Baseline Risk and Marginal Willingness to Pay for Health Risk Reduction

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Issue Addressed

- Reducing risk to human health is an important source of benefits in public policies to improve environmental, transportation, and workplace safety.
- Conventional calculation of total health benefits: MWTP for health risk reduction is a constant that does not depend on baseline risk
  - Total mortality benefits = VSL x number of lives "saved"
  - Total morbidity benefits = MWTP x number of cases avoided
- Does MWTP for health risk reduction vary with baseline risk? If so, how?
  - Theory gives no clear guidance
  - Empirical estimates are inconclusive
- If MWTP for health risk reduction varies with baseline risk, how would estimates of total health benefits be affected?
- Do differences in baseline risk explain differences in disease-specific or context-dependent MWTP values?

Main Elements of Paper

- EU models of household decision-making
  - Parent makes decisions for herself and one child
  - Two health states: healthy/sick
  - Exogenous risk vs. endogenous risk
- Survey data on morbidity risk from heart disease
  - Individualized measures of baseline risk
  - Stated preference values of MWTP
- Econometric analysis
- Main results
  - MWTP for health risk reduction inversely related to baseline risk
  - MWTP x cases avoided substantially overestimates total health benefits

Conceptual Framework

- Exogenous risk model

$$EU = (1 - r)H + rS$$

- Endogenous risk model

$$EU = (1 - r(X,G))H + r(X,G)S$$

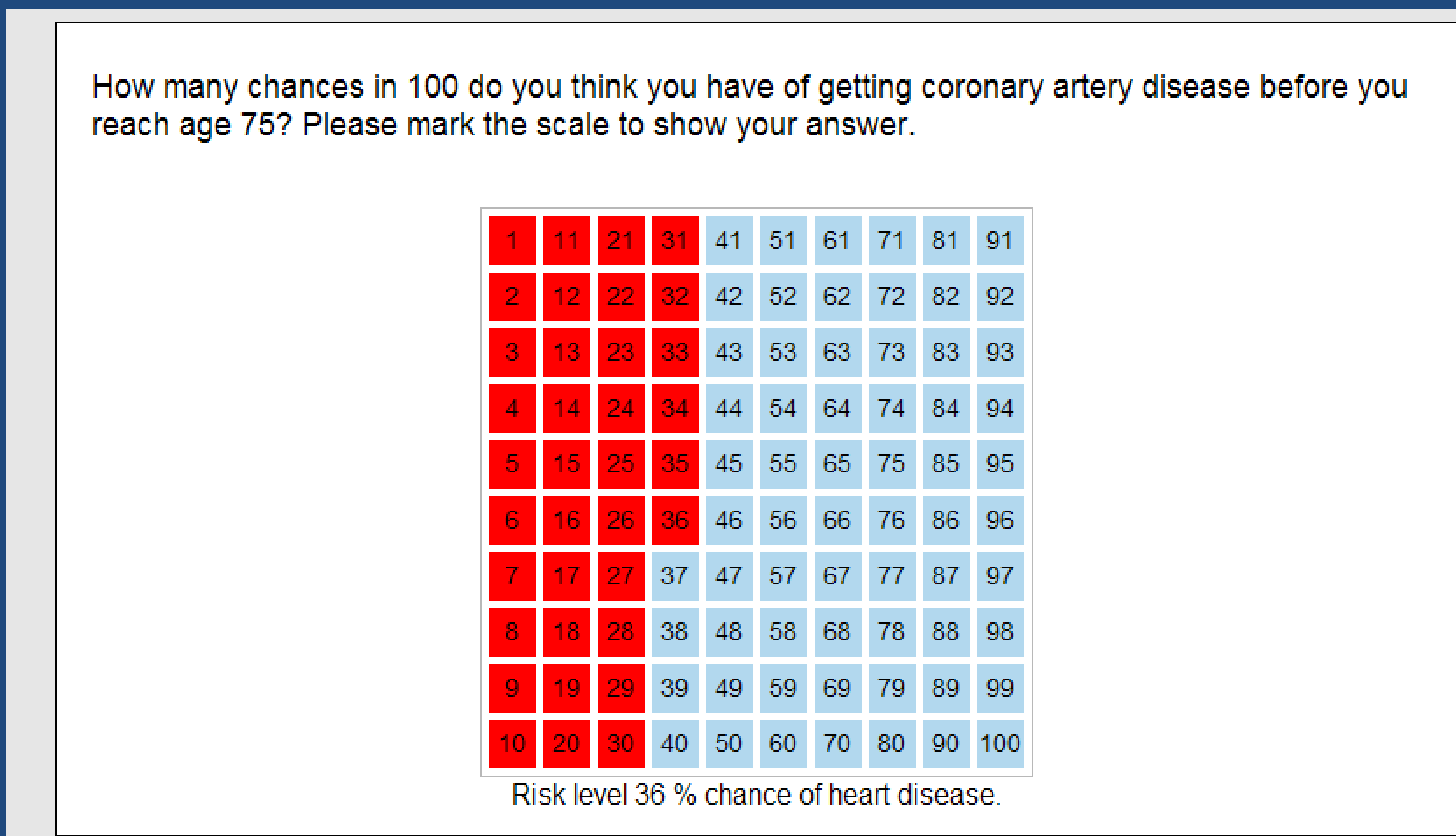
- Comparison of models: Assume $H' - S' \geq 0$
  - Exogenous risk model: MWTP increases with increases in baseline risk
  - Endogenous risk model
    - MWTP decreases with increases in baseline risk
    - Efficiency condition requiring that parents equate marginal cost of risk reduction for themselves and their child
- Empirical results favor endogenous risk model

