Willingness to Pay for Health Risk Reductions: Differences by Type of Illness

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Motivating Questions

- Does WTP vary by type of disease?
  - Allow WTP for health risk reductions to vary by 11 different major health threats
    - Vary by 5 types of cancer, heart disease, heart attack, stroke, respiratory disease, Alzheimer's disease, traffic accidents
- Is there a cancer premium?
- Does controllability of the disease matter?
  - Skin Cancer (controllable though sunscreen)
  - Alzheimer's, Diabetes (no cure)
- Does latency matter differently by disease?

Previous Literature

- Dread and Bad Deaths
  - Sunstein (1997)
  - Chilton et al. (2006)
- Cancer Premium
  - Van Houtven et al. (2008)
  - Trumbo et al. (2007)
  - Savage (1991, 1993)
- Risk perception is related to dread and controllability
  - Slovic (1987)
- Diseases and Latency
  - Van Houtven et al. (2008)
  - Hammitt and Liu (2004)

The Survey Data

- Existing survey about WTP for health risk reductions by Cameron and DeShazo (2008)
- Survey fielded using the standing consumer panel maintained by Knowledge Networks, Inc.
  - Internet
  - Web TV
- 1800 US subjects
- 79 percent response rate
- Pretesting
  - One-on-one focus sessions
  - External panel of distinguished reviewers
  - Canadian sample pre-test (more than 1000)

The Survey

5 Modules:

1. Subjective information
2. Illness profile tutorial
3. Risk tutorial
4. Conjoint choice sets
   - 3 alternatives per choice set
     (Program A, Program B, Neither Program)
   - 5 independent choice sets per respondent
   - Extensive randomized design
5. Debriefing questions

The Survey: One Randomized Choice Scenario

Choose the program that reduces the illness that you most want to avoid. But think carefully about whether the costs are too high for you. If both programs are too expensive, then choose Neither Program.

If you choose "neither program", remember that you could die early from a number of causes, including the ones described below.

	Program A for Diabetes	**Program B for Heart Attack**
Symptoms/ Treatment	Get sick when 77 years-old 6 weeks of hospitalization No surgery Moderate pain for 7 years	Get sick when 67 years-old No hospitalization No surgery Severe pain for a few hours
Recovery/ Life expectancy	Do not recover Die at 84 instead of 88	Do not recover Die suddenly at 67 instead of 88
Risk Reduction	10% From 10 in 1,000 to 9 in 1,000	10% From 40 in 1,000 to 36 in 1,000
Costs to you	$12 per month [= $144 per year]	$17 per month [= $204 per year]
Your choice	○ **Reduce my chance of diabetes**	○ **Reduce my chance of heart attack**
	○ **Neither Program**	

The Survey: An Illness Profile

Disease labels are assigned to these illness profiles. It is possible to have two identical illness profiles with different disease labels.

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		

Sketch of the Econometric Implementation

- Random Utility Model with 3 alternatives
- Builds on basic model in Cameron and DeShazo (2008); quadratic in net income
- Choices assumed to maximize present discounted expected utility
- Utility defined over
  - net income,
  - a complete time profile of avoided adverse health states relative to status quo:
    - sick-years,
    - post-illness years,
    - lost life-years.

The Basic Estimating Equation

Homogeneous Preferences (except age)

$$PDV\left(E\left[\Delta V_i^A\right]\right) = \beta_0\left[\textit{linear income term}_i^A\right] + \beta_1\left[\textit{quadratic income term}_i^A\right]$$

$$+\alpha_1\left\{\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\right\} \quad \text{...sick-years term (base)}$$

$$+\alpha_2\left\{\Delta\Pi_i^{AS}\log\left(pdvr_i^A+1\right)\right\} \quad \text{...recovered-years term (base)}$$

$$+\alpha_3\left\{\Delta\Pi_i^{AS}\log\left(pdvl_i^A+1\right)\right\} \quad \text{...lost life-years term (base)}$$

