion to variance	✓	✓	✓
Probability pessimism or optimism		✓	✓
Loss aversion in utilities			✓
Loss aversion in probabilities			✓

# Interpretation of utility curvature

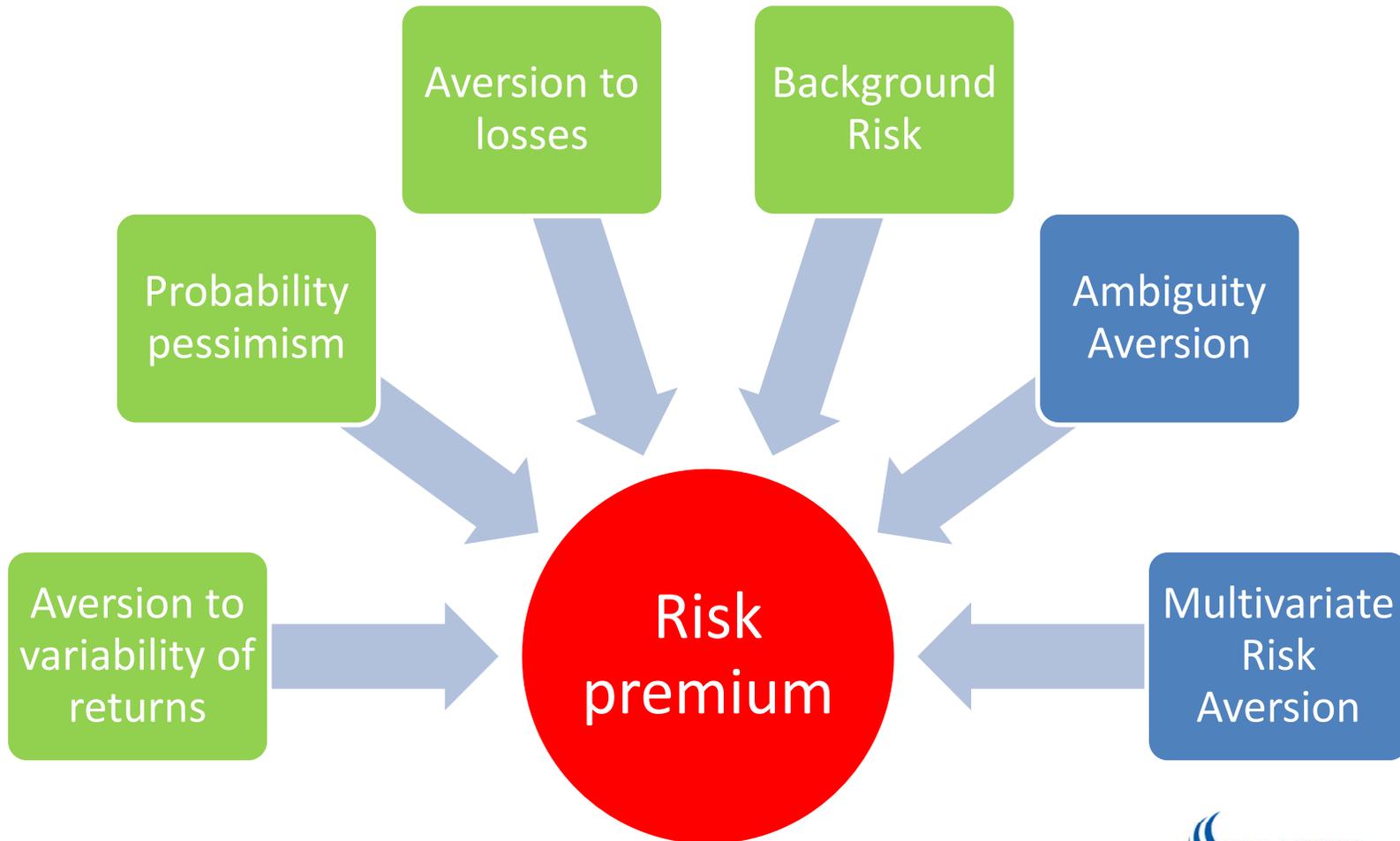
- > Concave U in gains is convex in losses



