The Effect of Children on Adult Demands for Health-Risk Reductions

Trudy Ann Cameron (corresponding author)
Department of Economics, University of Oregon
PLC 435, 1285 University of Oregon
cameron@uoregon.edu
Eugene, OR 97403-1285
(541) 346-1242 (phone)
(541) 346-1243 (fax)

J.R. DeShazo
School of Public Affairs, UCLA
UCLA Lewis Center for Regional Policy Studies
3250 Public Policy Building, Box 951656
Los Angeles, CA 90095-1656.
deshazo@ucla.edu

Erica H. Johnson
School of Business Administration, Gonzaga University
502 E. Boone, AD Box 9
Spokane, WA 99258
johnsone@jepson.gonzaga.edu

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ABSTRACT

We examine patterns in adults’ willingness to pay for health-risk reductions by allowing both their marginal utilities of income and their marginal disutilities from health risks to vary systematically with the structures of their households. Demand by adults for programs which reduce their own health risks is found to be influenced by (1) their parenthood status, (2) the numbers of children in different age brackets currently in their households, (3) the ages of the adults themselves, (4) the latency period before they would fall ill, and (5) whether there will still be children in the household at that time. For younger adults, willingness to pay by parents is greater than for non-parents, and increases with each additional young child. For middle-aged adults, willingness to pay for corresponding risk reductions falls when teenagers are present and falls further with each additional teenager in the household.

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1. Introduction

Parents can choose to invest in their own health and in the health of their children. Jacobson (2000) developed a theoretical model of family-provided health to more fully explain the determinants and dynamics of health investments in adults and children. In her model, investments in each family member’s health are jointly determined by the allocation of income and time made by other family members. Subsequently, Bolin and co-authors (2001, 2002a, 2002b) considered models of non-unitary household decision-making to predict inter-adult household allocations of investment in health. This growing and heterogeneous theoretical literature has yet to be confronted with much empirical data on patterns in actual households’ investments in health.

We begin to fill this gap in the literature by conducting an empirical assessment of the extent to which adults may change their investments in their own health as a function of the numbers and ages of children present in their households. We also provide examples of estimates, for specific types of adults in specific types of households, of their willingness to pay (WTP) to reduce the risk of sick-time and lost life-years as a function of household structure. We further contribute to the literature on the family’s role in the production of health by exploring some empirical evidence concerning several other questions. For example, we describe how the likely timing of a parents’ future adverse health states, interacted with the anticipated timing of their children’s departure from home, can affect the parents’ current investments in mitigation of their own health risks. We also assess empirically how parents’ WTP to reduce their own health risks varies by gender and across single-income and dual-income households. Because the theoretical predictions of existing models are ambiguous with respect to the direction of adult investment in health risk reductions in the presence of children, our empirical findings do not provide a head-to-head testing of existing theories. However, our findings may contribute to future theoretical models by 1) revealing empirical regularities relevant to presently ambiguous theoretical predictions and 2) highlighting patterns of behavior for which no theory yet exists.
Researchers have, of course, looked at many empirical aspects of child health more generally, and at parents’ WTP for improvements in the health of their children.1 Numerous studies also explore a parent’s propensity to invest in their children’s health by reducing the child’s risk of illness or death through improved access to medications and better safety measures. Among these, Thomas (1990) and Strauss and Thomas (1998) compare investments in the health of children by mothers and fathers, but not parental investments in their own health as our paper does.2 Liu et al. (2000) focus on Taiwanese mothers’ WTP to reduce the duration and severity of a cold for themselves and their children, and Jenkins et al. (2001) focus on parents’ WTP for safer bicycle helmets for their children.3 Evans et al. (2006) examine how individual preferences for public policy changes are influenced by the time spent on the care of a dependent (e.g. an elderly parent or a child). Dockins et al. (2002) and Scapecchi (2006) both address the question of whether there are differences in WTP to reduce health risks for children versus adults. Our work differs from these prior studies because we focus on adults’ WTP for health-risk reductions for themselves as a function of the presence of children of different ages.

Perhaps Cropper and Sussman (1988) come closest to the issues addressed in this paper. They are concerned that “one must know the difference between the willingness to pay of single people and those with dependents for a change in own risk of death” (p. 259). Their research, however, considers WTP for health risk reductions—over the life-cycle and in the presence of families—from a mostly theoretical perspective (with the help of some aggregate data from the U.S. Bureau of the Census and mortality rates for white males from the U.S. National Center for Health Statistics).

1 Some examples from the child health literature include Currie and Hotz (2004), who find that a requirement of more education for day-care providers leads to fewer accidents involving the children in their care. Currie and Moretti (2003) find that an increase in a mother’s education will, among other things, improve the health of her infant. Currie and Neidell (2005) and Chay and Greenstone (2003) look at the measurable negative effects of air pollution on infant health.

2 Men report more unearned income than women in Thomas (1990) which may explain their higher investments. This unearned income is controlled for in robustness checks, but Thomas finds that there is still a difference in investments between mothers and fathers.

3 Other examples include Agee and Crocker (1996); Barron et al. (2004); Chenevier and LeLorier (2005); Dickie (2005); Dickie and Gerking (2006); Dickie and Gerking (2007); Dickie and Messman (2004) and Maguire et al. (2004).
Our analysis also contributes to the literature concerned with estimation of the “value of a statistical life” (VSL). This literature does not consider how the VSL of an adult may vary in the presence of children. The main contribution of the present paper is to show how WTP varies along this dimension. This is important because some of the current literature focuses on whether it is appropriate to use some fraction or multiple of a parent’s WTP to reduce their own health risks as an estimate of their WTP to reduce their child’s risk. However, if WTP is different for parents and non-parents, this “benefits transfer” strategy may be inappropriate. We take advantage of a unique stated preference data set that allows us to control for household structure and distinguish between the WTP amounts for parents and non-parents.

Using a model developed in Cameron and DeShazo (2008), we reach beyond a simple average VSL to present our findings in terms of a more general function that describes willingness to pay for a microrisk reduction (i.e. a 0.000001 decrease in risk). Like the VSL, this WTP is constructed from a ratio of the marginal utility of a risk reduction to the marginal utility of income. A methodological advantage of our approach is that we are able to estimate the adult’s marginal utility of income as well as separate (and non-constant) marginal disutilities of future periods of illness and years of lost life. Given our utility-theoretic choice modeling framework, we can permit each of these marginal utilities to vary systematically with the gender of the adult and the nature of the household to which they belong. Another

4 Since not all readers may be familiar with the concept of a statistical life, we digress to explain this concept. A VSL is an average, scaled willingness to pay to reduce mortality risk. Estimates of WTP by an individual are based on small reductions in mortality risks. The decrease in mortality risk may come from many sources including increased access to medicines and disease prevention. Each available estimate typically corresponds to a differently-sized risk reduction, so it is not possible to average the underlying unscaled WTP estimates. Thus, WTP estimates need to be standardized on some common size of risk reduction before an average can be taken. The convention is to use the ratio of the marginal utility of a risk reduction to the marginal utility of income (a marginal rate of substitution), which is equivalent to scaling all of these tiny risk reductions and their corresponding WTP estimates to a vastly larger 1.00 risk change. The average of a set of scaled-up WTP estimates is termed the “value of a statistical life.” For use in benefit-cost analyses, however, the VSL is scaled right back down to the very tiny individual risk reductions represented by most health, environmental, and safety regulations. The U.S. Environmental Protection Agency, for example, uses a VSL value of roughly $6-$7 million for a normalized risk change of 1.00. The U.S. Department of Transportation has traditionally used a smaller number, on the order of $3-4 million during the 2003 time period relevant to our analysis.

5 We are grateful to an anonymous referee for reminding us to mention this point.
important aspect of our model is its ability to control explicitly for the current age of the adult as well as their future age when the health risk would present itself as illness or death.

To preview briefly the survey data we use, we note here that our data are drawn from an extensive existing stated preference survey by Cameron and DeShazo (2008) that elicits individuals’ demands for programs to reduce their risks of a variety of specific major health threats. Each illness is described as a time sequence of health states that the individual has some risk of facing over their remaining lifetime. The intervention programs to reduce these risks are described as an annual pin-prick diagnostic blood test and, if needed, associated drug therapies and life-style changes. The estimating sample consists of choices by over 1,800 individuals who are representative of the U.S. population in terms of standard demographic characteristics. In addition to thorough pre-testing of the survey, extensive robustness and validity checks of the individuals’ responses have been conducted.

