Valuing Lives Saved from Environmental, Transport and Health Policies

A meta-analysis of VSL estimates from Stated Preference Studies

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Overview of the presentation

- Introduction and Background
- Description of the data used in the meta-analysis
- Meta-regression results
- Numerical examples of VSL values based on the analysis
- Conclusions
- Further work

Why Meta-Analysis (MA)?

- Increased use of CBA in environmental decision-making.
  → increased demand for VSL estimates
  → benefit transfer
    - naïve/simple unit value transfer
    - benefit function transfer
    - meta-analysis (MA)

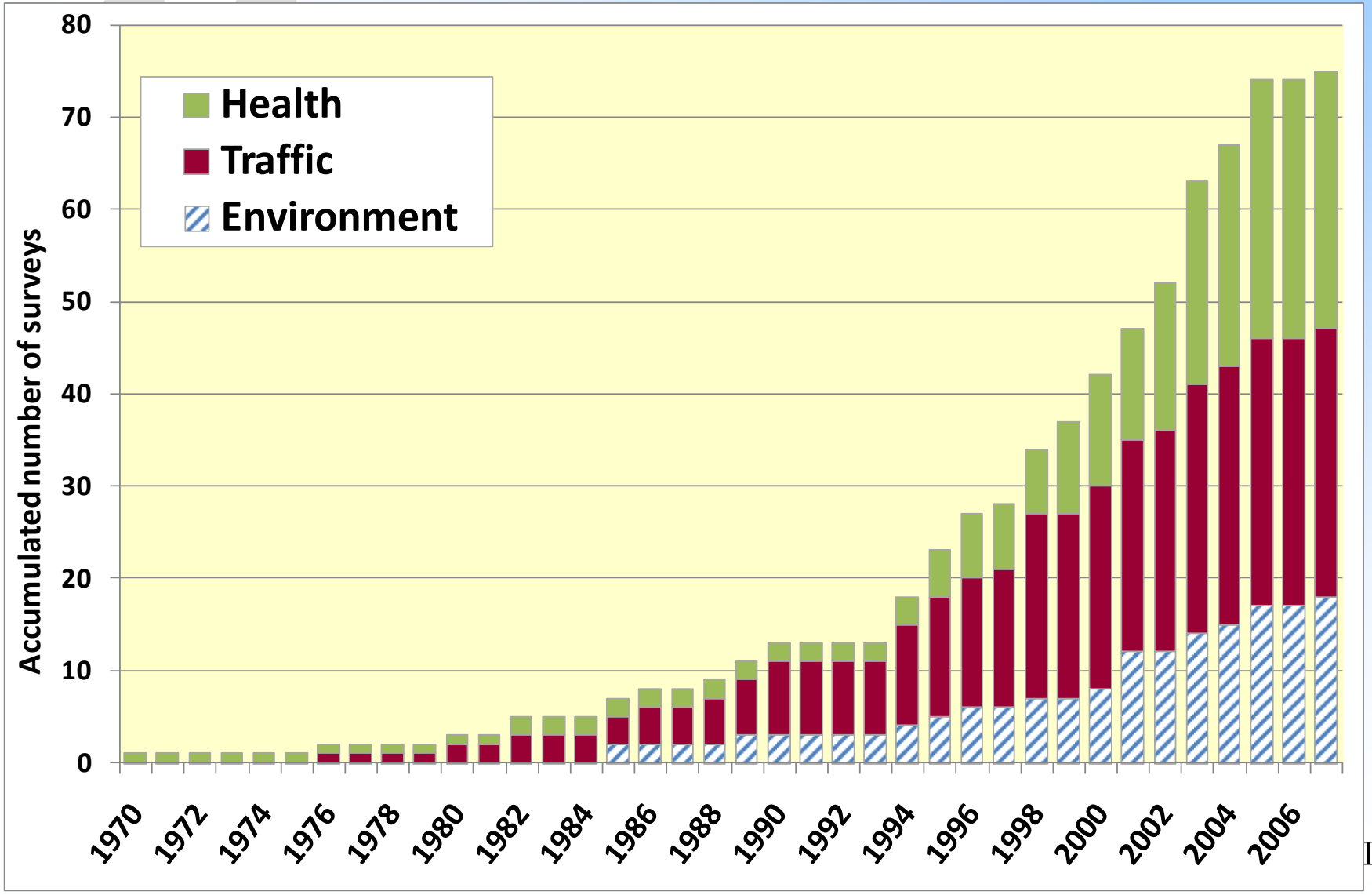
- Need to understand better *why* VSL estimates vary across Stated Preference studies (mostly CV), and *how* VSL vary with context and across different sectors (Health, Transport, Environment) worldwide.