# More Components of the risk premium



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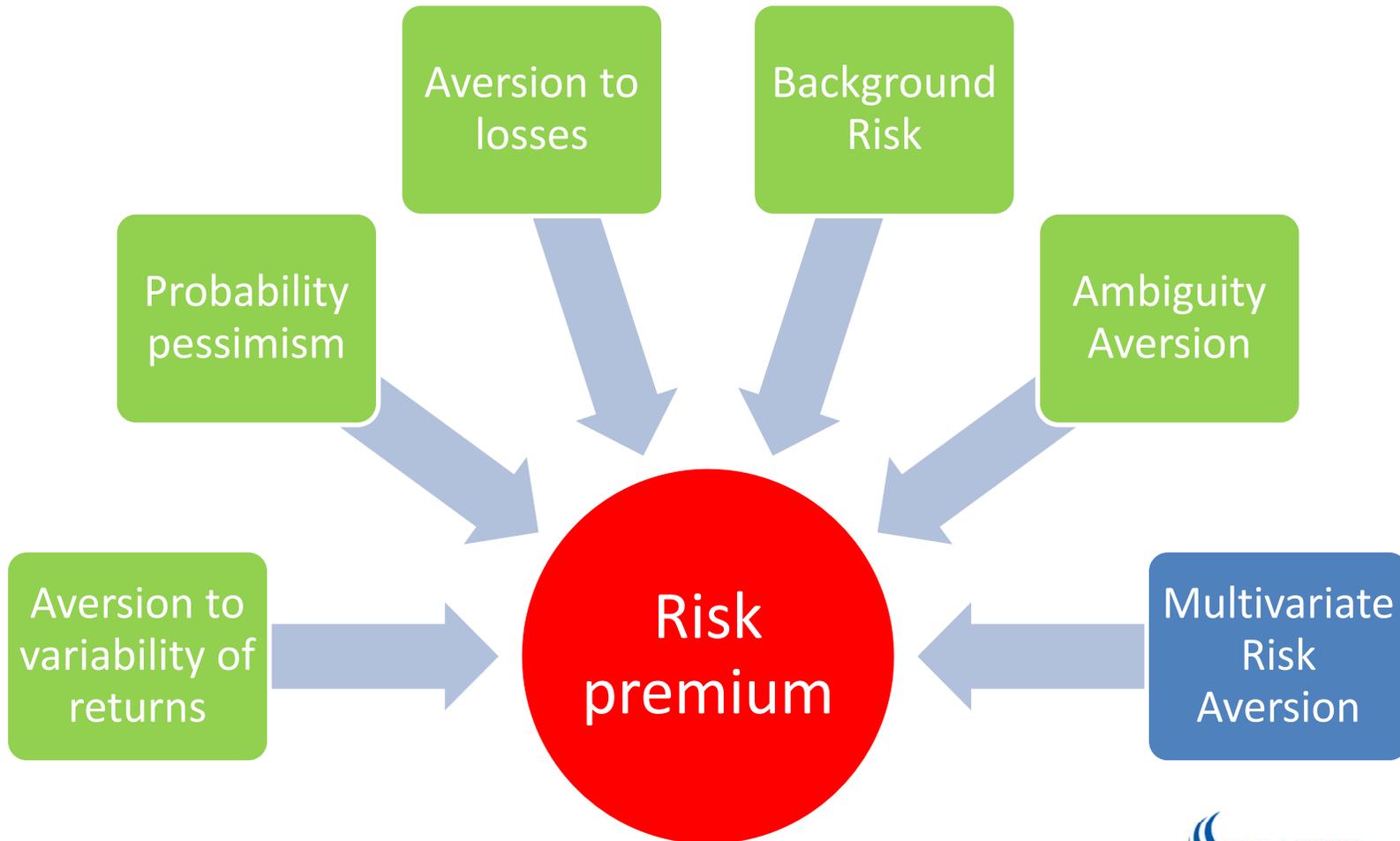




# Background Risks

- > These are risks that are present and that cannot be easily insured: e.g., Human Capital, income risk
  
