WTP for Reductions in Morbidity Risks

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Cameron/DeShazo (2013) SP study

- Potential illness and eventual death are part of everyone's "illness profile" (or "health profile," if you will)
- Survey offers two programs (or neither) to *reduce the subject's risk* of experiencing a *specific adverse health profile* over their remaining life expectancy, *at a specific annual cost*
- Each adverse health "profile" has
  - A specific name (e.g. heart disease, colon cancer, etc.)
  - Some characteristics
  - A specific ***time profile*** of adverse health states (pre-illness years, sick-years, recovered/remission years, and lost life-years)

Trudy Ann Cameron and J.R. DeShazo (2013) "Demand for health risk reductions," *Journal of Environmental Economics and Management* 65(1) 87-109. (2013 JEEM D'Arge/Kneese Award)

Private choices: Illness profiles

Environmental health threats are not all just "sudden death now" (i.e. all colored rectangles below would be black)

Illness Profile 1: A nonfatal illness (with recovery) that reduces life expectancy

Time: Now		Disease Onset t_0	Recovery t_R	Death t_D	Nominal Life Expectancy t_E
Illness Profile	Latency Period	Sick Years	Recovered Years	Lost Life Years	
Health Status	healthy	sick	recovered		

Illness Profile 2: A fatal illness (no recovery)

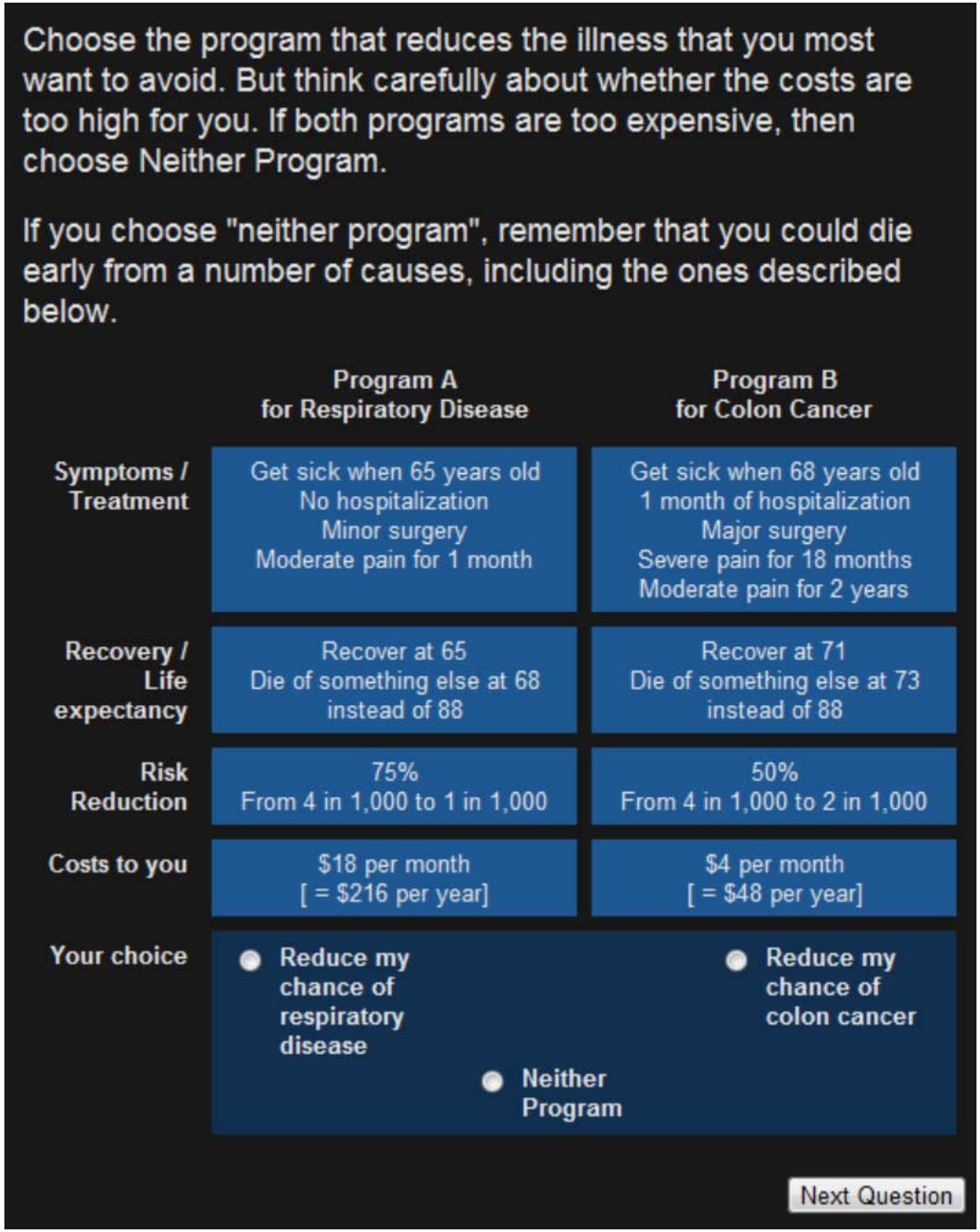
Time: Now		Disease Onset t_0	Death t_D	Nominal Life Expectancy t_E
Illness Profile	Latency Period	Sick Years	Lost Life Years	
Health Status	healthy	sick		