- Many meta-analyses of Revealed Preference studies on VSL but few of Stated Preferences studies

Database of SP studies

- 68 surveys (90 studies/reports/papers) worldwide
  - **A total of 900 mean VSL estimates**
- Only *stated preferences* surveys of *adult* VSL …
- … derived from WTP (or WTA) for changes in environmentally related risks, traffic risks and health risks.

Accumulated number of surveys



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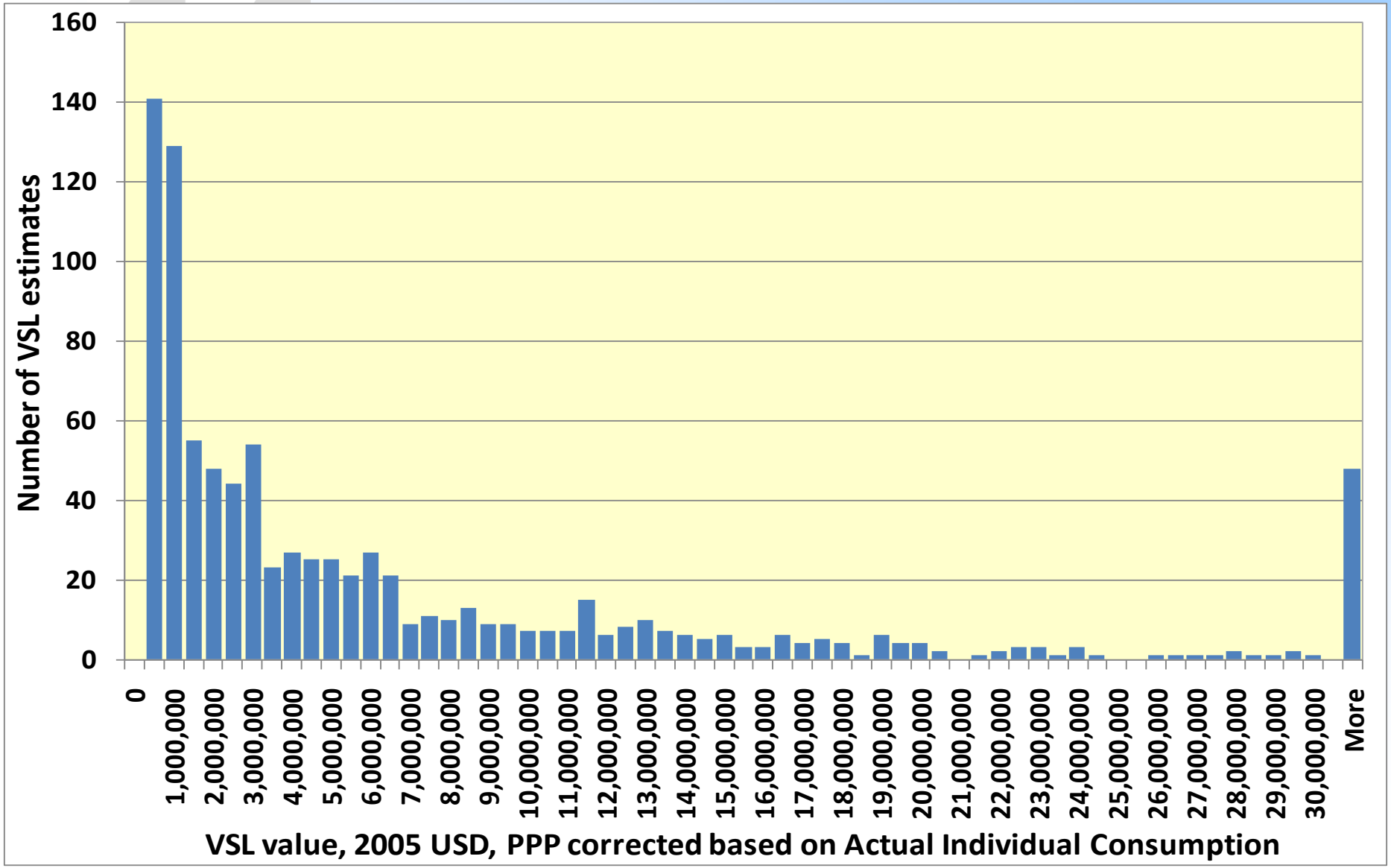
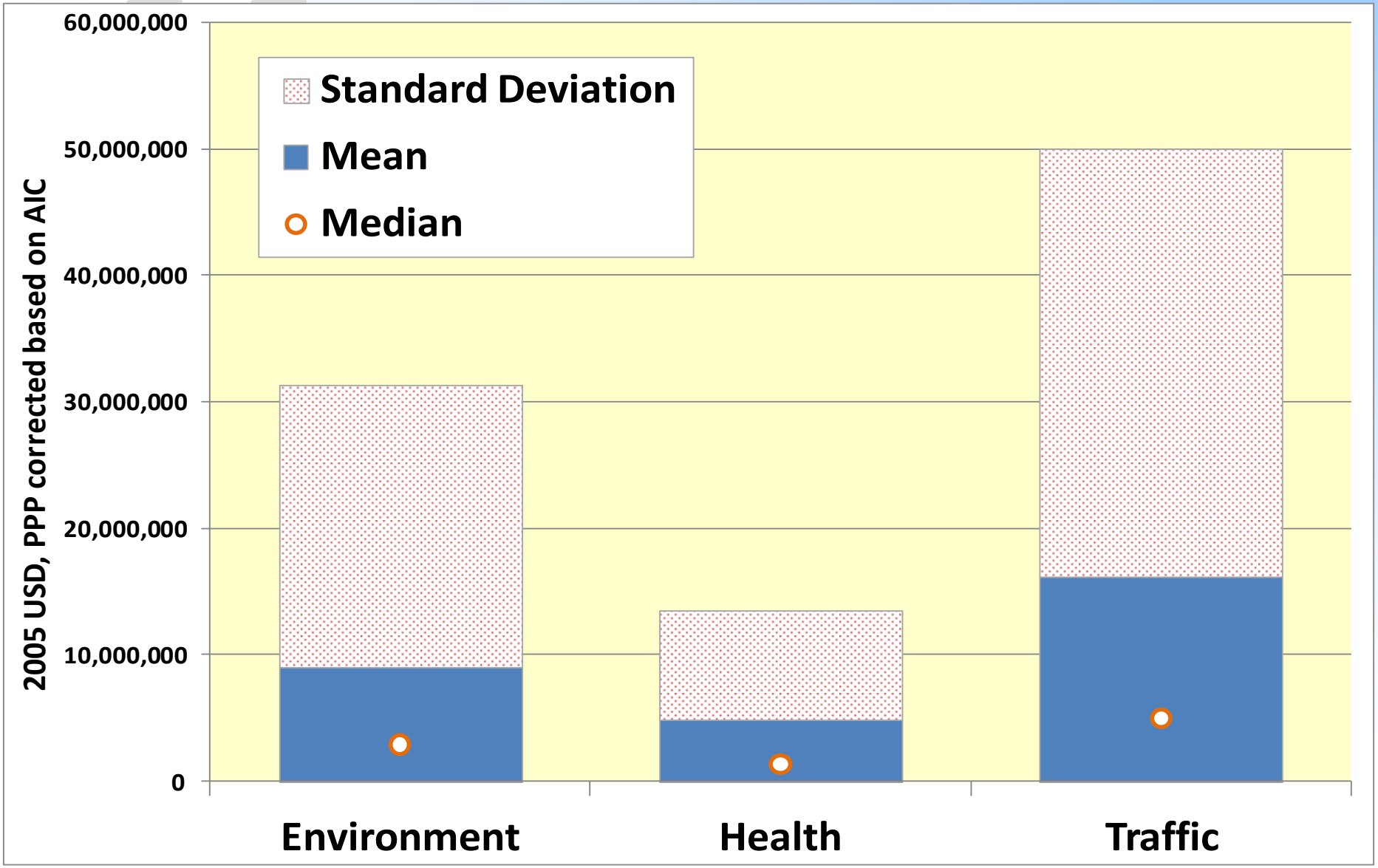
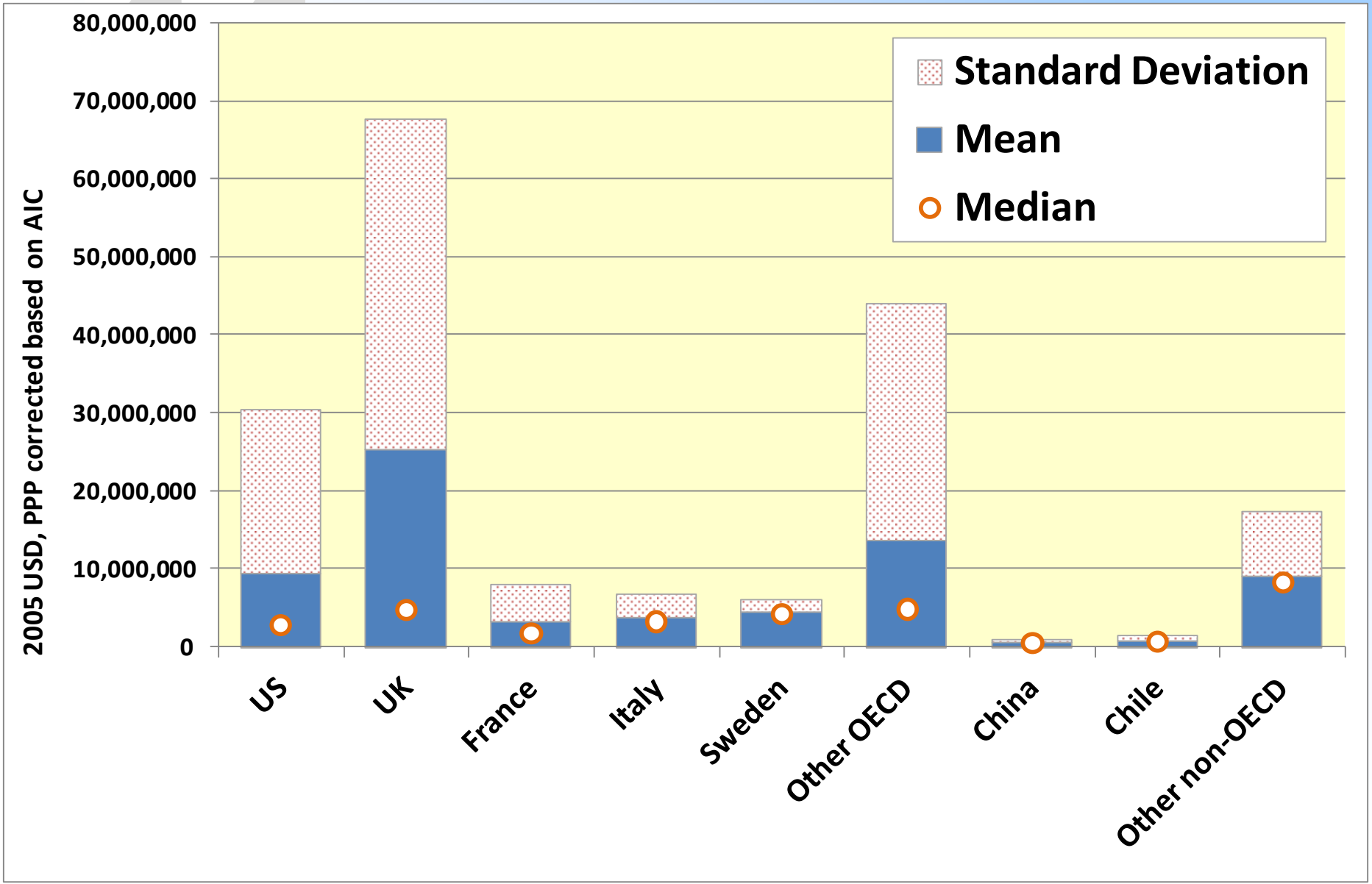
Distribution of the mean VSL estimates