Based on our analysis of this data, we provide the first empirical evidence of differences between parents and non-parents in willingness to pay to reduce the risk of suffering a future time profile of adverse health states. We show how the marginal (dis)utility of prospective sick-years and prospective lost life-years—and hence $WTP$ to reduce the risk of an adverse health profile—differ for males and females, according to the number of children in different age groups presently in the household, across single- versus dual-income households, and as a function of whether children will still be present in the household when the illness or injury strikes (if there is a latency period involved).

We find that the number of children in different age groups affects the adult’s marginal utility of income (which reflects competing demands on the household’s budget that may edge out expenditures on the adult’s own health-risk reduction efforts). Concurrently, we find evidence that the number of children in different age categories affects the adult’s expected disutility from prospective sick-time and prospective lost life-years—especially when the illness profile in question will affect the adult while there are still likely to be children under the age of eighteen in the household. Evaluating the net effects on $WTP$, we find that for younger adults, willingness to pay by parents is greater than for non-parents, and it increases with each additional young child. In contrast, for middle-aged adults, willingness to pay for
corresponding risk reductions is lower when teenagers are present and falls further with each additional teenager in the household.

The next section briefly reviews the literature, emphasizing recent theoretical interest in the issues explored here. Section 3 outlines the survey method and the available data. The fourth section explains the structural indirect utility-based choice model we use to explain our respondents’ stated choices. This utility-theoretic choice model forms the basis for our empirical specifications. Sections 5 and 6 discuss our parameter estimates and illustrate their implications for WTP for health risk reductions under different circumstances, and Section 7 concludes.

2. Literature on Family Structure and Demand for Health

   Early theoretical models of the family, such as Becker and Tomes (1976) and Leibowitz (1974), focus on parents’ investments in their children rather than in themselves. However, parents’ investments in their own health may also represent indirect investments in the well-being of an individual’s children. Jacobson (2000) recently developed a theoretical model of family-provided health to more fully explain determinants of health investments in both adults and children. By treating the family, instead of the individual, as the producer of health, she illustrates how investments in each family member’s health are jointly determined by the allocation of income and time made by other family members.6

   The health of a child is determined both by the family’s allocation of market goods to the child and by its allocation of health-denominated parental time to the child. Consequently, we would expect that utility-maximizing parents explicitly consider the role that their own health plays in determining the health and human capital development of their children. Jacobson also shows that parents need not be altruistic to invest in their children’s health (although most parents probably are altruistic toward their own children). Even parents who are entirely selfish (e.g. those who do not appear to derive utility directly from the happiness of their child) will invest in the health of that child since failing to do so may have negative consequences for parents’ incomes (e.g. a sick child may reduce the time a parent may allocate to the labor market or to consumption activities).

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6 Jacobson extends Grossman (1972) who models the individual as the producer of health.
The model by Jacobson (2000) shows that family members, instead of equalizing health outcomes for each family member, equalize the marginal utility of lifetime health normalized by the price of health for that family member. Her analysis also shows that health influences income in two separate ways—good health allows a parent to work and good health increases the parent’s wage rate. Since children require both income and time from a parent, we would expect our empirical analysis to show that the presence of children can affect parental decisions in two ways. We expect children to increase a parent’s marginal utility of income since the additional costs of caring for children will make the family budget tighter. We also expect children to increase a parent’s marginal utility of healthy time, since time spent in all pursuits becomes more valuable at the margin as the parent needs healthy time both to care for a child and to work.

Jacobson’s model assumes that both parents have common preferences, but she admits that this assumption may not be realistic. Jacobson’s model was extended by Bolin et al. (2001), Bolin et al. (2002a) and Bolin et al. (2002b) who hypothesize that a family’s investments in the health of the mother, versus that of the father, will be different and will depend on their relative labor market opportunity costs, among other things. These authors highlight the ways in which mothers’ and fathers’ investments in their own health can vary as a result of intra-household decision-making and Nash bargaining between husband and wife.

To explain differences in men’s and women’s willingness to pay, these models illuminate the roles of several factors that may vary systematically across husbands and wives. Specifically, these factors include labor market opportunity costs, the marginal utility of health improvement, and the marginal productivity of the parent’s healthy time for the child’s development. For our empirical analysis, this suggests that if a woman earns a lower income and/or derives greater marginal utility from additional income and faces relatively lower (and longer-latency) health risks than her husband, she may be less willing to pay to reduce the risk of getting sick or dying in the near term.

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7 The child’s health is also determined by efficiency parameters for both the mother and father. See equation (22) on p. 622 of Jacobson (2000).
If the inter-parent allocation process is an outcome of Nash bargaining, Bolin et al. (2002b) suggest that each parent’s control over family income may have an impact upon their own health investments. Each parent’s degree of control over how income is allocated may depend in part upon both the share of total household income earned by that parent and the leverage generated from the threat of a possible exit from the household. (If the wife has her own income, for example, a husband’s threat of exit from the marriage has smaller financial consequences for her.) This suggests for our empirical analysis that women who have independent incomes will be both more inclined, and more able, to invest in reducing their own health risks than will women who depend entirely upon their husbands’ incomes.

We also expect willingness to pay for health-risk reductions to differ systematically with a parent’s age. Although there is yet no definite consensus about how VSL changes with age, Viscusi and Aldy (2003) study VSL estimates as a function of age and find that VSL tends to increase until individuals reach their mid-50’s and then to decline as people get older.\(^8\) In our study, we control very carefully for the age of the adult when evaluating willingness to pay for health-risk reductions—so we can distinguish between the effect of the parent’s own age and the effect of parenthood status and the ages of any children in the household.

3. Available Choice Data

Existing market-based data are not adequate to infer individuals’ demands for risk reductions with respect to future time profiles of illness or injury. The revealed preference (RP) data which are most typically used concern tradeoffs between on-the-job fatality risks and wages. More-dangerous jobs tend to involve a wage premium, so workers’ choices among jobs with different risk levels and different wages provide an indication of how much money those workers are willing to forego for risk reductions. There are dozens of empirical studies concerning the job choices of labor market participants. However, groups other than working-aged males may not be represented very well by these measures. This may be problematic because the amounts people are willing to pay for prospective risk reductions may vary

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\(^8\)Evans and Smith (2006), however, find an ambiguous relationship between VSL and age. Other researchers have tended to find that VSL and age have an inverted U-shape relationship.
considerably by gender, age, and labor market status. For example, stay-at-home mothers of young children may be especially under-represented in wage-risk studies. For any group which is not in the labor market, stated preference (SP) data can be one of the few viable sources of rich information concerning willingness to pay for prospective health risk reductions.

Cameron and DeShazo (2008) use stated preference methods to elicit preferences for programs to reduce the risk of morbidity and mortality in a general population sample of adults in the United States. The survey was developed carefully using 36 detailed in-person cognitive interviews, three pretests and a large pilot study. Knowledge Networks, Inc. administered the survey to 2,439 of their panelists and achieved a respectable 79% response rate. In brief, the survey consists of five modules. The first module asks respondents to rate their subjective risks, from low to high, of contracting each of a range of major illnesses or injuries. Individuals are also asked to think about how lifestyle changes would reduce their risks of these illnesses and how difficult it might be to implement these lifestyle changes.

The second module in the survey is a detailed tutorial that explains the concept of an “illness profile” to be summarized in the upcoming choice sets. An illness profile is a description of a sequence of future health states associated with a major illness or injury that the respondent may face over his or her remaining lifetime. The major and potentially life-threatening illnesses which are described in the survey are labeled as one of five specific types of cancer (breast cancer for women, prostate cancer for men, plus lung cancer, colon cancer, and skin cancer), heart attack, heart disease, stroke, respiratory illness, diabetes, traffic accident, or Alzheimer’s disease. An illness profile includes the years before the individual becomes sick (i.e. the latency period), illness-years while the individual is sick, any recovered/remission years if the individual survives the illness or injury, and lost life-years if the individual dies earlier than he would have in the absence of the illness or injury. After the tutorial about illness profiles, the individual is informed that he or she might soon be able to purchase new programs that would reduce the risks of experiencing certain illness profiles. Each illness-related risk-reduction

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9For more information on the survey instrument and the data, see Cameron and DeShazo (2008). For more detail on the survey, please see an annotated sample at: http://www.uoregon.edu/~cameron/vsl/Annotated_survey_DeShazo_Cameron.pdf.
program described in the survey consists of a diagnostic blood test plus possible drug therapies and/or life-style changes, available at a specified overall cost that is not covered by insurance.10

The third, and key, module of each survey involves a set of five different three-alternative conjoint choice experiments where the individual is asked to choose one of two possible health-risk reducing programs or a status quo alternative. Each program reduces the individual’s risk of experiencing a specific illness profile. The illness profile is described in terms of its baseline probability, age at onset, duration, severity of symptoms and type of treatment, and eventual outcome (recovery or death). Each corresponding risk reduction program is defined in terms of the extent to which it can be expected to reduce this risk, as well as its monthly and annual cost. Figure 1 provides one randomized example of the type of a stated choice scenario posed to respondents. This first choice set summary was presented only after its contents had been laid out and discussed, row by row, over the sixteen preceding pages of the survey instrument.