Focus: Private risk reduction preferences

- *Formal* economic model of optimizing behavior
  - WTP depends on the subject's income and age
  - WTP depends on the future profile of health states for the health risk in question (*not just sudden death now*—e.g with latency, sick-time, fatal or non-fatal, recovery/remission)
- WTP can be calculated for a wide variety of health risks (e.g. loss of life-years at the very end of life, rather than sudden death now)
- Morbidity and mortality not independent
  - Allows marginal disutility of a lost life-year to depend on how many sick-years precede it

The main survey

- For US *Private Choices* survey : 11,385 total choices by 1,800+ people (a representative sample of the U.S. population aged 25-93)



Private choices

- 26 pages of training material, then these summaries
- Two illness profiles and the cost of reducing your risk of experiencing them
- Choice sets were unique to each person, designed by their age and gender

Lots of model structure from utility theory: Indirect utility… *in period t*

- Under Program A, or No Program (N)
- If health (H), or get sick (S)
- Utility depends on
  - Some function of net Income: f(net Y)
  - Health status indicators

$$V_t^{AH} = f\left(netY_t\right) + \varepsilon_t^{AH}$$

$$V_t^{AS} = f\left(netY_t\right) + \alpha_1 1\left(illness_t\right) + \alpha_2 1\left(recovered_t\right) + \alpha_3 1\left(lost\ life\text{-}year_t\right) + \varepsilon_t^{AS}$$

$$V_t^{NH} = f\left(netY_t\right) + \varepsilon_t^{NH}$$

$$V_t^{NS} = f\left(netY_t\right) + \alpha_1 1\left(illness_t\right) + \alpha_2 1\left(recovered_t\right) + \alpha_3 1\left(lost\ life\text{-}year_t\right) + \varepsilon_t^{NS}$$

Much tedious arithmetic leads to…

- Present discounted expected utility difference:

$$\Delta PDV\left(E\left[V\right]\right) = \left\{ \begin{array}{l} f\left(Y-c\right)cterm \\ \quad + f\left(Y\right)yterm1 \\ + f\left(\gamma_1 Y\right)yterm2 \\ + f\left(\gamma_2 Y\right)yterm3 \end{array} \right\} + \alpha term\ \Delta\pi^{AS} + \varepsilon$$

where $cterm = \left(1-\pi^{AS}\right)pdvc + \pi^{AS}\left(pdve + \gamma_3 pdvi + pdvr + \gamma_4 pdvl\right)$

$$yterm1 = (-1)\left\{\left(1-\pi^{NS}\right)pdvc + \pi^{NS}\left(pdve + pdvr\right)\right\}$$

$$yterm2 = \left((1-\gamma_3)\pi^{AS} - \pi^{NS}\right)pdvi$$

$$yterm3 = \left((1-\gamma_4)\pi^{AS} - \pi^{NS}\right)pdvl$$

$\alpha term = \left[\alpha_1 pdvi + \alpha_2 pdvr + \alpha_3 pdvl\right]$ illness profile information

