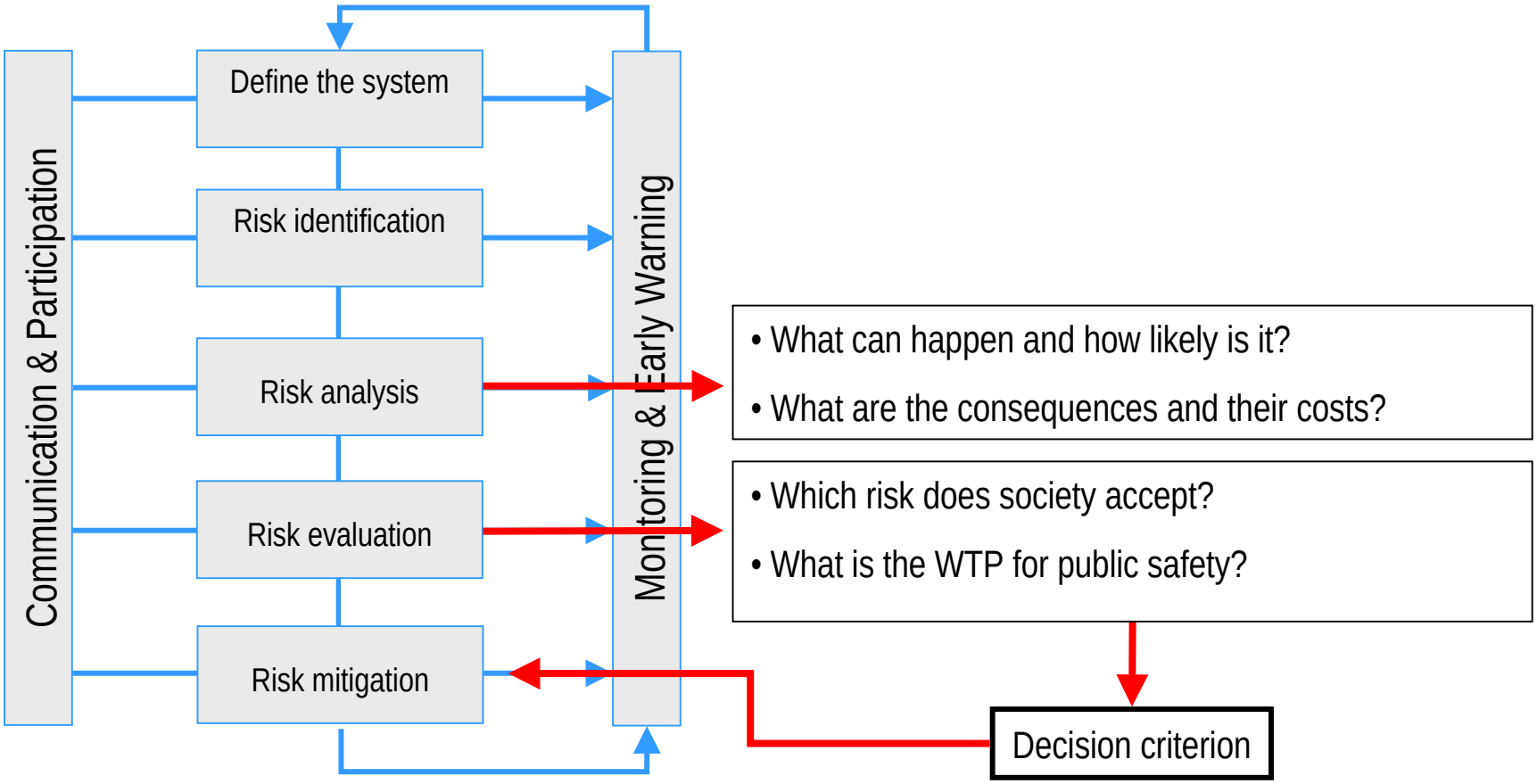
On the Economic Evaluation of Countermeasures