$$+\alpha_4\left\{\Delta\Pi_i^{AS}\left[\log\left(pdvl_i^A+1\right)\right]^2\right\} \quad \text{...[lost life-years]}^2$$

$$+\alpha_5\left\{\Delta\Pi_i^{AS}\left[\log\left(pdvi_i^A+1\right)\right]\left[\log\left(pdvl_i^A+1\right)\right]\right\} \quad \text{...[sick-years]} \cdot \text{[lost life-years]}$$

$$+\varepsilon_i^A$$

where

$$\alpha_3 = \alpha_{30} + \alpha_{31}age_{i0} + \alpha_{32}age_{i0}^2$$
$$\alpha_4 = \alpha_{40} + \alpha_{41}age_{i0} + \alpha_{42}age_{i0}^2$$
$$\alpha_5 = \alpha_{50} + \alpha_{51}age_{i0} + \alpha_{52}age_{i0}^2$$

pdv = present discounted value of health state years

How should disease enter into the model?

Heterogeneous preferences (by disease)

$$PDV\left(E\left[\Delta V_i^A\right]\right) = \beta_0\left[\textit{linear income term}_i^A\right] + \beta_1\left[\textit{quadratic income term}_i^A\right]$$

$$+\left[\theta + \sum_{d=2}^{11}\theta_d \mathbf{1}(\textit{disease}_{di}^A)\right] \quad \textbf{...disease labels}$$

$$+\left[\alpha_1 + \sum_{d=2}^{11}\alpha_{1d}\mathbf{1}(\textit{disease}_{di}^A)\right]\left\{\Delta\Pi_i^{AS}\log\left(\textit{pdvi}_i^A + 1\right)\right\} \quad \textbf{...sick-years term}$$

$$+\alpha_2\left\{\Delta\Pi_i^{AS}\log\left(\textit{pdvr}_i^A + 1\right)\right\} \quad \text{...recovered-years term}$$

$$+\left[\alpha_3 + \sum_{d=2}^{11}\alpha_{3d}\mathbf{1}(\textit{disease}_{di}^A)\right]\left\{\Delta\Pi_i^{AS}\log\left(\textit{pdvl}_i^A + 1\right)\right\} \quad \textbf{...lost life-years term}$$

$$+\alpha_4\left\{\Delta\Pi_i^{AS}\left[\log\left(\textit{pdvl}_i^A + 1\right)\right]^2\right\} \quad \text{...[lost life-years]}^2$$

$$+\alpha_5\left\{\Delta\Pi_i^{AS}\left[\log\left(\textit{pdvi}_i^A + 1\right)\right]\left[\log\left(\textit{pdvl}_i^A + 1\right)\right]\right\} \quad \text{...[sick-years]} \cdot \text{[lost life-years]}$$

$$+\varepsilon_i^A$$

where

$$\alpha_3 = \alpha_{30} + \alpha_{31}\textit{age}_{i0} + \alpha_{32}\textit{age}_{i0}^2$$
$$\alpha_4 = \alpha_{40} + \alpha_{41}\textit{age}_{i0} + \alpha_{42}\textit{age}_{i0}^2$$
$$\alpha_5 = \alpha_{50} + \alpha_{51}\textit{age}_{i0} + \alpha_{52}\textit{age}_{i0}^2$$

pdv = present discounted value of health state years

Results: Marginal Utilities of Health State Terms

Table 2: Parsimonious Model

Basic Model Terms:	
$(\beta_{00} \times 10^5)$[linear net income term]	5.369 (7.80)***
$(\beta_{10} \times 10^9)$[quadratic net income term]	-.198 (3.90)***
(δ_j) **disease-specific indicators**	**(expanded in Table 2a)**
$(\alpha_{20})\Delta\Pi_i^{AS} \log(pdvr_i^A + 1)$	-17.42 (1.64)
$(\boldsymbol{\alpha_{10}})\boldsymbol{\Delta\Pi_i^{AS}}\left[\log(\mathbf{pdvi_i^A + 1})\right]$	**(expanded in Table 2b)**
$(\alpha_{13})\left[P(sel_i) - \overline{P}\right]\Delta\Pi_i^{AS}\left[\log(pdvi_i^A + 1)\right]$	3.517 (2.35)**
$(\boldsymbol{\alpha_{30}})\boldsymbol{\Delta\Pi_i^{AS}}\log(\mathbf{pdvl_i^A + 1})$	**(expanded in Table 2c)**

Continued...