Heterogeneity via systematically varying utility parameters

- Replace simple linear combination of discounted future health states in $\alpha term_i^j$ with a *flexible* functional form (shifted translog with parameters quadratic in age)

$$
\begin{bmatrix}
\alpha_{10}\log\left(pdvi_i^j+1\right)+\alpha_{20}\log\left(pdvr_i^j+1\right)+\alpha_{21}age_{i0}\log\left(pdvr_i^j+1\right) \\
+\alpha_{30}\log\left(pdvl_i^j+1\right)+\alpha_{31}age_{i0}\log\left(pdvl_i^j+1\right)+\alpha_{32}age_{i0}^2\log\left(pdvl_i^j+1\right) \\
+\alpha_{40}\left[\log\left(pdvl_i^j+1\right)\right]^2+\alpha_{41}age_{i0}\left[\log\left(pdvl_i^j+1\right)\right]^2+\alpha_{42}age_{i0}^2\left[\log\left(pdvl_i^j+1\right)\right]^2 \\
+\alpha_{40}\left[\log\left(pdvi_i^j+1\right)\cdot\log\left(pdvl_i^j+1\right)\right]+\alpha_{41}age_{i0}\left[\log\left(pdvi_i^j+1\right)\cdot\log\left(pdvl_i^j+1\right)\right] \\
+\alpha_{42}age_{i0}^2\left[\log\left(pdvi_i^j+1\right)\cdot\log\left(pdvl_i^j+1\right)\right]
\end{bmatrix}
$$

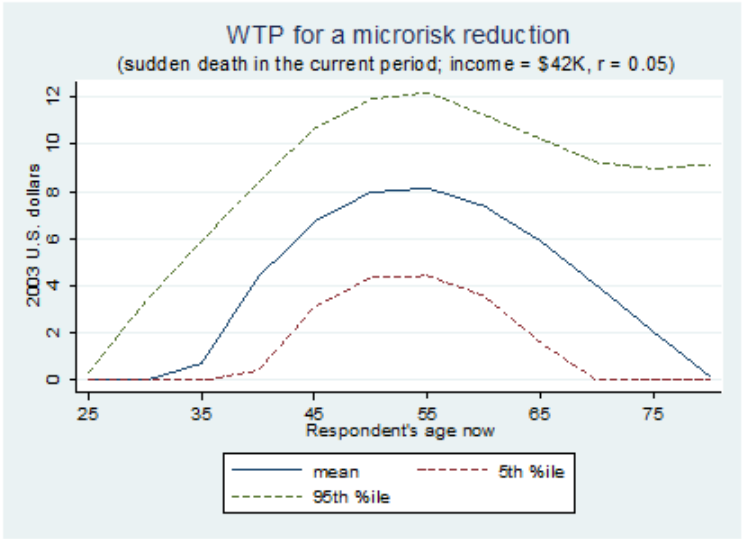
Key innovation

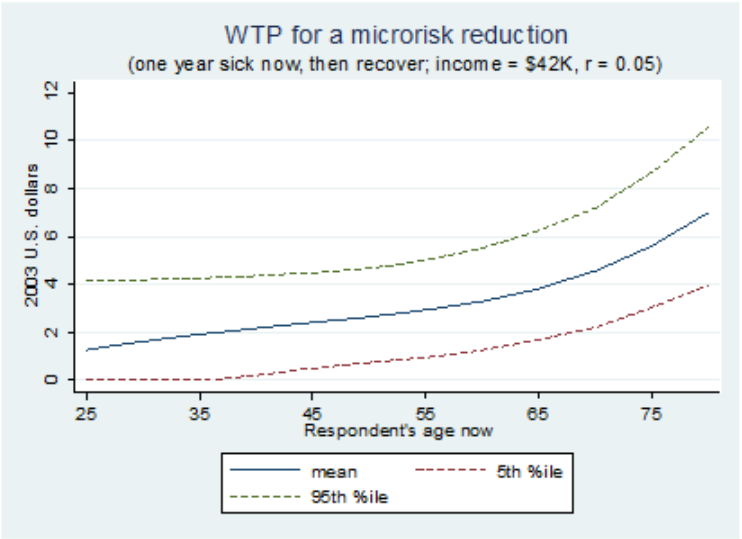
- ***NOT*** *merely a new way* to estimate the usual wage-risk VSL for "sudden death now" (although we can)
- We can compute WTP for:
  - A specified reduction in the risk of any arbitrarily specified illness profile (consisting of a mix of pre-illness years, sick-years, recovered-years and lost life-years)
  - For anybody with a specified income and a specified current age
- Benchmarks well for VSL (illness profile=sudden death now) for 45-year-old with $42K income