Module 4 of the survey contains debriefing questions to permit cross-checks of the consistency of responses. Module 5 is collected separately from our survey and contains detailed socio-demographic data for the individual and the household, as well as responses to a battery of health-related questions (including any illnesses the individual has already faced).

Extensive robustness and validity checks of the individuals’ responses have been conducted to evaluate most of the common problems which may affect SP analyses.11 These include risk comprehension verification where individuals are asked to rank the sizes of stated risk reductions, checks on the subjective complexity of each choice sets where individuals are asked to rate the difficulty of the choice sets (see Duquette et al, 2009), and the recommended “cheap talk” reminder so that individuals are

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10 Early drafts of the survey made an effort to spell out that the quoted costs were intended to capture all of the monetized opportunity costs of participating in the program, but this additional material had to be cut to keep the survey within its length restrictions. An anonymous referee has suggested that we consider respondents’ subjective perceptions about how easy it would be to improve their health habits. Respondents who would find it harder to make life-style changes have larger coefficients on their net income variable, which could be taking up the effect of what is instead just a larger value of perceived net income (i.e. smaller perceived program costs). Thus respondents do not, on average, appear to be imputing significantly larger full costs than are stated in the choice scenarios.

11 See Cameron and DeShazo (2008) for the details.
careful to consider their budget constraints and not overstate their willingness to pay. Individuals are specifically instructed to assume that each choice set is independent of the other choice sets. In preliminary simple ad hoc specifications, respondents’ choices are readily demonstrated to be markedly sensitive to the changes in the scope of the central attributes of these choice sets (i.e. the cost of the program and the size of the risk reduction). Although systematic sample selection effects are very minor, they are assessed and controlled for, with methods explained in detail in Cameron and DeShazo (2006). Finally, Cameron and DeShazo (2008) demonstrate that the WTP implications from a basic model—with preferences that are assumed to be homogeneous except with respect to age, and for the VSL-type health risk consisting of sudden death in the current period—are entirely consistent with contemporary government assumptions about the value of a statistical life. For a 45-year-old with $42,000 in household income, and assuming a 5% discount rate, the model’s WTP estimate corresponds to a VSL of roughly $5.4 million with a 90% range between $3.6 million and $7.4 million. This interval captures the VSL estimates actually used by both the U.S. Department of Transportation and the U.S. EPA during the same time period.

The variables from the survey which are pertinent to the present empirical analysis are summarized in Table 1. These variables include attributes of the different illness profiles presented to respondents (latency, present discounted sick-years, recovered/post-illness years, and lost life-years). The list also includes attributes of the proposed risk reduction programs which are described as reducing the individual’s chance of suffering from these adverse health states (including the cost of the program and the size of the risk reduction). The household’s budget and the structure of earnings are captured by household income data and an indicator for the presence of more than one income-earner in the

12 A number of individuals and/or choice sets were dropped from the analysis according to three exclusion criteria. Exclusion for risk comprehension was activated if the respondent could not successfully rank the sizes of the risk reductions associated with two risk mitigation programs. The 1,629 choices by these individuals were excluded from the analysis. Exclusion for outright scenario rejection was activated for choices where the respondent chose the “neither program” alternative and in the follow-up question which probed why, reported “I did not believe the programs would work” as the only reason for this choice. A total of 2,236 choices were excluded due to scenario rejection. A further 332 choices were excluded due to a minor error in the randomized design for these choice sets which led to the result that suffering from the illness in question would extend the respondent’s life expectancy by a small amount. While this could conceivably happen, we had not intended this to occur, so we dropped these choices.
household. The respondent’s gender is also employed in our models. The illness profile information, combined with household demographic information including the respondent’s own current age and data on the numbers and ages of children currently in the household, allows us also to determine whether the onset of adverse health states in a given illness profile will occur when there are likely to be children still under the age of eighteen present in the respondent’s household.

4. A Random Utility Choice Model

We use a specification that generalizes the utility-theoretic choice model presented in Cameron and DeShazo (2008). In that paper, it is established that stated choices in this general population sample appear to be best explained by a model that involves constrained discounted expected utility. Utility is modeled as being additively separable in two components, the first pertaining to income and costs, and the second pertaining to health state durations. Thus the marginal utility of income does not depend upon health states, and the marginal utility of present discounted health states does not depend upon net income. In our basic specifications, these restrictions are not rejected by the data. To permit systematically varying degrees of diminishing marginal utility with respect to net income, indirect utility is modeled as quadratic, rather than simply linear, in net income.

As a sketch of the basic model, we will consider just a pair-wise choice between Program A and the status-quo alternative (N). First consider what happens if individual \( i \) chooses the status quo alternative. Let \( \Pi_i^{NS} \) be the probability of suffering a given adverse health profile—i.e. getting sick (S) and experiencing the specified series of health states over time. Under the status quo with no risk-reducing program, discounted expected utility, with the expectation taken across getting sick or staying healthy (H), can be denoted as:

\[
\text{PDV} \left( E \left[ V_i^N \right] \right) = \text{PDV} \left( \Pi_i^{NS} V_i^{NS} + (1 - \Pi_i^{NS}) V_i^{NH} \right)
\]

\(^{13}\) The model for a three-way discrete choice, between two alternative programs and the status quo, is analogous.
If individual $i$ chooses Program A, however, then the probability of suffering the adverse health profile is lower. Let $\Pi_i^{AS}$ be the (reduced) probability of suffering the adverse health profile if Program A is chosen. Then $\Delta \Pi_i^{AS} = \Pi_i^{AS} - \Pi_i^{NS} < 0$ is the risk change to be achieved by participating in Program A.

We can write the expected utility from choosing Program A as:

$$PDV(E[V^A_i]) = PDV(\Pi_i^{AS}V_i^{AS} + (1 - \Pi_i^{AS})V_i^{AH})$$

Then the difference in the present discounted expected utility when an individual chooses Program A instead of the status quo can be denoted by:

$$\Delta PDV[E(V^A_i)] = PDV[E(V^A_i)] - PDV[E(V^N_i)]$$

(1)

Our empirical specification is based on the assumption that a rational individual will choose Program A if $\Delta PDV[E(V^A_i)] > 0$, and the status quo otherwise.

Operationally, the sequence of health states making up the illness profile to be addressed by Program A is captured by a set of mutually exclusive and exhaustive $(0, 1)$ indicator variables associated with each future time period $t$. We use the indicator $1(pre^A_t)$ for pre-illness years, $1(ill^A_t)$ for illness-years, $1(rcv^A_t)$ for recovered or post-illness years, and $1(yl_t^A)$ for life-years lost. Individuals are modeled as expecting to pay the annual cost of the risk reduction program only during pre-illness and recovered years, but not if they are sick or dead. They are also modeled as expecting to receive roughly their current level of real income for as long as they live.

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Page 21 of the survey instrument specifies that the respondent “would need to pay for, and participate in, a program for the next [x] years to get its benefits,” where the value of [x] reflects the respondents current age and corresponding nominal life expectancy. Test subjects believed they would not have to pay for the tests while they were actually sick with the illness in question, and certainly not after they were dead, so we imposed this assumption in our empirical models.