Field study

- National probability sample of parents from Knowledge Networks panel
- Panel is a probability sample representative of US households
- Total sample: n=3155
  - "Soft launch" n=505
  - Matched spouses sample =832
- In this study, n=1778 of unmatched spouses
- Each respondent had at least one biological child between the ages of 6-16 years
- Sample child selected at random
- Computerized survey instrument delivered by e-mail to selected panel members

Survey Elements (1)

- Risk scale to elicit <u>individualized</u> perceived risk of coronary artery disease before age 75 years.



How many chances in 100 do you think you have of getting coronary artery disease before you reach age 75? Please mark the scale to show your answer.

1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100

Risk level 36 % chance of heart disease.

Survey Elements (2)

- Provide information about heart disease
  - Average risks
  - Gender
  - Risk factors: smoking, cholesterol, blood pressure, diabetes, BMI, diet, exercise, family history.
- Elicit revised perceptions of risk by allowing changes in initial answer

Mean Perceived Risks of Heart Disease (Chances in 100)

	Mother		Father	
	Self	Child	Self	Child
Initial Perception	35	28	37	27
Revised Perception	32	24	35	23
"Actual" by gender	19		35	

Survey Elements (4)

- Elicit stated WTP for vaccines to reduce heart disease risk
  - Random assignment of exogenous proportionate changes in risk
  - Random assignment of prices
  - Referendum question
  - Treat uncertain purchase intentions as a “no”
- Each parent made one vaccine choice for self and one for child, in random order

Experimental Design

	Parent	Child
Proportionate HD risk reductions	10%	20%
	70%	80%

Prices	$10	$20	$40	$80	$160

Purchase Intentions

- Increased with increases in risk reduction
- Decreased with price increases
- For the child vaccine, positive fraction of parents said “yes” at every design point
  - 18% said “yes” at 20% risk reduction/$160
  - 53% said “yes” at 80% risk reduction/$10
- Same general outcome for parent vaccine

Econometric Methods (1)

- Two equations (Parent, child)
- Dependent variable: whether parent stated intention to purchase the vaccine (for self or child)
  - Coded 1 if yes, 0 if no
  - If yes but uncertain coded as if no (i.e., 0)
- Covariates (experimentally assigned)
  - % risk reduction
  - Vaccine price
  - Constant term
- MWTP for reduction in heart disease by 1 percentage point equates to the ratio of
  - Coefficient of % risk reduction to
  - Negative of coefficient of price