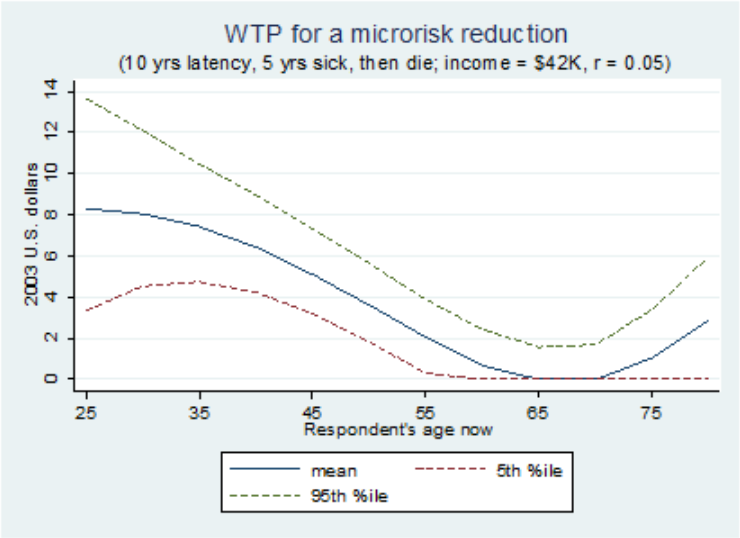
Key results?

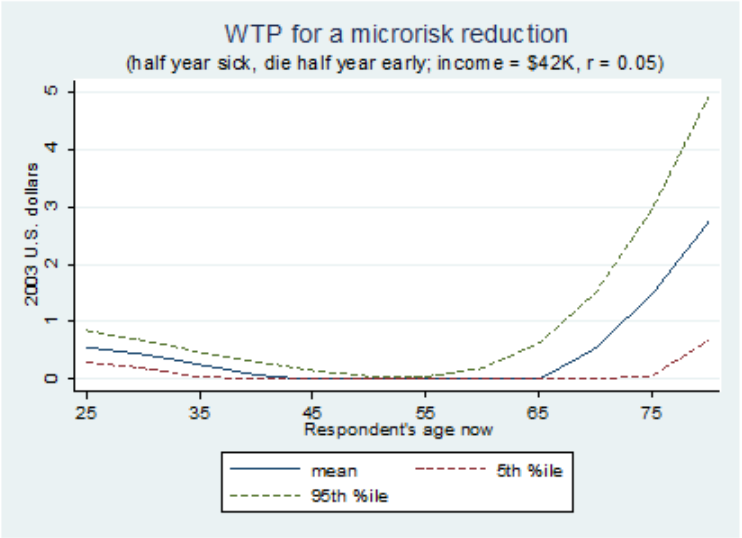
- Willingness to pay for health risk reduction depends strongly on the *time profile* for the illness in question
- Willingness to pay differs according to the *type of person* being asked to consider their willingness to swap other goods and services for the same type of risk reduction

WTP to reduce health risk depends on (a) illness profile in question and (b) individual characteristics (here, age)









Generalizations: WTP by type of illness

- Disease names were randomly assigned to illness profiles, subject only to plausibility
- Is WTP systematically different across types of health risks? Yes!
- Next page: some results by age and disease

- WTP by disease
  - Cameron, T.A., J.R. DeShazo, E.H. Johnson (2010) "Willingness to Pay for Health Risk Reductions: Differences by Type of Illness"