It proved impossible, within survey length constraints, to elicit comprehensive expectations about the time profile of future income, with and without each type of illness. We assume that the individual believes that disability insurance and savings will make up roughly their current real income during illness, but they will receive no regular income after their death. There is no information about planned bequests in our data.
Discounting is fundamental to our analysis, given that each illness profile spans the rest of each person’s life. Define the discount rate as \( r \) and let \( \delta^t = (1 + r)^{-t} \). The present discounted number of years making up the remainder of the individual’s (cumulative) nominal life expectancy, \( T_i \), is given by

\[
pdvc_i^A = \sum_{t=1}^{T_i} \delta^t.
\]

With the help of the four different health-state indicator variables, future time periods in each health state are discounted and summed from \( t = 1 \) to \( t = T_i \) and the resulting terms are denoted by \( pdve_i^A = \sum \delta^t \cdot (pre_i^A) \), \( pdvi_i^A = \sum \delta^t \cdot (ill_i^A) \), \( pdvr_i^A = \sum \delta^t \cdot (rcv_i^A) \) and \( pdvl_i^A = \sum \delta^t \cdot (lyl_i^A) \). Since the different health states exhaust the individual’s nominal life expectancy, it will be the case that

\[
pdve_i^A + pdvi_i^A + pdvr_i^A + pdvl_i^A = pdvc_i^A.
\]

To accommodate the assumption that each individual expects to pay program costs only during the pre-illness or recovered/remission periods, we define \( pdvp_i^A = pdve_i^A + pdvr_i^A \), the present discounted time over which payments must be made. This can be interpreted as the discounted duration of program costs. The notation can be simplified further when we define

\[
cterm_i^A = [(1 - \Pi_i^{A^S}) \cdot pdvc_i^A + \Pi_i^{A^S} \cdot pdvp_i^A],
\]

where \( cterm_i^A \) can be explained intuitively as the expected number of present discounted years over which the program costs will be paid if the individual chooses Program A. We also define \( yterm_i^A = [-pdvc_i^A + \Pi_i^{A^S} \cdot pdvi_i^{A^S} + \Pi_i^{A^S} \cdot pdvl_i^A]. \) (This \( yterm_i^A \) variable does not seem to have a similarly straightforward intuitive explanation. We use this abbreviation merely to simplify the notation below.) The generic expected utility-difference in equation (1) that drives the individual’s choice between Program A and the status quo can then be defined as:

\[
16 \text{ Illness profiles were tailored in advance to each panelist’s gender and current age. Due to the advance preparation of randomized illness profiles, we could ensure that gender-specific illnesses were correctly assigned and that no respondent was asked to consider an illness that would begin prior to their current age.}

\[
17 \text{ The complexity of this term stems from the assumed pattern of income and program costs across the individual’s probabilistic future health states.}
\]

\[
18 \text{ Where there will be an analogous term for the utility difference between Program B and the status quo in our three-alternative model.}
\]
\[ \Delta PDV[E(V^A_i)] = \beta_0 \{(Y_i - c_i^A) cterm_i^A + Y_i yterm_i^A\} \\
+ \beta_1 \{(Y_i - c_i^A)^2 cterm_i^A + Y_i^2 yterm_i^A\} \\
+ \alpha_1 \{\Delta \Pi_i^{AS} pdvi_i^A\} + \alpha_2 \{\Delta \Pi_i^{AS} pdvr_i^A\} + \alpha_3 \{\Delta \Pi_i^{AS} pdvl_i^A\} + \epsilon_i^A \]  

(2)

In what follows, we will use the shorthand notation of \( pterm_i^A \) (the “profile” term) to refer generically to the full set of terms in \( \Delta PDV[E(V^A_i)] \) which involve discounted time in each of the three future adverse health states: illness (\( pdvi \)), recovery/remission (\( pdvr \)), and lost life-years (\( pdvl \)).\(^{19}\) In equation (2), the five terms in curly braces can be constructed from the data, given specific assumptions about the discount rate. The unknown indirect utility parameters can then be estimated using McFadden’s conditional logit choice model.\(^{20}\)

Estimates of \( WTP \) for a specified risk reduction can be derived by recombining the estimated parameters and the data employed in the choice model in equation (2). The appropriate utility-theoretic demand construct is a so-called “option price.” In the sense of Graham (1981), the option price for a risk-reduction program is the maximum common certain payment that makes the individual just indifferent between paying for the program (and enjoying the risk reduction) and not paying for the program (and not enjoying the risk reduction).\(^{21}\) The annual option price \( \hat{c}_i^A \) that makes the expression in equation (2) exactly zero can be calculated as:

\[ \hat{c}_i^A = Y_i - f^{-1}\left(\frac{(\beta_0 + \beta_1 Y_i) yterm_i^A + pterm_i^A + \epsilon_i^A}{-(\beta_0 + \beta_1 Y_i) cterm_i^A}\right) \]

(3)

\(^{19}\) We note that since health status and net income are assumed to be constant within each health state interval, one can freely reverse the order of the discounting and expectations operations.

\(^{20}\) In this paper, we assume a common discount rate of 5%. Cameron and DeShazo (2008) explore the consequences of assuming either a 3% discount rate or a 7% discount rate. Work in progress also involves the estimation of individual-specific discount rates simultaneously with these stated choices concerning health risk reduction programs, using additional data on intertemporal choices by a separate sample of respondents from the same population. Preliminary results, however, suggest that the 5% across-the-board discount rate assumption produces a maximized value of the log-likelihood function that is almost 80 points higher than the individual-specific fitted discount rates which are a function of sociodemographic characteristics of each individual.

\(^{21}\) This notion of an option price differs from the sense in which is customarily used in the finance literature.
Where \( f(Y) = (\beta_0 + \beta_1 Y_i)Y_i = \beta_0 Y_i + \beta_1 Y_i^2 \), so that \( f^{-1}(\cdot) \) is the solution to a quadratic form. The expected present value of this stream of annual payments must be calculated over the individual’s remaining nominal lifespan:

\[
E[PV(\hat{\xi}_i^A)] = cterm_i^A [\hat{\xi}_i^A]
\] (4)

To convert this expected present-value option price into a measure of the \( WTP \) for a microrisk reduction, one can normalize arbitrarily on a one-in-one-million risk change by dividing this \( WTP \) by the absolute size of the risk reduction and scaling by .000001 to produce:

\[
WTP = \frac{E[PV(\hat{\xi}_i^A)]}{\Delta \Pi_i^A} \times 0.000001
\] (5)

Multiplying by 1.0 instead of 0.000001 would produce a number comparable to the value of a statistical life (\( VSL \)) for the appropriate “sudden death now” illness profile. Note that this \( WTP \) construct depends fundamentally on the individual’s age and income, as well as on the illness profile in question and the estimated indirect utility parameters in equation (2). It is not a simple constant.

As described in Cameron and DeShazo (2008), the data suggest that the basic, homogeneous-preferences model given in equation (2) is dominated by a specification that is not merely linear in the terms involving present discounted health-state years. We can rewrite the terms in equation (2) that involve the \( \alpha \) coefficients. Note that the status quo involves no risk reductions, so \( \Delta \Pi_i^{N_S} = 0 \) and so does \( pterm_i^N \). The simplest linear version of the illness profile term can be written as:

\[
pterm_i^j = \Delta \Pi_i^{jS}[\alpha_1 pdvi_i^j + \alpha_2 pdvrl_i^j + \alpha_3 pdvl_i^j], \quad j = A, B
\] (6)

However, this simple linear specification in our discounted health state variables does not explain respondents’ stated choices as well as an alternative model that employs shifted logarithms, such as \( \log(pdvi + 1) \), etc. We invoke then the well-known ability of the translog functional form to serve as a flexible second-order local approximation to any arbitrary function. If we start from a form that is fully translog (including all squares and pairwise interaction terms for the three shifted log terms), and then
retain only those terms where the $\alpha$ coefficients are robustly statistically significantly different from zero, $\text{pterm}_i^j$ becomes:

$$\text{pterm}_i^j = \Delta \Pi_i^{18} \left[ \alpha_1 \log(pdv_{i}^j + 1) + \alpha_2 \log(pdv_{i}^j + 1) + \alpha_3 \log(pdv_{i}^j + 1) \right]$$

Finally, because the opportunity for longer durations in each health state is unavoidably correlated with the youth of the respondent, these $\alpha$ coefficients must be allowed to differ systematically with the respondent’s current age wherever this generalization is warranted by the data. This leads to a model where $\alpha_3 = \alpha_{30} + \alpha_{31} \text{age}_i + \alpha_{32} \text{age}_i^2$, and analogously for $\alpha_4$ and $\alpha_5$.

This quadratic-in-age systematic variation in parameters permits non-constant age profiles for the model’s $WTP$ estimates. For the special case of a $VSL$-type illness profile consisting of “sudden death in the current period,” the $\text{pterm}_i^j$ specification in equation (7) produces the typical inverted U-shape for a plot of $WTP$ as a function of the respondent’s current age, with higher $WTP$ values during middle age and lower values for younger and older respondents.22

One additional important modification is used in the models in this paper. Cameron et al. (2007) use the translog-type specification from Cameron and DeShazo (2008) as their base model and then investigate the effects of “scenario adjustment.” A respondent’s subjective perceptions do not always match the assumptions embedded in the illness profile descriptions. Thus Cameron et al. (2007) construct a variable called $\text{bendiff}_i^j$, which approximates the individual’s over- or under-estimate of the latency of each health problem addressed by each risk-reduction program. After each stated choice in the survey, respondents are asked when they, personally, believe they would begin to experience the benefits of each of the two risk-reduction programs they have just considered. A separate indicator variable, $1(\text{never}_i^j)$, is also used—for those programs where the individual states that “the program will never benefit me.” If

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22 However, Cameron and DeShazo (2008) show that for other more-general illness profiles, the shape of $WTP$ as a function of the respondent’s current age can be very different.
\( l(never_i) = 0 \) and \( bendiff_i = 0 \), the individual is deemed to have accepted the illness profile as it is described in the scenario. Controlling for non-zero values of these variables allows us to estimate the main parameters in the model without bias from this source—i.e. as if all individuals had fully accepted the relevance, to their own case, of the stated latency of each illness profile.