Results: Marginal Utilities of Health State Terms

Table 2: Parsimonious Model

Basic Model Terms:	
Continued...	
$(\alpha_{31})age_{i0} \cdot \Delta\Pi_i^{AS} \log\left(pdvl_i^A + 1\right)$	19.29 (2.73)***
$(\alpha_{32})age_{i0}^2 \cdot \Delta\Pi_i^{AS} \log\left(pdvl_i^A + 1\right)$	-.1614 (2.39)**
$(\alpha_{40})\Delta\Pi_i^{AS}\left[\log\left(pdvl_i^A + 1\right)\right]^2$	221.5 (2.51)**
$(\alpha_{41})age_{i0} \cdot \Delta\Pi_i^{AS}\left[\log\left(pdvl_i^A + 1\right)\right]^2$	-8.218 (2.29)**
$(\alpha_{42})age_{i0}^2 \cdot \Delta\Pi_i^{AS}\left[\log\left(pdvl_i^A + 1\right)\right]^2$	.07364 (2.12)**
$(\alpha_{52})age_{i0}^2 \cdot \Delta\Pi_i^{AS}\left[\log\left(pdvi_i^A + 1\right)\right] \cdot \left[\log\left(pdvl_i^A + 1\right)\right]$	.006295 (2.22)**
Observations	20544
LogL	-10356.924

Results: Marginal Utilities of Health State Terms

Table 2a: Disease Label Shifters

Disease Labels: (base case = heart disease)	**Basic Terms**	**Shifters** * Age	**Shifters** * Smoker
heart attack	.6626	-	-
	(8.40)***		
breast cancer	.653	-	-
	(5.22)***		
prostate cancer	.6285	-	-
	(4.66)***		
lung cancer	-.2941	-	.309
	(3.37)***		(8.44)***
colon cancer	.2128	-	-
	(2.91)***		
skin cancer	-.4215	-	-
	(5.27)***		
respiratory disease	-.4092	-	.1894
	(4.63)***		(4.92)***
stroke	.4475	-	-
	(5.56)***		
traffic accident	-	-.005923	-
		(3.91)***	
diabetes	.8273	-.0179	-
	(3.60)***	(3.95)***	
Alzheimer's disease	.4747	-.01119	-
	(1.44)	(1.74)*	

Results: Marginal Utilities of Health State Terms

Table 2b: Sick Year Shifters

		Shifters	
Sick Year Terms:	**Basic Terms**	* Age	* Smoker
$(\alpha_{10})\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)$ (base case = heart disease)	-56.65	-.6759	-
	(4.88)***	(2.55)**	
*heart attack	78.68	-	-
	(3.24)***		
*breast cancer	-	1.205	-
		(2.10)**	
*prostate cancer	74.55	-	-
	(2.19)**		
*stroke	76.24	-	-
	(3.10)***		

Results: Marginal Utilities of Health State Terms

Table 2c: Lost-life Year Shifters

		Shifters	
Lost-life Year Terms:	**Basic Terms**	* Age	* Smoker
$(\alpha_{30})\Delta\Pi_i^{AS}\log\left(pdvl_i^A+1\right)$ (base case = heart disease)	-565.2	-	-
	(3.22)***		
*Alzheimer's disease	275.5	-4.964	-
	(2.73)***	(2.75)***	

WTP for Microrisk Reductions

$$\text{WTP} = \frac{\text{marginal utility of health states}}{\text{marginal utility of net income}}$$