WTP for microrisk reduction, by illness

Profile	Sudden Death Now		
Health Threat			
Age now	30	45	60
Breast Cancer	7.87	8.39	6.98
Prostate Cancer	7.38	7.78	6.4
Colon Cancer	4.46	4.88	3.47
Lung Cancer	.95	0.97	0.22
…* smoker	10.59	11.05	9.62
Skin Cancer	0.43	0.36	0.04
Heart Attack	8.22	8.68	7.29
Heart Disease	8.26	8.73	7.36
Stroke	6.37	6.79	5.4
Respiratory Disease	0.38	0.29	0.03
…* smoker	5.95	6.34	5.01
Traffic Accident	1.11	0.82	0.07
Diabetes	5.3	3.36	0.3
Alzheimer's Disease	0.2	0.85	2.24

- Relative to $6M benchmark VSL (or $6 per microrisk reduction), heterogeneity is obvious
- Proposed VSL "cancer premium" won't fix everything
- Subjective risk differences obviously matter (smoker results)

Parenthood and WTP for *own* risk reductions

- When kids are young, parents are WTP more to protect their own healthy time
- When kids are older, parents protect their incomes (In high-income U.S.: college, cars, weddings?)
  - "The more teenagers in your house, the less disutility you derive from being dead?"

- *Private Choices*: U.S. sample
  - Cameron, T.A., DeShazo, J.R., Johnson, E.H., 2010a. "The effect of children on adult demands for health-risk reductions" *Journal of Health Economics* 29, 364-376.

Comorbidity analysis

- Exploring "why bother?" and "dead anyway" effects
- For the *illness in question* and for *other illnesses,* WTP depends on
  - subjective health risks (our questions)
  - objective health status (KN's health profiles)
  - county-level pattern of the last decade's causes of death (compressed mortality files)

- *Private Choices*: U.S. sample
- DeShazo, J.R., Cameron, T.A., "The Effect of Health Status on Willingness to Pay for Morbidity and Mortality Risk Reductions," Working Paper, Department of Economics, University of Oregon

- Image: Wikimedia Commons

Age effects analysis

- Potential explanation for the fuss over the "senior death discount"
  - WTP *increases* with the future age when you will experience adverse health states
  - WTP *declines* with your age now, when you are being asked to consider these future health states

- *Private Choices*: U.S. sample
- DeShazo, J.R., Cameron, T.A., "Two Types of Age Effects in the Demand for Reductions in Mortality Risks with Differing Latencies," Working Paper, Department of Economics, University of Oregon, Eugene, OR 97403.

Structurally derived QALY concept

- We let the red parameters vary by disease name, calculate marginal rates of substitution

MRS between discounted sick-time and healthy-time: "At the margin, how much discounted time in current health, *pdve*, is equivalent to one unit of discounted time sick, *pdvi*?" (Or, of lost life-time, *pdvl*)

$$\frac{\partial PDV(V_i^j)}{\partial pdvi_i^j} \Big/ \frac{\partial PDV(V_i^j)}{\partial pdve_i^j} = \frac{\beta\left[\frac{(\gamma_1 Y_i)^{0.45}-1}{0.45}\right] + \frac{1}{(pdvi_i^j+1)}\left[\alpha_{10} + (\alpha_{50} + \alpha_{51} age_{i0})\log(pdvl_i^j+1)\right]}{\beta\left[\frac{(Y_i)^{0.45}-1}{0.45}\right]}$$

WTP for Treatment? Prevention?

- **Health literature? Treatment programs:** For people already sick
  - No uncertainty about getting sick
  - No latency before getting sick
  - WTP to reduce illness or postpone death, based on (personal) experience with this illness, expert opinion about being sick

- **Environmental protection? Prevention policies:** Ex ante tradeoffs, by currently healthy people, to reduce the risk of future illness and/or premature mortality?
  - Depends on perceptions, forecasts; latency
  - Perception/fears of illness may be inaccurate. Should we estimate WTP conditional on perceptions, then adjust to yield WTP for "true" illness

- Trudy Ann Cameron (2014) "Valuing morbidity in environmental benefit-cost analysis" *Annual Review of Resource Economics*, 6: 249-72

WTP to reduce morbidity?