In the present paper, we use the model from Cameron et al. (2007) that includes \( l(never_i) \) and \( bendiff_i \) as our “baseline” model and focus on the consequences of introducing additional interaction terms that involve gender, marriage, the numbers of children in four distinct age groups, single- versus dual-income households, and whether children are likely still to be present in the household at the onset of the particular illness or injury as it is described in each choice set.

5. Empirical Estimation

We structure our empirical analysis to provide answers to several questions. Recall that \( WTP \) for the health risk reduction is determined by the ratio of marginal (dis)utility of risk to the marginal utility of income. Our first set of models describes how the gender, age and household structure affects an individual’s marginal (dis)utility of risk and marginal utility of income respectively. Second, with these marginal utility estimates in hand, we can ask about the net effects of gender, age and household structure on an adult’s willingness to pay to reduce risks to their own health.

There is little theory to guide exactly how household structure should enter into our empirical model to explain a respondent’s utility-maximizing choice among a pair of health risk reduction programs and the status quo. Our exploration coalesced around a set of five increasingly general conditional logit random utility models (\( RUMs \)). \(^{23}\) These models are based on an initial specification that is quadratic in discounted net income and employs age-varying translog-like transformations of terms in the numbers of

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\(^{23}\) The models in this paper are estimated using a conventional conditional fixed-effects logit specification. In recent years, of course, random parameter specifications have become increasingly popular. Explorations of random parameters models in simpler versions of models using these data have not yielded dramatically different results in terms of the expected values of the key parameters, so we continue to use the conditional logit specification. We desire to characterize systematic heterogeneity, rather than merely to accommodate unobserved heterogeneity in preferences, although richer models could of course attempt to model both forms.
sick-years, recovered (post-illness) years and lost life-years which make up each illness profile. We considered various dimensions of heterogeneity with respect to gender and household structure and converged on a parsimonious specification which appears to be best supported by the stated choices of these respondents. Our preferred specification is shown in Table 2, which displays all 40 of the parameters in the model. The complete progression of models is contained in an appendix, available from the authors.

In Table 3, we summarize in a more-accessible form just the key results concerning statistically significant heterogeneity with respect to gender and household structure for our preferred parsimonious model. Note that this table includes only 21 of the same parameters reported in Table 2, but we have now arranged these selected parameters strategically to highlight the baseline coefficients (i.e. those which apply for males with no children) in column (1). Row headings identify the basic variables and column headings (2) through (10) identify the key interaction terms. The coefficients on the key interaction terms appearing in the model in Table 2 are arrayed so that they line up with the baseline coefficients which they serve to shift. Recall that the age of the respondent, him- or herself, is extensively controlled-for in the baseline specification—entering as it does, quadratically, as a shifter of three of the main coefficients in the translog-type portion of the model, laid out in equation (7). Without these respondent-age controls, there would be a much greater chance that the ages of children in the household merely proxy for the age of the respondent, where the latter is known to be correlated with individual subjective health risks.24

The following discussion focuses on two different classes of utility parameters. These two classes correspond to the two main ingredients used in the calculation of $WTP$ for health-risk reductions: (a.) the marginal utility of net income, and (b.) the marginal (dis)utility from discounted future time in adverse health states. $WTP$ is constructed as a marginal rate of substitution—a ratio where the numerator involves the coefficients in class (b.), and the denominator involves the coefficients in class (a.) which serve to

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24 It is of course relevant that child-bearing decisions are endogenous. At the point in time when our respondents are asked to consider new health-risk reduction programs in the survey, however, the number of children presently in the household can at least be considered a predetermined variable.
convert utility into dollars. The presence of children of different ages in the household, as well as the other variables considered in this study, affect the utility parameter estimates in both of these classes, and thus the estimated \( WTP \) for a particular respondent facing a specified illness profile.  

5.1 Heterogeneity in the marginal utility of income

The first two rows of Table 3 reveal how the respondent’s marginal utility of net income can be affected by the gender of the respondent and the structure of the household to which he or she belongs—the current presence of children, the structure of household income, and the likely presence of children at the onset of the prospective illness or injury. Net income measures the household’s consumption of all other goods and services aside from the risk-reduction programs in the stated preference choice scenarios. The marginal utility of income thus reflects marginal utility from other types of expenditures. The remaining rows in Table 3 show how the “marginal utility of health state” parameters are affected by family structure and will be discussed in Section 5.2.

5.1.1 Linear term in net income

Our summary in Table 3 offers support for the various informal hypotheses suggested in the introduction to this paper. In the first row, column (2) shows a coefficient on the indicator variable for female which more than doubles the size of the baseline coefficient for unmarried males with no children present. This suggests that the marginal utility of income is higher for women at all levels of income. These coefficients support our conjecture that women may be willing to pay less than men for health-risk reductions.

Columns (3) through (8) in the first row of Table 3 show the influence of the numbers of children in different age groups on the marginal utility of income. There is a coefficient of about -2.3 on the interaction of the female indicator variable and the number of children aged six through twelve. For one such child, this coefficient offsets the basic female differential by about one third, and suggests that a

\[ WTP \]

In Dupont (2004), gender and parenthood indicators (and their interactions) enter directly into an atheoretic \( WTP \) function. Her model does not distinguish between marginal utilities of income and marginal utilities (or disutilities) from variations in environmental quality. Thus, only the net effects of these two influences can be discerned.
mother’s marginal utility of income is lower when children reach this age. This coincides with the time when many mothers return to the labor market, and thus may experience an increase in their own incomes. As college costs and other expenses start looming in the presence of children aged thirteen through seventeen, we find that both males and females tend to exhibit higher marginal utilities of income, with a coefficient which suggests about a forty-five percent increase over the baseline coefficient for males without children present. Having teenagers, and thus a higher marginal utility of income, will tend to reduce both parents’ demands for programs to reduce risks to their own health. Parents thus appear to be more willing to pay to reduce their own health risks when their children are younger.

In column (9) of Table 3, we see that the presence of two incomes in the household, captured by the indicator variable \(1(\text{dualinc})\), appears as though it may decrease the marginal utility of income, but only for women. In the majority of cases, the “second income” is still likely to be the woman’s own income. This may offer some support for our conjecture that a woman who has her own income (controlling for overall family income), may be more inclined to spend money on health-risk reductions for herself.

5.1.2 Quadratic terms in net income

The quadratic income term in row 2 of Table 3 should reflect the degree of financial risk aversion. A negative coefficient on the quadratic term in net income implies that the marginal utility of income declines as income increases. Males in households with no children present appear to have roughly constant marginal utilities of income. The negative coefficient on the interaction of the female indicator variable with the quadratic income term suggests that women are more risk-averse with respect to income changes than men (i.e. they exhibit diminishing marginal utilities of income, on average). Note

\[\text{26} \text{ Unfortunately, our data contain information only about total household income, not the separate incomes of each household member.}\]

\[\text{27} \text{ In other related models, this parameter has an estimated magnitude is similar, but it does attain significance. Hence we retain this variable, even though its coefficient misses being statistically significant at the 10\% level in this particular specification.}\]

\[\text{28} \text{ The Knowledge Networks Inc. panelist profile data contains detailed information on employment status (in nine discrete categories). In future work, we may consider systematic variation in demand for health risk reductions as a function not only of the number of workers in a household, but also the respondents’ own employment status.}\]
that the coefficient in column (3), however, suggests that both genders appear to be more risk averse with respect to income when there are infants in the household, as seen in the negative and statistically significant coefficient on the quadratic income term in this case (although females will continue to be more risk-averse than males).

A higher marginal utility of income for women will tend to reduce the implied \( WTP \) for microrisk reductions, since this marginal utility enters via the denominator of the \( WTP \) formula. However, since the marginal utility of income declines more quickly for women as their incomes are higher, women’s demands for health-risk reduction programs will increase more quickly as a function of income.