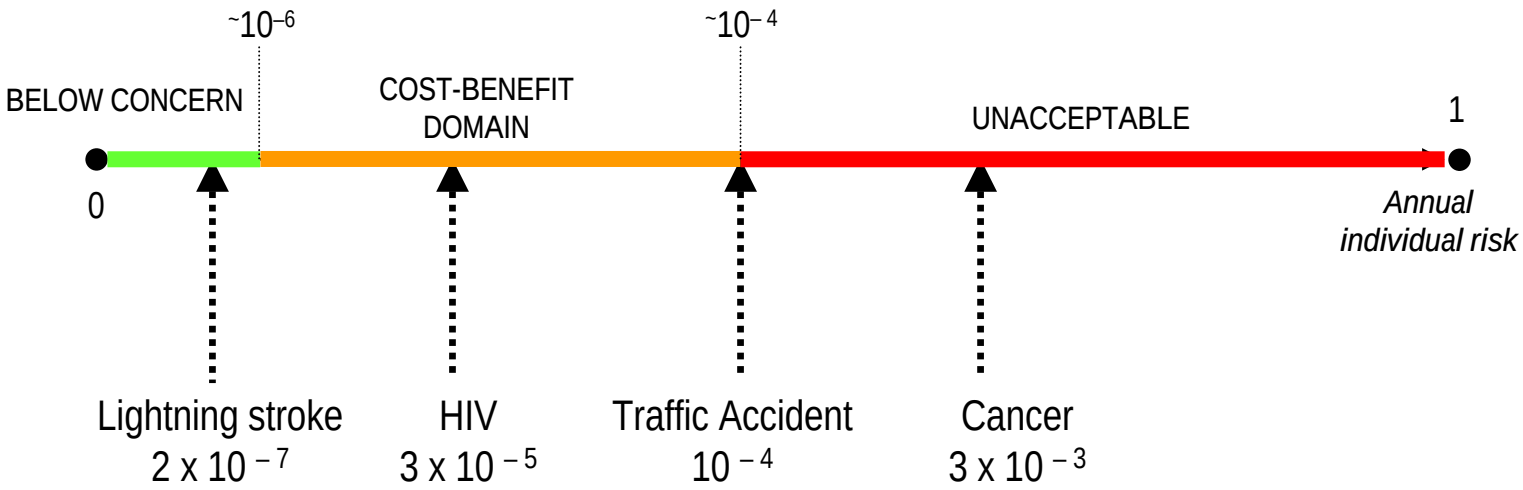
Outline

1. Framework for Natural Hazard Management
2. Acceptability of Risks
3. Evaluating Risks
4. Value of Statistical Life
5. Choice Experiment
6. Conclusion

1. Framework for Natural Hazard Management



2. Acceptability of Risks: Safety Goal Approach



3. Evaluating Risks: Cost-Benefit domain

Method	CBA	CEA
Decision Rule	„Maximize net benefit”	„Minimize risk from a given budget”
Theoretic Background	Welfare Economics	Decision Science
Aims at	Maximizing societal utility	Minimizing individual risks
Applied to	Environmental Risks • Low baseline risk (< 10^{-4}) • Population based view • Long-term perspective	Health Risks • High baseline risk (> 10^{-2}) • Individual based view • Short-term perspective

3. Evaluating Risks: CBA versus CEA

- Theoretical superiority of CBA

  ⇒ *The essence of economic analysis is to compare all of the benefits of the proposed action to all of the costs*