- We use a more general construct than a VSL
- Illness profile = latency, sick-years, post-illness years, lost life-years and now type of illness
- Based on sick-years and lost life-years, not just the whole remaining life
- Microrisk: numbers can be interpreted as dollars for a 1-in-1-million risk change

WTP Simulations

- Two illustrative illness profiles
  - Sudden death now (like conventional VSL)
  - 10 years latency, five years sick, then death (i.e. with latency)
- Results shown are for an individual earning $42,000
- Based on 1,000 random draws from joint distribution of the MLE parameters
- Means are displayed in the following slides (5th and 95th percentiles shown in paper)

Results: WTP for Microrisk Reductions

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

Results: 45-year-olds

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

Results: Cancer

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

Results: Heart

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

Results: Non-smokers

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

Results: Smokers

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

Results: Low WTP

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

Results: An increase in WTP with age

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

Results: WTP over 6 million

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

Results: WTP under 6 million

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
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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

Results: WTP with latency

Profile	**10 year latency; sick 5 years, then death**		
Health Threat			
Age now	**30**	**45**	**60**
Breast Cancer	8.66	6.64	4.44
Prostate Cancer	7.25	5.65	4.05
Colon Cancer	6.32	4.76	3.09
Lung Cancer	2.36	0.78	0.04
…* smoker	12.43	10.93	9.24
Skin Cancer	1.37	0.16	0
Heart Attack	7.58	6.09	4.4
Heart Disease	9.05	7.01	4.82
Stroke	5.96	4.33	2.7
Respiratory Disease	1.18	0.13	0
…* smoker	7.81	6.22	4.62
Traffic Accident	2.69	0.63	0.01
Diabetes	7.15	3.24	0.07
Alzheimer's Disease	0.73	0.91	1.03

Results: 30-year-olds

Profile	10 year latency; sick 5 years, then death		
Health Threat			
Age now	**30**	**45**	**60**
Breast Cancer	8.66	6.64	4.44
Prostate Cancer	7.25	5.65	4.05
Colon Cancer	6.32	4.76	3.09
Lung Cancer	2.36	0.78	0.04
…* smoker	12.43	10.93	9.24
Skin Cancer	1.37	0.16	0
Heart Attack	7.58	6.09	4.4
Heart Disease	9.05	7.01	4.82
Stroke	5.96	4.33	2.7
Respiratory Disease	1.18	0.13	0
…* smoker	7.81	6.22	4.62
Traffic Accident	2.69	0.63	0.01
Diabetes	7.15	3.24	0.07
Alzheimer's Disease	0.73	0.91	1.03

Findings

- People's preferences among risk reduction programs seem to vary with the disease in question
  - Higher WTP for reducing risk of breast cancer, prostate cancer, heart attack and heart disease
  - Lower WTP for skin cancer, Alzheimer's disease
  - Smokers appear to have much higher WTP to reduce the risk of lung cancer and respiratory disease than non-smokers
- Caveat: May be difficult to discriminate between disease label effects and perceptions about the efficacy of the intervention (blood test, medications; safety equipment for vehicles)

Findings

- Some cancers have a noticeable premium, some do not
- Striking differences between smokers and non-smokers
- We find a smaller WTP for reducing traffic risks than for other health risks
- Age has a strong correlation with how people perceive health threats, their vulnerability, and the quality of medical care they would receive
  - For roughly half of the diseases we address, age has a systematic effect that differs from the age effects in the basic model
- Control for a lot of heterogeneity in subjective perceptions about individual risks, vulnerability, controllability and confidence

Conclusions

- WTP *does* seem to differ by type of disease
- Acknowledge political difficulty of differentiated VSLs
  - Positive/normative considerations need to be kept separate
  - Most relevant when some policy targets a *specific* risk that affects a *specific* sub-population and neither is "typical"
  - Might be prudent to consider whether one-size-fits-all VSL differs from WTP tailored to the risk and population in question