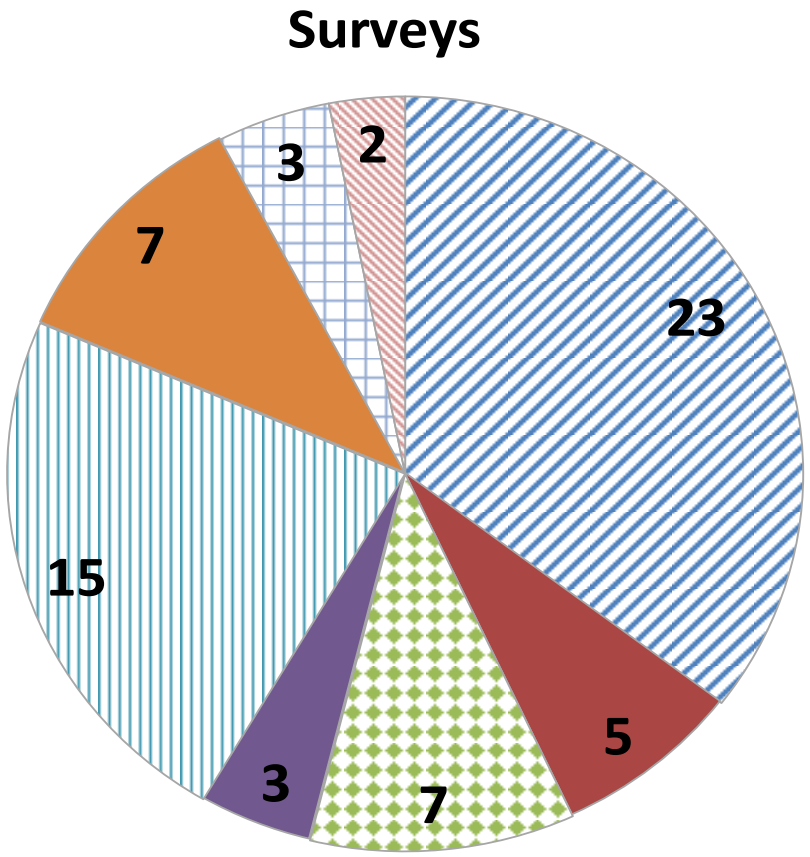
VSL by risk type

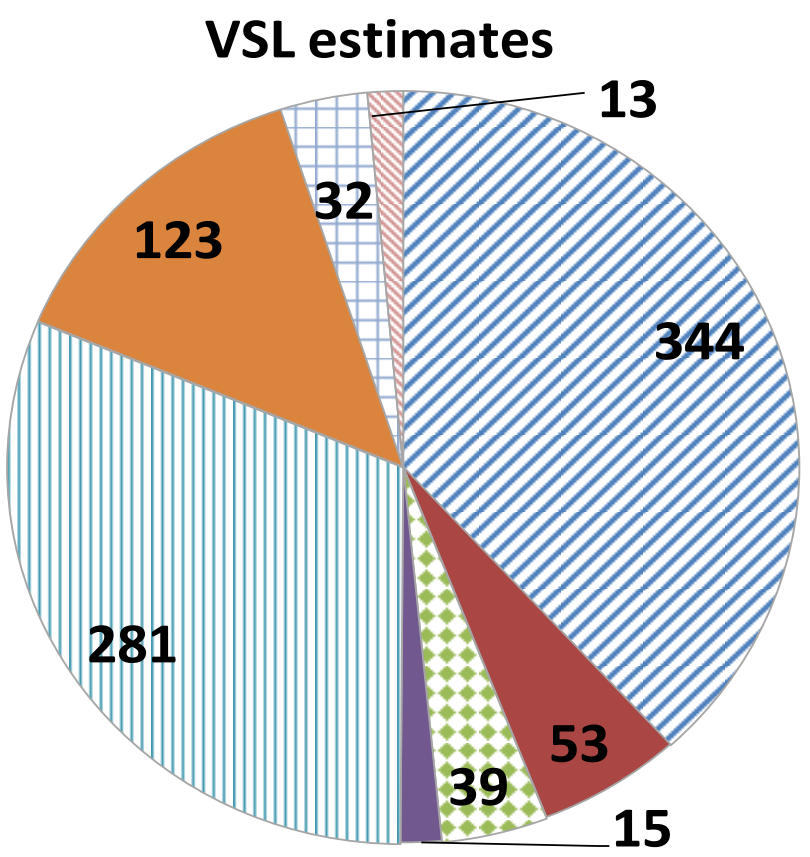


VSL by country



VSL by survey method





Face-to-face
Telephone
Mail
Self-administrated without PC
Self-administrated with PC
Web-based
Other
Blank