- Near-equivalence of CBA and CEA

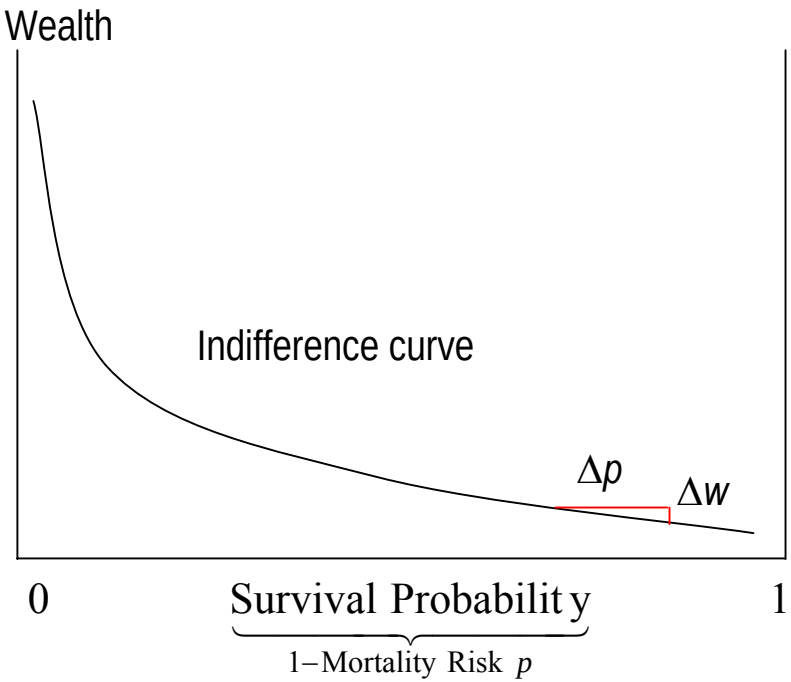
  ⇒ *Under a given budget constraint, both approaches should lead to similar policy decisions*

- Comparability

  ⇒ *Find a cutoff value per life saved*

4. Value of Statistical Life: Conceptual Foundations

VSL does not „*value prevention of a specific death but* [...] *small changes in mortality risk across a population*"