**5.2 Heterogeneity in marginal utilities from avoided health risks**

The third through seventh rows of Table 3 reveal the sources of statistically significant heterogeneity in estimated (dis)utilities of discounted future time in different adverse health states. Again, column (1) of Table 3 shows the baseline coefficient values (for unmarried males with no children).

**5.2.1 Gender**

In Table 3, column (2) shows that females with no children display a positive coefficient differential that offsets the baseline disutility displayed by males with no children, both for sick-years and for lost life-years. This shows that females derive less disutility from the prospect of a discounted future sick-year or a lost life-year than do males.

**5.2.2 Children currently in the household**

Columns 3 through 8 of Table 3 reveal some statistically significant heterogeneity due to household structure and the numbers of children in different age groups. In the presence of pre-school children (aged two through five years), males appear to have a much lower disutility from sick-time than do childless males as shown by the positive coefficient of about 104 in column (4), which more than offsets the baseline coefficient of about -71. Column (5) suggests, in contrast, that women with preschool children in their household may have a substantially greater disutility for sick-time than childless males.
and certainly more than males with preschoolers in their household. Perhaps children of this age are recognized to be exceptionally dependent upon their mother’s care-giving, so mothers view their own healthy time as an essential input into their pre-school children’s health.

In row (3), the presence of pre-school children may decrease fathers’ disutility from sick-time. For both parents, however, the presence of children in this age group appears to increase the disutility from discounted lost life-years in row (4). The baseline coefficient on the lost life-years term, for males with no children, is about -600, and the coefficient differential for each preschool child is about -34.

These coefficients discussed in this subsection appear to support, for the most part, our conjecture that parents’ marginal utility from healthy time is higher in the presence of children. The only coefficient that does not support this conjecture is the apparent decrease in a father’s disutility from sick time in the presence of preschoolers. To speculate about possible reasons for this unexpected positive coefficient, perhaps being merely sick has the compensating benefit of an opportunity to be home with the family while the prospect of death certainly does not have this compensating feature. The illnesses in question are serious and often life-threatening. However, they may not be perceived as such by younger males. This finding clearly requires further study to resolve.

One of the more entertaining empirical results in this paper is the finding that, in the presence of additional teenagers (i.e. children between the ages of thirteen and seventeen), both males and females perceive lesser disutility from discounted lost life-years. This may imply that parents view their own healthy time as a progressively less essential input into their child’s wellbeing as the child gets older. However, a cynic might conclude that living with more teenagers makes the prospect of being dead start to look better and better. This lesser disutility of lost life-years, combined with the higher marginal utility of income with each teenager (as noted in Section 5.1.1), produces a significant drop in parental willingness to pay for their own health-risk reductions during their children’s teen years. Unfortunately,

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29 For people under fifty, subjective risks for many of the illnesses in question are uniformly rather low. After about fifty, however, morbidity and mortality risks tend to become far more salient.
this could be the decade in many adults’ lives when investments in maintaining good health may actually be very important.

5.2.3  Future presence of children

In column (8) of Table 3, we show the significant effects of the indicator variable, $1(\text{child at onset})$. This indicator captures any systematic effect produced by an illness profile for which the onset of the illness occurs when at least one child currently in the household will still be under eighteen years of age. This is true for 3% of the 15,040 illness profiles used in the choices analyzed in this study (i.e. for about 430 profiles). The perceived disutility from sick-time is dramatically greater, for both genders, if the illness profile in question features an onset time when there will likely still be dependent children in the household. If a parent gets sick, the ailing parent may be less able to care for the child, and any children still in the household may have to bear part of the burden of caring for the sick parent.

The indicator $1(\text{child at onset})$ is a statistically significant shifter of the coefficients on each of the three variables involving interactions between discounted sick-years and discounted lost life-years. The coefficient on the interaction term involving discounted sick-years and discounted lost life-years suggests that the disutility of each discounted lost life-year is greatly lessened if it is preceded by an additional discounted sick-year. The interactions with age, however, suggest that this offsetting effect declines and then rises with the age of the respondent at the time of questioning. The minimum occurs at about age 44 if a child is present at the onset of the disease. If none of the current children will be under eighteen at the onset of the illness, the minimum $WTP$ occurs at about 51 years of age.

5.2.4  Single Parent and Marriage

It is worth noting that we expected an indicator for likely single-parent status to play a prominent role in these models. When this variable is added as a shifter to the variables already included in our preferred specification, none of the coefficients on the interaction terms bear t-test statistics much in excess of 1.0. It is likely that gender and the effect of the dual income indicator on the marginal utility of
net income (as discussed in section 5.1.1) are already picking up most of the effect of the single-parent indicator.

As shown in column (10), we do find an increase in the disutility of lost-life years for married adults, relative to non-married adults, as captured by the coefficient of about – 35 on the \( I(married) \) indicator.

5.3 Competing effects

As noted, our empirical models allow heterogeneity to enter via the marginal utility of household net income (i.e. the utility from all other types of household consumption) and via the disutility associated with changes in the probability of being prospectively sick or dead. In the first case, the denominator of \( WTP \) is affected, and in the second case, the numerator. For some of our dimensions of heterogeneity, the numerator effect may dominate, while for others, the denominator effect will be the clearest. Among the estimates discussed in this section, gender clearly acts in both places, as does the presence of teenagers. The presence of infants and young school-aged children seems to show up predominantly via the marginal utility of income, whereas the effects of preschoolers, and still having children in the house at the time of future illness onset, seem to act predominantly via the disutility of adverse health states. It may take a lot more data than we have at our disposal to be absolutely sure where each effect is acting and to what degree.

6. Results for Simulated Distributions of Microrisk Reductions

Demand for health-risk reductions depends upon both the marginal utility of income and the disutility from the sick-time and lost life-years associated with the health risk in question. This demand, for a specific individual and a specific health threat, can be summarized by reporting the \( WTP \) for a microrisk reduction, which is a more-general analog to the value of a statistical life. Recall that \( VSLs \) tend to be viewed as one-size-fits-all measures of demand for mortality risk reductions, where the form of the mortality risk is limited to “sudden death now.” Our measures incorporate morbidity as well as mortality, and involve varying latencies and varying durations of time in different adverse future health states.
Fitted WTP varies systematically with the individual’s income and age, as well as with the exact nature of the illness profile under consideration. In Tables 4 and 5, we display the results of some illustrative simulations of the distributions of “WTP for a microrisk reduction” implied by our fitted model. The top four rows of Table 4 are for individuals who are now thirty years of age and married, with differing numbers of pre-school children present in the household. The bottom four rows are results for 30-year-olds who are unmarried with varying numbers of pre-school children. In both Table 4 and Table 5, we calculate the simulated distribution of WTP for a microrisk reduction corresponding to two very simple illness profiles: Profile 1: sudden death this year; and Profile 2: nine years in the future, the individual gets sick for one year, then dies. Profile 1 is the closest our model can come to a VSL-type estimate (if the WTP is multiplied by 1 million). Note, however, that unlike a conventional VSL estimate, our WTP estimates depend fundamentally on age and income. Table 5 has a similar layout and the same illness profiles, but applies to 45-year-olds with different numbers of teenagers.

In our simulations for thirty-year-olds, we consider persons in households with zero children, with one preschooler, and with two preschoolers. For Profile 2 for this group, we assume that there will be at least one child present at the time of onset, so the \( 1(child \text{ at onset}^j) \) variable will be set equal to 1.

In the simulations for 45-year-olds, in Profile 1 (sudden death now), the youngest teenager will still be at home and the \( 1(child \text{ at onset}^j) \) indicator will be set equal to 1 in these simulations. For Profile 2 (with a nine-year latency), the youngest child currently in the thirteen- to seventeen-year-old interval will be at least 22 years old at the time of onset, and thus relatively independent. The variable \( 1(child \text{ at onset}^j) \) is thus set equal to zero for all of these simulations.

In Tables 4 and 5, we show the medians as well as the 5th and 95th percentiles of the simulated distributions of WTP based on 1,000 random draws from the joint distribution of the maximum likelihood estimates of model parameters. For married thirty-year-old males with zero, one, or two preschool children, willingness to pay for a microrisk reduction in the case of sudden death is about $8.81, $11.01,
and $13.16. For 45-year-old males with zero, one, or two teenage children, WTP for a microrisk reduction in sudden death is about $9.56, $5.61, and $3.57.

6.1 Married

For both age groups and both males and females, those who are unmarried have a lower WTP across the board than those who are married, while controlling for the overall income earned in the household. The number of married individuals in the sample is 1,604. Our results suggest that marriage has an effect on WTP. Table 3 suggests that this effect operates predominantly through the increased disutility of lost life-years when a spouse is present.