- Q: Why don't pharmaceutical companies do more WTP studies for potential new drugs that *reduce morbidity*?
  - Don't want to draw attention to the price attribute?
  - Consumers don't hear about drug prices?
  - Insurance blunts price perceptions of doctors, patients?
  - Non-zero price elasticity would destroy fiction that good health is priceless?
- Surprising that for-profit *health insurers* don't solicit more WTP studies concerning drug treatments

Exploit side-effects attribute?

- Some researchers estimate WTP for new drugs
- One attribute of the different drugs in the choice set may be the probability of specific side effects
  - *Probabilistic future* adverse health states
- Then IF
  - Preferences of healthy people are the same as those of these sick people, and
  - Side effects mimic the symptoms of other public health problems
  - May be able to use WTP to reduce side effects to measure benefits of public health risk reduction

CEA/HTA and WTP to reduce morbidity

- De-contextualized (important)
  - Heterogeneous *illnesses* reduced to bundles of health state *attributes*
  - Weighted to form *one-dimensional index*: QALYs, DALYs (visual analog scale, etc.)
  - KEY: Where do the weights come from? Non-structural "atheoretic" regression-type models
- But…weights, aka marginal (dis)utilities, CAN be derived from utility-theoretic choice models

I.e. EQ-5D-5L	Alternative 1	Alternative 2
Time in health state	10 years	2 years
Mobility	1	1
Self-care	2	1
Usual activites	2	1
Pain/discomfort	3	1
Anxiety/depression	4	1
Net Monthly Income	$ 4000	$ 4000

Don't want to ***consider*** tradeoffs against income/money?

- "Choice economists" can (and do) sometimes estimate "utility" under each alternative as a function of sets of *indicators* for each level of each of 5 illness attributes
  - E.g. conjoint choice experiments by Hole, Norman & Viney (*Health Econ.,* 2016)
- Let the marginal disutility of *time in a given adverse health state* depend systematically on each of the separate EQ-5D components
  - E.g. Time trade-off? Marg. Rate of Substitution between time in one state and time in another….

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Net Monthly Income	$ 4000	$ 4000

But what do the study subjects assume?