- > The presence of these risks can affect insurance decisions in other dimensions (e.g. health insurance)
  - Can make you behave as if you were more risk averse
  - Can use outside income to hedge other risks

# More Components of the risk premium

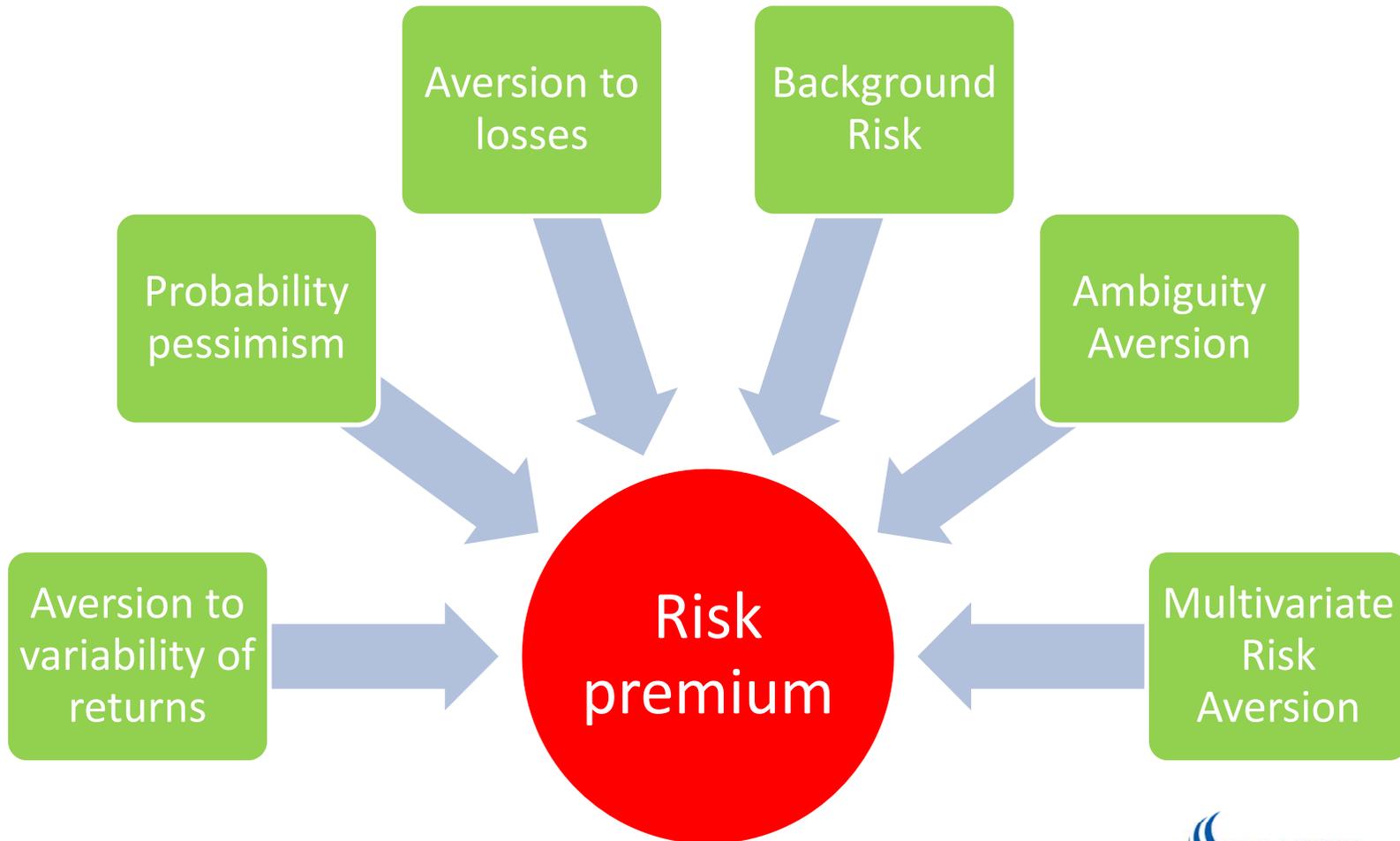




# A Non-Trivial Distinction: Risk vs. Uncertainty

- > Under EUT all probabilities are the same
  - A 50/50 chance of winning \$100 in a coin flip vs. a subjectively assessed 50/50 chance of winning \$100 in the stock market
- > But people may have a preference for known probabilities
- > This distinction has a long tradition in decision theory:
  - Knight [1921] and Ellsberg [1961].
- > There are now many models that deal with this type of uncertainty that is called *ambiguity*.
- > Classic insurance theory results may not hold.