6.2 Gender

Our WTP simulations suggest that women reveal a much lower willingness to pay for risk reductions than men under both illness profiles and for both age groups. This provides support for the conjecture that women may be less willing to pay to reduce health risks for themselves. The estimated differences in WTP between men and women control for household income levels, so this finding is not merely an artifact of the lower average incomes of women. Before introducing the effects of children, women have both a higher marginal utility of income and a lesser disutility from discounted adverse health states, both of which contribute to a lower WTP for health risk reductions.

6.3 Presence of children

For thirty-year-olds, the presence of each additional child aged two to five increases the WTP by about 20-25 percent for both males and females, which shows support for our conjecture that there is an increase in parents’ marginal utility of healthy time in the presence of preschool children. A thirty-year-old female, having zero, one, or two preschool children and facing an illness profile of sudden death this year is associated with a WTP for a microrisk reduction equal to $3.59, $4.50 and $5.42. That is a 25% increase for the first child and an additional 20% increase for the second child. Profile 2 shows a similar increase in WTP with additional children. Both illness profiles for thirty-year-olds exhibit a similar pattern in general, due in part to the fact that at least one current child will likely be under the age of
eighteen when the illness strikes. Compared to our estimates for “unmarried, 0 children,” these numbers are roughly in line with the estimates of the size of the “family existence” term in Cropper and Sussman (1988), which amounts to about forty percent of total WTP between ages twenty-five and forty.

In contrast, for 45-year-olds, WTP declines about 30-40 percent for each additional child age thirteen to seventeen years old. For example, being a 45-year-old female, having zero, one, or two teenagers and facing a risk of sudden death this year, is associated with a WTP of $3.96, $2.83 and $2.01. This decline is likely due to the fact that the presence of the teenagers seems to both increase the adults’ marginal utility of income, and decrease their disutility from discounted lost life-years. We speculate that the growing need to provide for college expenses and the other significant costs associated with older children may tend to outweigh adults’ concerns about investing in their own future health. Furthermore, the growing independence of children this age means that the parent’s own health is a less essential input into the child’s well-being. These results are at odds with the findings of Cropper and Sussman (1988), who find that the “family existence” term increases with age, reaching about 53 percent of WTP by age 60.30

6.4 Presence of a second income

We simulate the WTP for women with and without two incomes in the household, while controlling for overall household income. We do this to evaluate the conjecture that women who have independent incomes will be more inclined and more able to invest in reducing their own health risks. For a thirty-year-old woman with two preschool children, a second income increases the WTP by $0.84, or by about 15 percent. For the second illness profile, a nine-year latency and then sickness for one year followed by death, the WTP increases by $0.52—a 16 percent increase in the WTP. For a 45-year-old woman with two teenagers, who faces a microrisk of sudden death now, the WTP increases by about 8 percent? These WTP estimates lend some support to the conjecture that women’s demands for health-risk reductions are sensitive to the proportion of household income represented by their own earnings. For a

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30 However, the “family” in this model includes a spouse, not just children.
45-year-old woman with two teenagers who is facing a microrisk of latent illness and death in ten years, however, \( WTP \) is much smaller, with or without a second income. This is due partially to the fact that no current teenager will still be under the age of 18 when the illness strikes in nine years.

### 6.5 Differences across illness profiles

For thirty-year-olds, compared to the \( WTP \) associated with the microrisk in Profile 1, \( WTP \) for the microrisk reduction in Profile 2 is lower by about 22 to 45 percent depending upon the number of children present and the gender of the adult. For example, the change between Profiles 1 and 2 for a married woman in a household with no children is from $3.59 to $2.69, while the change for a married woman in a household with two preschool children is from $5.42 to $3.28.

These \( WTP \) differences across illness profiles are even larger for 45-year-olds. In moving from Profile 1 to Profile 2, the \( WTP \) for a microrisk reduction declines by about 45 to 54 percent depending upon the number of children present and the gender of the adult. For example, the decline for a woman in a household with no children is from $3.96 to $2.07 (about 48 percent), while the decline for a woman in a household with two teenagers is from $2.01 to approximately $0.77 (a decline of about 54 percent). These changes illuminate the potential for differences in willingness to pay for health-risk reductions according to the nature of the illness profile in question.

### 7. Conclusion

We find the presence of children has significant effects on adults’ marginal utilities of income. Controlling for the subject’s own age, our results suggest that parents of infants are, on average, more risk-averse than other people with respect to net income. Controlling for household income, women tend to have higher marginal utilities of income (perhaps because of their somewhat longer life expectancies). However, a woman’s marginal utility of income is significantly lower in the presence of grade-school children—coinciding with the time that many mothers return to the labor market, and thus experience an increase in their own incomes. When children reach their teenage years, perhaps because the prospect of college expenses starts to loom large, we find that parents’ marginal utilities of income are higher.
The marginal disutilities of adverse health states appear to differ systematically by household structure as well. We show that for each additional pre-school child, women exhibit an increased marginal disutility of a sick-year—perhaps because they view their own healthy time as an essential input into their children’s well-being at this age. However, for each additional pre-school child, men appear to exhibit an increased disutility of a lost life-year—perhaps because their continued income-earning power is viewed as essential to the child’s future wellbeing. In contrast, in the presence of each additional teenager, both mothers and fathers reveal a decrease in their disutility of a lost life-year. This may be because parents, as their children grow older and more self-sufficient, view their own healthy time as a less essential input into the child’s wellbeing. At the same time, with each additional teenager, the marginal utility of parents’ income is greater (e.g. because income at this stage can be put to many other good uses, such as college expenses to enhance the child’s human capital, as noted above).

There appears to be some evidence that parents are much more concerned about preserving their future health if they will still have children at home when they might become ill. However, their sense of urgency about their own health protection may be lower for illnesses or injuries that will not affect them until after their children are grown and gone. Concern about the prospect of children still at home is most clearly expressed through differences in the substitutability between sick-years and lost life-years. This perceived substitutability differs with the age of the respondent (it tends to be quadratic in age, with a minimum during middle age). In this model, which controls for household structure, age effects on substitutability are statistically significant only if children are likely to be present at the onset of the illness.

Willingness to pay calculations combine two components—the marginal disutility of adverse health states and the marginal utility of income—and both of these components vary systematically with household structure. For parents, we find that willingness to pay to avoid health risks varies systematically with the age of the parent as well as the numbers of children in each age group presently in the household. Simulations based on our estimated model reveal that, for younger adults, the presence of each additional preschool child increases the WTP by about 20-25 percent for males and females. In
contrast, for middle-aged adults, the $WTP$ to reduce the risk of sudden death declines about 30-40 percent for each additional teenager in the household. Although men are willing to invest more than women, in absolute terms, to reduce their own health risks, women exhibit a much higher percentage increase in $WTP$ for health-risk reductions when children are present in the household. We speculate that, controlling for income, the household may view the mother’s health as a more essential input into the production of healthy children’s well-being than a father’s health, on average.

Finally, also controlling for overall household income, our evidence from this model (and also from other models not presented in this paper) suggests that women in households with two income-earners may invest more in their own health-risk reductions than do women in households with only one income-earner. Presumably, women with their own incomes find themselves both more inclined, and more able, to direct household resources towards their own health protection.

A few caveats need to be highlighted. The empirical results in this paper reflect the assumption that individuals use a 5% discount rate. The issue of discounting is the subject of ongoing research, since, for the basic model in Cameron and DeShazo (2008), $WTP$ estimates vary somewhat with the assumed rate of discount. Knowledge Networks, Inc. report only the numbers of children in the respondent’s household in each of four age categories. They do not report the genders of children in the survey and do not ask whether the adults who participated in the survey are actually the parents of these children. We sometimes refer in the paper to “mothers” and “fathers,” but we cannot be certain that these blood relationships exist. Finally, the illustrative examples concentrate upon illness profiles that involve sudden death now or sickness for a year, at a point nine years in the future, followed by death. Of course, the fitted model is general enough to admit for a wide variety of illness profiles, including non-fatal major illnesses and cases where long periods of morbidity may precede mortality. We have selected just a few arbitrary examples as illustrations for this paper.

This research also complements the much different vein of research represented by investigations concerning the willingness to pay by parents or society to reduce health risks faced by children themselves. To the extent that the presence of children alters adults’ willingness to pay for health-risk
reductions for themselves, these changes in demand may reflect parental altruism toward children (i.e. parental concern for the value that their children place on the parent’s health). Or, they may reflect the influence of competing demands on the household budget represented by the addition of financial responsibility for the care of children of different ages.