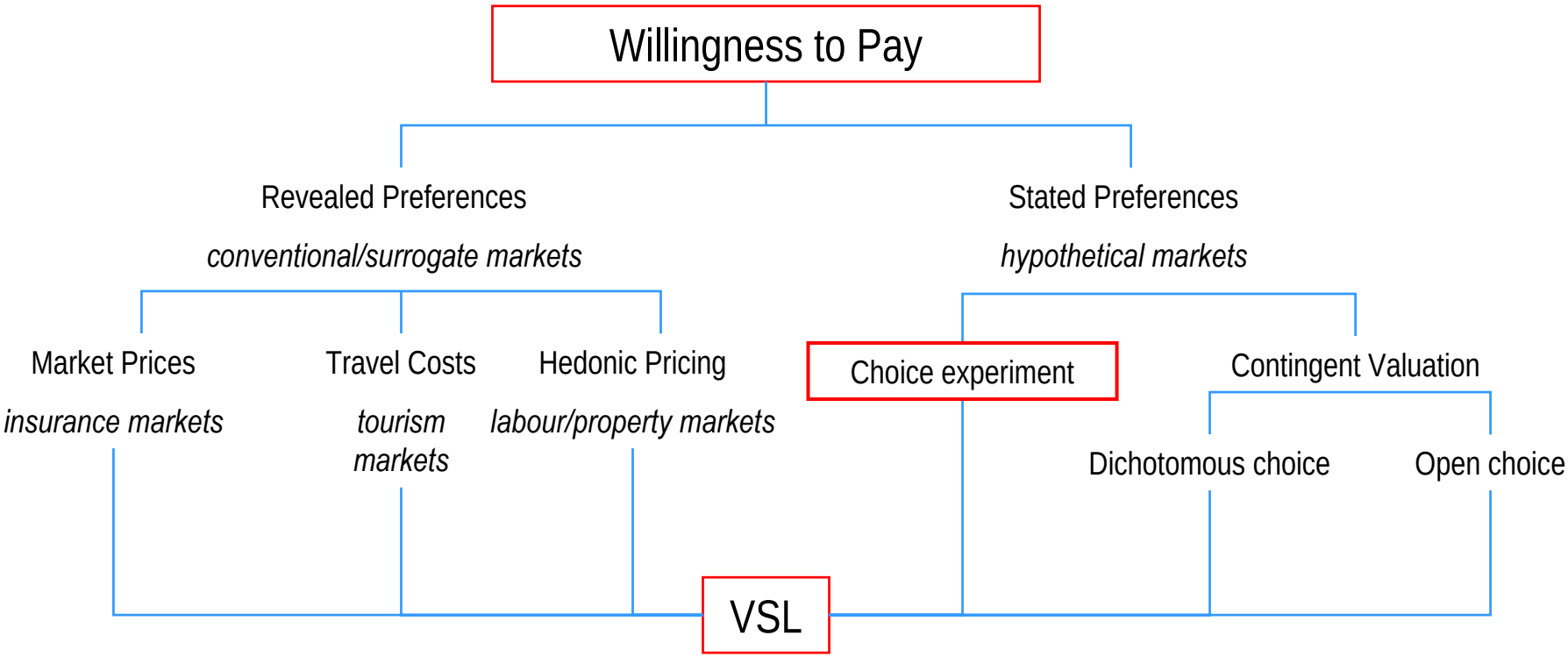


$$EU_0 = (1 - p_0)\, u_a(w_0) + p_0\, u_d(w_0)$$

$$\mathrm{VSL} = \left.\frac{dw}{dp}\right|_{p=p_0} = \frac{u_a(w_0)}{(1 - p_0)\, u_a'(w_0)}$$

$$\Rightarrow \mathrm{VSL} \times \Delta p = WSL[\Delta p] \equiv EU[\Delta p]$$

4. Value of Statistical Life: Empirical Approaches



5. Choice Experiment: Theoretical Idea

Utility of the risk reduction policy *j* can be split into a **reasoning**-based part expressed by the indirect utility function V_j and a **intuition**-based random part ε_j.

[1] $U_{k,i} = V_{k,i} + \varepsilon_{k,i}.$ Utility = Deterministic component + Stochastic component

[2] $k \succ j \Leftrightarrow U_k > U_j, \quad \forall\ j \in C, k \neq j.$

[3] i chooses k if $(V_{k,i} + \varepsilon_{k,i}) > (V_{j,i} + \varepsilon_{j,i}).$

5. Choice Experiment: Survey

3.1 Which of these policies to maintain protection measures on cantonal and communal roads in Alpine regions of Switzerland would you support?

	Policy A	Policy B	None of both
Avoided fatalities per year:	**12** out of 7'500'000 residents of Switzerland	**16** out of 7'500'000 residents of Switzerland	
Duration over which protection is provided:	10 years	10 years	Both policies are not convincing me.
Maintenance of protection measures against:	Rock fall	Snow avalanches	I am therefore **not** willing to make a payment contribution.
My **one-time** payment: (see the red fields on p. 7)	1%: CHF _____	2%: CHF _____	
I choose:	❑ Policy A	❑ Policy B	❑ None of both

5. Choice Experiment: Model

- Choice analysis based on the multinomial logit model:

$$\Pr(k \mid i) = \exp(V_{k,i}) / \sum_{j \in C} \exp(V_{j,i}).$$

- The use of MNL requires an appropriate indirect utility function *V*:

$$V_{j,i} = \theta_{1,i} \Delta RISK + \theta_{2,i} COST + \ldots + \theta_{j,i} X_{j,i}.$$

- It can be shown that:

$$VSL = (\partial V / \partial \Delta RISK) / (\partial V / \partial COST) = \hat{\theta}_1 / \hat{\theta}_2.$$

5. Choice Experiment: First Results

- First VSL estimates between €3.7 and 4.5 million per life saved

  ⇒ *Estimates are in range with other studies and with the rule of thumb currently used in Switzerland (€3.2-6.4 million per life saved)*

- Differences in WTP for avoidance of different hazard types

  ⇒ *Different perceptions of avalanches, rock falls, and ordinary traffic accidents*

- Risk framing plays significant role

  ⇒ *Differences with regard to reference description*

6. Conclusion

- It is not sufficient for risk management to know what can happen

- If we are striving for optimal protection against natural hazards, we need to know more about society's perception of these risks

- Integrating results from choice experiments into cost-benefit analyses is ONE promising approach

- We only addressed the cutoff value per life saved; much has to be done on other aspects that people regard as important for their WTP

Thank you for your attention

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