# More Components of the risk premium





# Multivariate risk Aversion

- > People make choices every day which involve uncertain outcomes over different dimensions
- > Economic theory simplifies the analysis by reducing the problem to one dimension:
  - A measure of wealth or consumption used to evaluate overall satisfaction of a multidimensional decision
  - Can use univariate risk aversion framework of Pratt [1964]
- > People can have different risk attitudes in different dimensions
  - Someone may love gambling but can be really risk averse about housing wealth



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# A Theorem of Mutual Insurance

- > Borch, Karl, “Equilibrium in a Reinsurance Market,” *Econometrica*, 30, 1962, 424-444.
- > Application of Arrow’s [1953] GE model.
  - Risk is the only commodity traded.
- > **Result 1 (mutuality):** Only aggregate “social” risk matters.
  - Individuals pool resources and get rid of idiosyncratic risk.
- > **Result 2:** The distribution of risk among individuals depends on the risk aversion and bargaining power of every individual.
  - Assumptions on risk aversion simplify the rule.



# A Theorem of Mutual Insurance

- > The theorem is robust to many behavioral assumptions:
  - EUT
  - Non-EUT and Ambiguity (under certain conditions)
  
- > Evidence of the mutuality principle in the lab and field
  - Informal Funeral [mutual] Insurance Schemes
  - Field: Townsend [1994] and Chiappori et al. [2011] found evidence of the *full risk sharing* hypothesis
  - Lab: Bone et al. [1999][2004]



# Mutual Insurance vs. Typical Insurance

- > This theorem describes a natural risk-sharing mechanism that can arise endogenously in local environments.
- > Formal insurers can certainly provide the same service
- > But, there are reasons why people might prefer informal/formal mutual insurance
  - Trust
  - Deep knowledge of consumer needs



# Mutual Insurance vs. Typical Insurance

- > However, there are limits to local mutual insurance
  - Epidemics, natural disasters, etc...
  
- > External insurers can play an important role insuring undiversifiable risks at the local level.
  
- > Can also even play a reinsurer role for local insurance schemes.
  - Clarke [2011]: "Reinsuring the Poor: Group Microinsurance Design and Costly State Verification"



# Optimal Insurance Contracts and Insurance Demand

- > Mossin, Jan, “Aspects of Rational Insurance Purchases,” *JPE*, 79, 1968, 553-568.
- > **Result 1:** Full insurance is optimal if insurance is actuarially fair.
  - Or, partial Insurance coverage is optimal if premium is above the actuarially fair value.
  - Smith [1968] derived a similar result.
- > **Result 2:** Insurance demand is decreasing in wealth if individual has decreasing absolute risk aversion (DARA).



# If it is optimal to fully insure, why don't the Poor do it'?

- > Liquidity constraints can partially explain low insurance demand in the poor.
  - E.g.: Liu and Mayers [2012]
  
- > People can put aside savings (financial or non-financial) to deal with risk
  - With liquidity constraints savings might be more attractive than insurance
  
- > Less liquidity constraints reduce the need for savings, liberating resources for insurance purchases.
  - Need to understand the set of hedging tools available to the Poor to identify the role of insurance.



# Optimal Insurance Contracts

- > Arrow, Kenneth, “Uncertainty and the Welfare Economics of Medical Care,” *AER*, 53, 1963, 941-969.
- > **Result 1:** If insurance loading is positive, the most preferred insurance contract is one with full insurance above a deductible.
- > **Result 2:** If insured and insurer are risk averse, the optimal arrangement is a coinsurance contract.
  - Application of Borch theorem on optimal risk sharing rules.
- > **Result 3:** Informational problems (MH and AS) can also explain incomplete risk transfer.