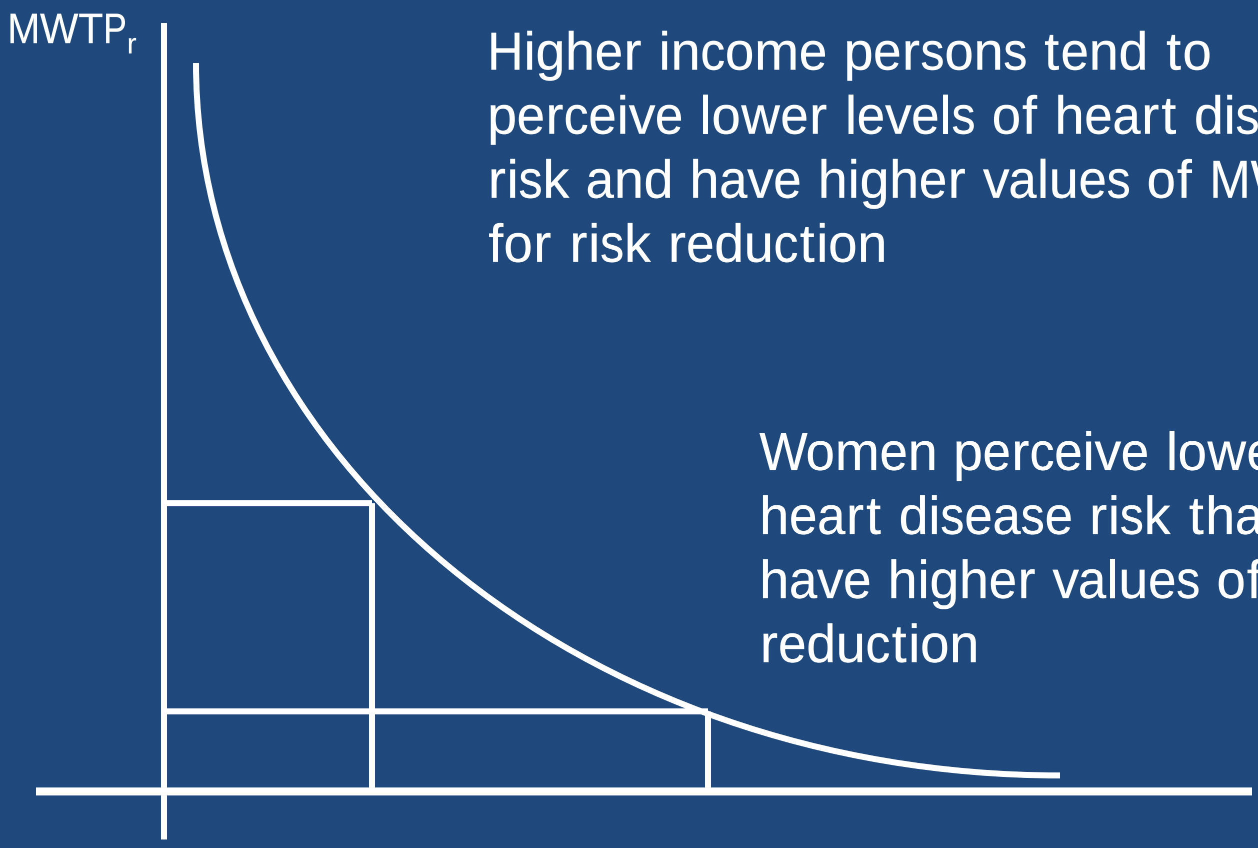
Results: Bivariate Probit Estimates, n=1778

Covariate	Child Equation	Parent Equation
Constant	-0.4055 (0.0315)	-0.4616 (0.0315)
% Risk Reduction	0.0076 (0.0008)	0.0100 (0.0009)
Price	-0.0035 (0.0006)	-0.0038 (0.0006)
ρ	0.902 (0.013)	
Log-Likelihood	-1741.56	

Results

- Annual MWTP for reduction in heart disease by 1 percentage point
  - Parents: $2.63
  - Children: $2.17
- Robust result—MWTP to reduce heart disease risk by 1 percentage point is independent of baseline risk
- Annual MWTP for reduction in heart disease risk by 1 chance in 100 decline as baseline risk increase
  - Rectangular hyperbola
  - MWTP (parents) = $2.63 x (100/R)
    - R = 100, MWTP=$2.63
    - R = 10, MWTP = $26.30

Implications (1)