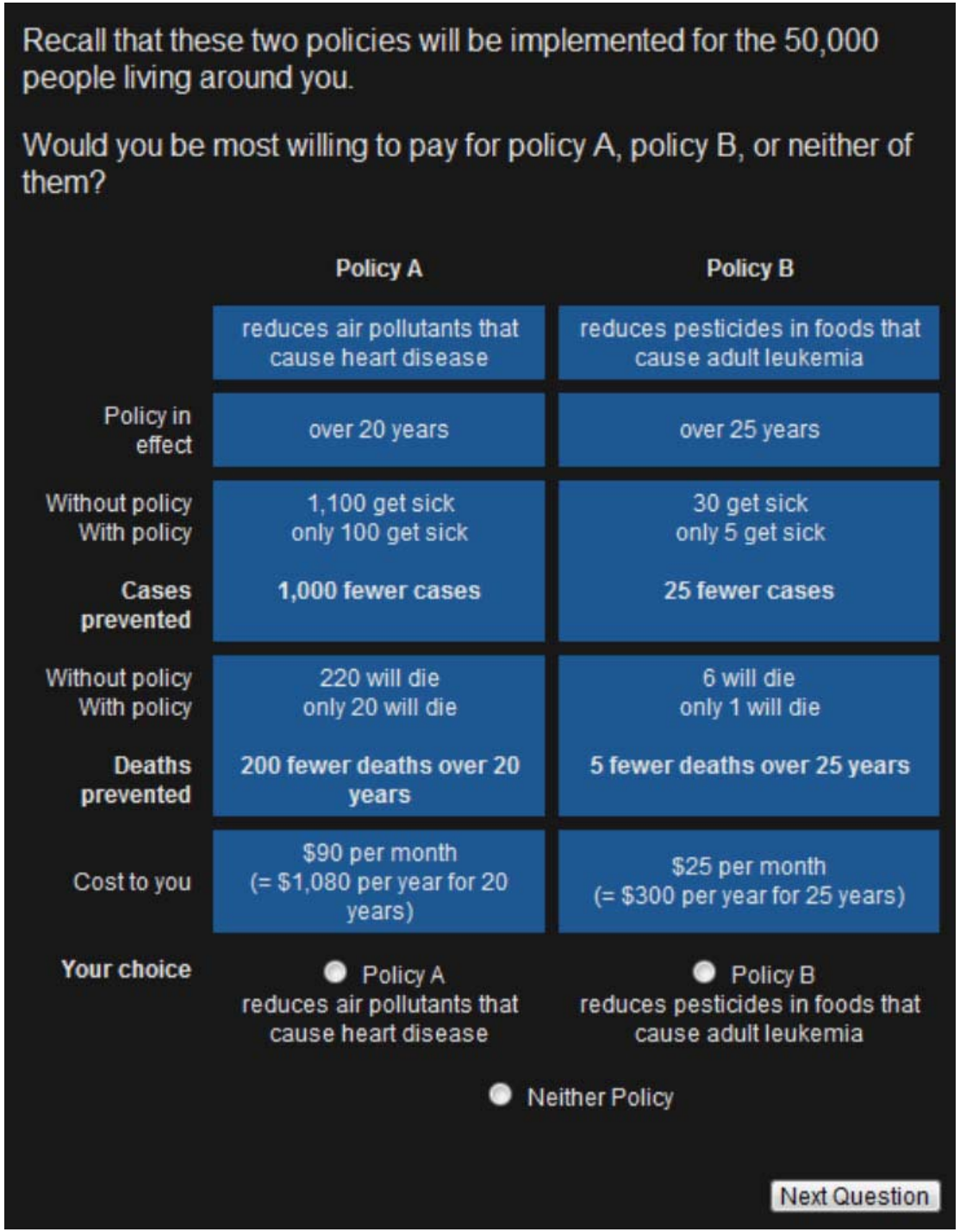
- **Failure** to include any difference in net income across alternatives? Subjects assume no difference? Realistic? Covered by "AFLAC"?
  - *Precludes* estimation of WTP measures
  - Subjects may or may not IMPUTE an income difference, *despite* researcher intention…. Omitted variables bias in estimation of marginal utilities for listed attributes.

Hammitt & Haninger (JEEM 2017)

- FINALLY! Include *price* as an attribute of health protection programs for illnesses described by:
  - Risk reduction
  - EQ-5D-3L converted to change in HRQL
  - Duration
- Estimating specification *not* structural—essentially a log-linear additively separable regression specification
- Outsources the formula for HRQLs; both
  - A strength…for what they are worth, we have lots of HRQLs, if we accept the preferences they embody
  - A weakness…precludes simultaneous estimation of all preference parameters, understates noise in the model

Other Cameron, DeShazo et al. projects

- Public Prevention Survey
  - Ask people about their willingness to incur the costs of (collective) public policies to reduce illnesses and deaths from a wide range of environmental threats
- Public Treatment Survey
  - Anticipating U.S. health care reform, ask people about their willingness to incur costs to treat other people who are already sick: increasing recoveries and avoiding premature deaths for children, adults, and seniors suffering



Public choices

Prevention

- Half of surveys omitted illness info

Public choices: Main "prevention" paper

- Omitting illness information matters; WTP for mortality risk reduction is different
- Heterogeneity by cause of illness, type of illness/death
- Prevention paper
  - Bosworth, Ryan C., Trudy Ann Cameron, and J.R. DeShazo (2009) "Demand for environmental policies to improve health: Evaluating community-level policy scenarios," *JEEM* **57**(3), 293-308.

Ounce of prevention, pound of cure?

- WTP for prevention policies versus WTP for treatment policies
  - Not a *marginal rate of transformation* (in health production)
  - More of a *marginal rate of substitution* (in policy preferences)

- Bosworth, Ryan C., Trudy Ann Cameron, and J.R. DeShazo (2010) "Is an ounce of prevention worth a pound of cure? Comparing demand for public prevention and treatment policies," *Medical Decision Making* 30(4) E40-E56.

Contact

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Of potential interest to general audiences:

Cameron, Trudy Ann (2010) “Euthanizing the Value of a Statistical Life,” *Review of Environmental Economics and Policy* 4(2) 161-178.