# Optimal Insurance Contracts

- > The optimality of a contract with a deductible extends to non-EUT theories and ambiguity theories.
  - Karni [1992], Machina [2000], Gollier [2011]
- > However, it may not hold in the presence of background risk (human capital, farming income):
  - A coinsurance contract might dominate one with a deductible
- > e.g: People may buy less insurance because they can self-hedge bigger losses and leave the coinsurance contract for lower and more frequent losses.
  - Do people prefer to insure big unfrequent losses or small and frequent losses?



# Risk Management: The Role of Prevention

- > Ehrlich, J and Becker, G., “Market Insurance, Self-Insurance and Self-Protection,” *JPE*, 80, 1972, 623-648.
- > **Result 1:** With no market insurance, individual engages in self-protection (e.g., theft alarms) and self-insurance (e.g., savings) activities.
  - Marginal benefits are weighted against marginal costs of Self-Protection and Self-Insurance activities.
- > **Result 2:** Self-insurance and market insurance are substitutes.
- > **Result 3:** Self-protection and market insurance may be complements or substitutes.



# Risk Management: Risk-Transfer Tools

- > Mayers, D. and Smith, C. W., “The Interdependence of Individual Portfolio Decisions and the Demand for Insurance,” *JPE*, 91, 1983, 304-311.
- > Insurance choices should not be analyzed in isolation.
- > The “Big Picture” of insurance and portfolio choices.
  - Risky traded assets
  - Risky non-traded assets (e.g. Human capital)
  - Insurable and non insurable risks.
- > Insurance is just one of the hedging tools.
  - Risky assets can hedge human capital risk → less insurance.
  - Correlation of Human capital and insurable risk → more insurance.



# Ambiguity and Optimality of Contracts

- > Probabilities may feel different depending on the source.
  - Objective probabilities (dice) vs. subjective probabilities (weather).
  - People that dislike not so well-defined probabilities are called ambiguity averse
- > Why is this relevant for Microinsurance?
  - In the field we elicit “risk” attitudes with objective probabilities to study decisions under subjective probabilities
- > Optimal risk-sharing agreements might change in the presence of ambiguity
  - If ambiguity is extreme, people may not engage in mutual insurance
  - A contract with a deductible might not be optimal with ambiguity and background risk present.



# Optimal Contracts, Multidimensional Risks and Multivariate Risk Aversion

- > Raviv, A., “The Design of an Optimal Insurance Policy,” *AER*, 69, 1979, 84-96.
- > In the presence of many risks:
- > **Result:** The optimal risk-sharing agreement has a deductible and a coinsurance of losses, and the contract is defined over aggregate losses.
- > An *umbrella policy* the optimal contract.



# Optimal Contracts, Multidimensional Risks and Multivariate Risk Aversion

- > People make choices over *risky bundles* and in the presence of other risks.
- > Risk aversion can differ in each dimension
  - Multivariate Risk Aversion: Kihlstrom and Mirman [1974]; Richard [1975]; Duncan [1977]; Karni [1979]
- > People exhibiting multivariate risk aversion value more flexible contracts:
  - Karni [1979]: With many risks, optimal risk-sharing contract stipulates a coinsurance proportion for each source of uncertainty



# Optimal Contracts, Multidimensional Risks and Multivariate Risk Aversion

- > The presence of background risk is also important for insurance demand:
  - Insurer default is a background risk that can desincentivize insurance demand
  - In general, contractual non-performance has an impact on consumer choices (Daniel).



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# Conclusions

- > Different behavioral assumptions have important impacts on the type of insurance contract people would like to buy.
- > Low insurance demand can relate to
  - Contracts not matching the tastes of buyers
  - The poor may already have in place ways to deal with risk
  - Others: Liquidity, contract non-performance
- > To provide better insurance for the poor we should answer the following questions
  - How are the risk attitudes of the poor characterized?
  - Are there any other formal and informal risk management tools in place?



# THANK YOU



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