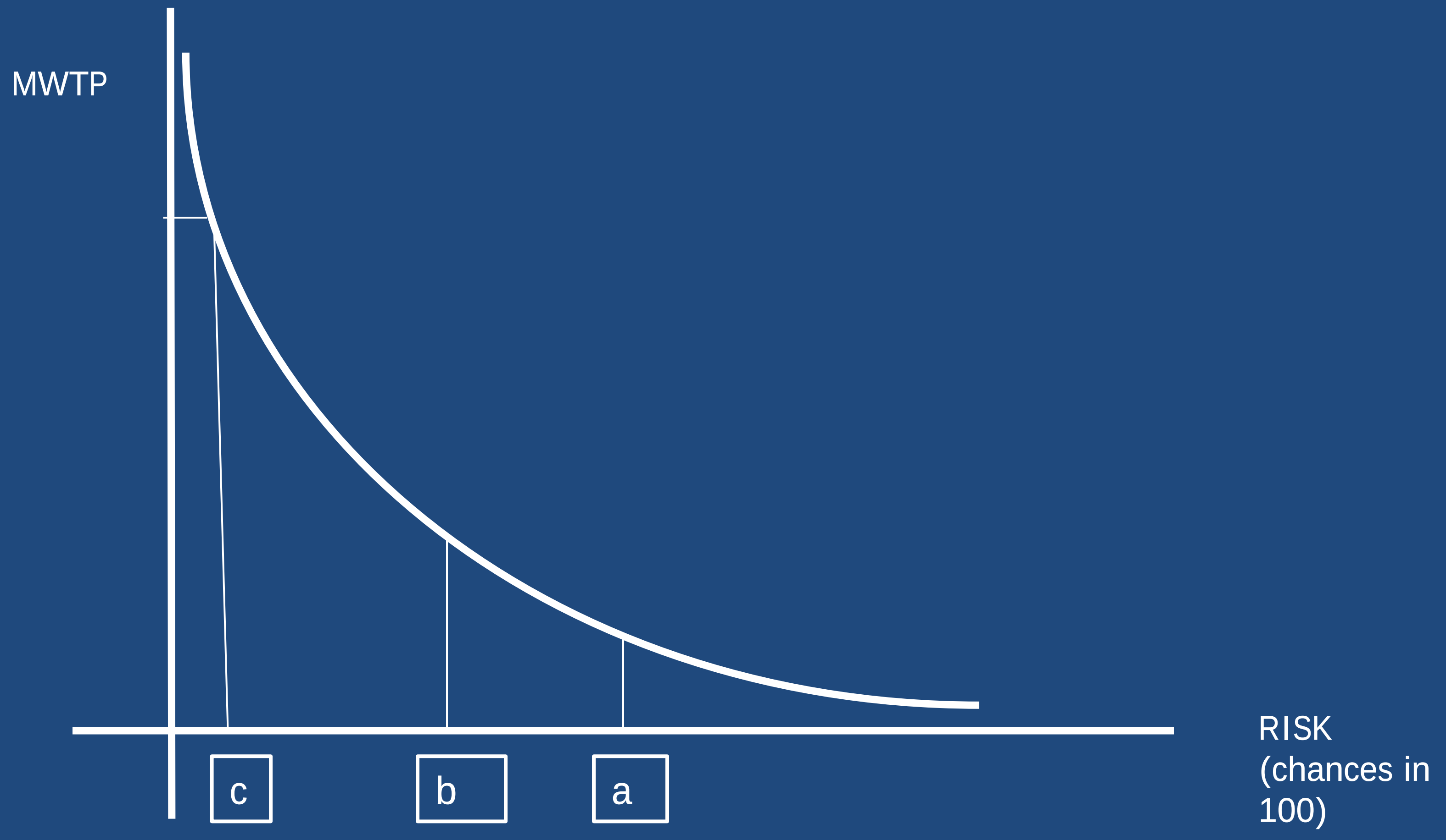


Higher income persons tend to perceive lower levels of heart disease risk and have higher values of MWTP for risk reduction

Women perceive lower levels of heart disease risk than men and have higher values of MWTP for risk reduction

Implications (2)

For policy purposes may want WTP for risk reduction over some range of risks



Policy Example

- Drawn from USEPA benefit-cost analysis of Clean Air Act Amendments of 1990
- Epidemiological estimates suggest that amendments led to (among other things)
  - Reductions in PM2.5
  - Cuts in annual mortality rate by 10%
- U.S. death rate (2007) = 804/100,000
- Reductions on PM2.5 cuts annual mortality rate by 80/100,000
- MWTP of 1 person to reduce deaths by 1 in 100,000 = $72.
- MWTP of 1 person to reduce deaths by 80/100,000 = $5760
- U.S. population (2020) = 300,000,000
- Total health benefits = $1.7 trillion (= 300,000,000 x $5760)
- Total lives “saved” = 240,000 (= 3000 x 80)

Example (3)

- Alternative calculation
- VSL based on labor market where the risk of death in an industrial accident is small (about 3/100,000 per year)
- MWTP of 100,00 persons to reduce risk of death by 1/100,000 = $7,200,000 and MWTP to reduce risk of death by 1 percentage point is $216 = (7,200,000 x 3)/100,000.
- MWTP of 100,000 persons to reduce risk of death from 804/100,000 to 724/100,000

$$\$216 \int_{724}^{804} (100,000 / R) dR = \$2,263,680$$

- MWTP of 300 million people to reduce this risk = $6.8 billion
- Conventional calculation is larger by a factor of about 250!
- Intuition: At 3 deaths per 100,000 of population, MWTP for a one unit reduction in risk is 250 times higher than at 750 deaths in 100,000.

Issues Remaining

- Functional form of relationship between MWTP for health risk reduction and baseline risk
  - Rectangular hyperbola?
  - Linear?
- Look at situations where perceived risk of bad health outcome is small
  - Specific types of cancer vs. heart disease
- Mortality risk vs. morbidity risk
- Revealed preference vs. contingent valuation
- Are differences between disease-specific or context-dependent MWTP values for risk reduction at least partially due to differences in baseline risk?