Meta-regression analysis

- Main purpose:
  - Try to explain why VSL estimates vary
  - Derive VSL estimates for policy use
- VSL function of three groups of variables
  - VSL = f (Risk, Method, Socio-economic/other)
- Model for statistical analysis:

$$VSL_{ms} = \beta_0 + \beta_X X^{j}_{ms} + \beta_M M^{k}_{ms} + \beta_S S^{q}_{ms} + e_{ms} + u_s$$

Variable group 1 (*X*): Risk context

- Risk type and context
  - Size of *baseline risk*
  - Size of *risk change* per year
  - Increase or decrease in risk?
  - Private or public risk?
  - Environmental, health or traffic risk?
  - Voluntary or “no-control” risk?
  - “Dread risk”? (*e.g.* cancer, suffering)
  - Other (visual tools, acute, latent risks, etc.)

Variable group 2 *(M)*: Method

- Valuation method characteristics:
  - Household or individual WTP
  - Payment for risk change voluntary? (donation)
  - WTA or WTP?
  - Survey method (phone, face-to-face)?
  - Type of CV question format
  - Statistical method used to estimate mean WTP
  - Other (response rate, payment duration, etc.)

Variable group 3 *(S)*: Socio-economic + other

- Socio-economic and other variables
  - Mean income of sample
  - Mean age in sample
  - National or sub-national (*e.g.* local/regional)
  - Year of survey
  - Country/region
  - Selected group (car owners, selected occupations)
  - Whether study was published
  - Other

MA regression models simulated

- Level 1: Complete dataset, different explanatory variables
  - Four models with different numbers of variables included
  - More variables imply more missing info, and lower number of observations
- Level 2: A subset of surveys that used similar methods
  - Four models that focus on non-method variables
- Random effects, panel data econometric model
  - Accounts for correlation in estimates from same survey
  - Double log gives better fit to data

Results: Level 1 models

Variable	Model 1	Model 2	Model 3	Model 4
	Full model (max variab and obs)	No method variables	Model 1 + Income and age	Model 1 + risk change
Ln risk change				-0.776***
Risk decrease	0.244	-0.759***	-0.983	-0.121
Private risk	0.699**	0.548***	0.098	1.684***
Environmental risk	-0.215	0.161	-1.225	-0.414
Health risk	-0.186	0.068	-1.806***	-0.618***
Any visual tool used	-1.123**	-1.171***	-0.742	-0.074
Controllable risk	-0.552	-0.511	0.331	-1.251***
Specific risk context	-0.355	-0.131	2.079**	0.908
Cancer risk	0.317	0.564**	0.197	0.131
CV dichotomous choice	1.045***		0.568***	0.652***
CV open-ended	0.289		0.325	0.124
Individual risk change	-1.583***		0.680	-1.545***
Monthly payment	0.219		0.383	-0.004
One-off lump-sum paym.	-0.427		-1.174***	-0.294
Payment is donation	2.289***		(dropped)	-0.374
Payment is tax	-0.282		-0.624	0.565
WTA	1.273***		0.438	0.209
Telephone survey	-0.752		0.286	0.555
Face-to-face survey	0.549		-0.759	-0.546
Parametric estimation	0.812***		0.620***	0.745***

Significance levels: *** p<0.01, ** p<0.05

Results: Level 1 (cont.)

Variable	Model 1 Full model (max variab and obs)	Model 2 No method variables	Model 3 Model 1 + Income and age	Model 4 Model 1 + risk change
Ln of mean income			1.255***	
Ln of mean age			0.822	
Ln of year	1.281***	0.956**	0.683**	-0.009
Only car-owners	-1.783**	-2.008**	-0.920	-3.267***
Only selected occupation	0.693	0.332	0.950***	0.877
Survey country in Europe	0.164	-0.112	0.618***	-0.173
Survey country in OECD	-0.426	0.564	-1.638***	0.309
Survey in rural area	-1.266	-0.119	(dropped)	-0.042
Nation-wide survey	0.350	0.539	0.405	-0.226
HDI of country is >0.9	0.699	0.194	-0.494	-0.158
Life expectancy is > 70	4.240***	3.264***	3.980***	3.213***
Study publ. in journal	0.303	0.517**	0.674***	0.094
Krupnick & Alberini ques.	-1.014**	-0.312	-1.195***	-0.205
VSL estimate in source	2.483***	0.185	0.591	-0.209
Constant	4.320*	8.703***	-5.569*	5.782***
R^2: overall	**0.691**	**0.485**	**0.898**	**0.778**
N	739	800	330	541
# surveys	43	52	31	34

Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Results of Level 1 models

- Generally high explanatory power
  - The non-method variables explain 50% of the variation
- Some risk variables are significant
  - Private risks are valued higher than public risks
  - The use of visual tools in the survey reduces VSL
  - People are willing to pay more to avoid risk increases
  - Some indication of lower VSL for health risks
  - Some indication of cancer and “suffering” premiums
  - Some indication that “perceived control” reduces VSL
  - VSL is *negatively* related to size of risk change

Results of Level 1 models (cont.)

- Many method variables are significant
  - Often found in MA studies
- Socio-economic & other variables:
  - High life expectancy (>70) gives higher VSL
  - Income significant, not age (as expected)
  - Surveys using Krupnick & Alberini's questionnaire give lower VSL
- Many signs are as expected → trust in data

Results: Level 2 models

Variable	Model 5 Risk characteristics only	Model 6 + Sample mean income	Model 7 + Share of sample > 60 years old	Model 8 Model 5 including baseline risk
Ln base-line risk				0.068
Ln risk change	-0.761***	-0.711***	-0.665***	-0.709***
Private risk	0.742***	0.353*	-2.970	0.687**
Latent risk	-0.288***	-0.227**	-0.101	-0.255***
Ln mean income		0.098	0.261**	
Ln % age > 60			1.263*	
Constant	7.451***	7.045***	10.335***	8.002***
R^2: overall	0.688	0.616	0.774	0.677
N	254	127	92	183
# surveys	10	10	8	7

Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Results of Level 2 models

- Limits the meta-analysis to Krupnick-Alberini surveys
  - By some regarded as “best practice”
  - Maximum 254 observations from total dataset
- 70% of variation is explained by three risk variables:
  - risk change, private & latency
- The risk change coefficient is still negative

  → If respondents are asked to value a large risk change, the VSL can be expected to be low
- Income is significant when age controlled for
- Including baseline risk does not matter

Numerical example 1

- Using Model 5, 1 in 10,000 risk reduction, public good, immediate impact (*i.e.*, no latency)
- lnVSL = 7.451 – 0.761*lnriskchange + 0.742*private – 0.288*latent
  - Inserting "0" for the variable "private" and "0" for the variable "latent", and ln(0.0001) for the risk change variable yields:
- lnVSL = 7.451 – 0.761*(-9.210) = 14.459
- VSL = 1,903,110 USD
- 5 in 10,000 risk reduction → VSL = 559,613 USD

Numerical example 2

- Using Model 7, 5 in 10,000 risk reduction, private good, immediate impact, 30% is above the age of 60, mean income is 56 000 USD per year.
- lnVSL = 10.335 – 0.665*lnriskchange – 2.970*private – 0.101*latent + 0.261*lnincome + 1.263*lnage_60
- lnVSL = 10.335 – 0.665*(-7.601) – 2.970*1 + 0.261*10.933 + 1.263*(-1.204) = 13.753
- VSL = 939,403 USD
- VSL for a population with a higher mean income level, and with a higher share of people above the age of 60, would yield a higher estimate of VSL.

Conclusions

- Meta-analysis is a powerful tool
- The MA results are generally encouraging
  - Non-method variables explain a large part of VSL
  - Many coefficients are as expected
- But, the MA reveals that:
  - people struggle with understanding risk changes
  - … or are people's preferences not so fine-tuned?

Further work

- PIMAVE – Policy-Implications of Meta-Analysis of VSL Estimates (OECD project; funded by EC)
- Sensitivity-analyses of the present meta-regression models
- More meta-regression models will be developed and tested
- The policy implications of all the work will be identified and published as an OECD document;
- Web-site with all the data used in the meta-analysis – and as much other relevant information as possible