In particular, our findings may be interpreted as recommending caution in any attempt to implement a “benefits transfer” to estimate society’s willingness to pay for health risk reductions for children. It may be tempting to use the ratio of parents’ WTP for their children’s health risk reductions to their WTP for their own health risk reductions where both are observed, and to transfer this ratio to contexts were only adult WTP is known. If parents and non-parents are willing to pay systematically different amounts for their own risk reductions, such benefits transfer strategies could be misleading.
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.

<table>
<thead>
<tr>
<th>Program A for Heart Disease</th>
<th>Program B for Colon Cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get sick when 71 years old</td>
<td>Get sick when 68 years old</td>
</tr>
<tr>
<td>2 weeks of hospitalization</td>
<td>1 month of hospitalization</td>
</tr>
<tr>
<td>No surgery</td>
<td>Major surgery</td>
</tr>
<tr>
<td>Moderate pain for remaining life</td>
<td>Severe pain for 18 months</td>
</tr>
<tr>
<td></td>
<td>Moderate Pain for 2 years</td>
</tr>
<tr>
<td><strong>Symptoms/Treatment</strong></td>
<td><strong>Recovery/Life expectancy</strong></td>
</tr>
<tr>
<td>Chronic heart condition</td>
<td>Recover at 71</td>
</tr>
<tr>
<td>Die at 79</td>
<td>Die of something else at 73</td>
</tr>
<tr>
<td><strong>Risk Reduction</strong></td>
<td><strong>Costs to you</strong></td>
</tr>
<tr>
<td>5%</td>
<td>$15 per month</td>
</tr>
<tr>
<td>From 40 in 1,000 to 38 in 1,000</td>
<td>$4 per month</td>
</tr>
<tr>
<td></td>
<td>[ = $180 per year]</td>
</tr>
<tr>
<td></td>
<td>[ = $48 per year]</td>
</tr>
<tr>
<td><strong>Your choice</strong></td>
<td></td>
</tr>
<tr>
<td>☐ Reduce my chance of heart disease</td>
<td>☐ Reduce my chance of colon cancer</td>
</tr>
<tr>
<td>[ ] Neither Program</td>
<td></td>
</tr>
</tbody>
</table>
Table 1: Descriptive statistics (assumes 5% discount rate)  
(7520 choice sets; 22560 alternatives; 15040 illness profiles; 1801 individuals)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Illness Profiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{latency}_j )</td>
<td>Time until onset (years)</td>
<td>19.58</td>
<td>12.02</td>
<td>1</td>
<td>60</td>
</tr>
<tr>
<td>( \text{pdvi}_j )</td>
<td>Present discounted sick-years</td>
<td>2.21</td>
<td>2.51</td>
<td>0</td>
<td>16.3</td>
</tr>
<tr>
<td>( \text{pdrv}_j )</td>
<td>Present discounted recovered-years</td>
<td>0.474</td>
<td>1.36</td>
<td>0</td>
<td>15.9</td>
</tr>
<tr>
<td>( \text{pdvl}_j )</td>
<td>Present discounted lost life-years</td>
<td>2.57</td>
<td>2.93</td>
<td>0</td>
<td>17.8</td>
</tr>
<tr>
<td>( \text{1(child at onset}_i ) )</td>
<td>=1 if current child &lt;18 at illness onset</td>
<td>.02859</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk-Reduction Programs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c_i )</td>
<td>Monthly cost</td>
<td>$29.87</td>
<td>28.71</td>
<td>2</td>
<td>140</td>
</tr>
<tr>
<td>( \Delta \Pi_i )</td>
<td>Risk change</td>
<td>-.00341</td>
<td>.00167</td>
<td>-0.006</td>
<td>-0.001</td>
</tr>
<tr>
<td><strong>Respondent Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Y_i )</td>
<td>Income 2002 $ US</td>
<td>$50,771</td>
<td>33,966</td>
<td>5,000</td>
<td>150,000</td>
</tr>
<tr>
<td>( \text{age}_{io} )</td>
<td>Age in years at time of survey</td>
<td>50.30</td>
<td>15.21</td>
<td>25</td>
<td>93</td>
</tr>
<tr>
<td>( \text{1(female}_i )</td>
<td>=1 if female, = 0 if male</td>
<td>0.513</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{1(married}_i )</td>
<td>=1 if married, = 0 if unmarried</td>
<td>0.688</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( nkids01_i )</td>
<td># children aged 0-1 yrs in hhld</td>
<td>.0161</td>
<td>.1352</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>( nkids25_i )</td>
<td># children aged 2-5 yrs in hhld</td>
<td>.1254</td>
<td>.3880</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>( nkids612_i )</td>
<td># children aged 6-12 yrs in hhld</td>
<td>.2143</td>
<td>.5737</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>( nkids1317_i )</td>
<td># children aged 13-17 yrs in hhld</td>
<td>.1575</td>
<td>.4563</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>( \text{1(dualinc}_i )</td>
<td>=1 if two incomes in household</td>
<td>.6356</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Illness Profile/Respondent Interactions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{1(never}_i )</td>
<td>=1 if the individual states that “the program will never benefit me”</td>
<td>0.385</td>
<td>.4865</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( bendiff}_i )</td>
<td>The individual’s overestimate of the latency</td>
<td>-5.95</td>
<td>11.08</td>
<td>-59</td>
<td>29</td>
</tr>
</tbody>
</table>
Table 2: Final Model (n = 1801 individuals, 7520 choices, 22560 alternatives)

<table>
<thead>
<tr>
<th>Term</th>
<th>Full Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear net income term</strong></td>
<td></td>
</tr>
<tr>
<td>( (\beta_{00} \times 10^4) \text{[linear net income term]} )</td>
<td>4.663 (6.21)**</td>
</tr>
<tr>
<td>( \ldots \times \text{l(female)} )</td>
<td>6.241 (5.28)**</td>
</tr>
<tr>
<td>( \ldots \times \text{l(female)} \times \text{nkids612} )</td>
<td>-2.266 (2.02)**</td>
</tr>
<tr>
<td>( \ldots \times \text{nkids1317} )</td>
<td>2.143 (2.31)**</td>
</tr>
<tr>
<td>( \ldots \times \text{l(female)} \times \text{l(dualinc)} )</td>
<td>-0.165 (1.59)</td>
</tr>
<tr>
<td><strong>Quadratic net income term</strong></td>
<td></td>
</tr>
<tr>
<td>( (\beta_{10} \times 10^6) \text{[quadratic net income term]} )</td>
<td>0</td>
</tr>
<tr>
<td>( \ldots \times \text{l(female)} )</td>
<td>-0.2835 (3.89)**</td>
</tr>
<tr>
<td>( \ldots \times \text{nkids01} )</td>
<td>-0.762 (2.41)**</td>
</tr>
<tr>
<td><strong>Sick-years terms</strong></td>
<td></td>
</tr>
<tr>
<td>( (\alpha_{10}) \Delta \Pi_i^{25} \log \left( pdvi_i^{25} + 1 \right) )</td>
<td>-70.71 (5.22)**</td>
</tr>
<tr>
<td>( \ldots \times \text{l(female)} )</td>
<td>28.4 (2.17)**</td>
</tr>
<tr>
<td>( \ldots \times \text{nkids25} )</td>
<td>103.8 (3.80)**</td>
</tr>
<tr>
<td>( \ldots \times \text{l(female)} \times \text{nkids25} )</td>
<td>-68.52 (2.11)**</td>
</tr>
<tr>
<td>( \ldots \times \text{l(child at onset)} )</td>
<td>-116 (3.07)**</td>
</tr>
<tr>
<td><strong>Recovered-years terms</strong></td>
<td></td>
</tr>
<tr>
<td>( (\alpha_{20}) \Delta \Pi_i^{25} \log \left( pdvr_i^{25} + 1 \right) )</td>
<td>-58.54 (5.78)**</td>
</tr>
</tbody>
</table>

(Continued)
Lost life-years terms

\( (\alpha_{30}) \Delta \Pi_i^{\beta} \log(pdv_i') + 1) \times l(female_i) \)

-600.2

(3.28)***

... \times l(married_i)

22.75

(2.02)**

... \times \text{nkids25}_i

-34.54

(3.09)***

... \times \text{nkids1317}_i

-33.66

(1.98)**

\( (\alpha_{31}) \text{age}_{i0} \cdot \Delta \Pi_i^{\beta} \log(pdv_i') + 1) \)

33.66

(4.67)***

\( (\alpha_{32}) \text{age}_{i0}^2 \cdot \Delta \Pi_i^{\beta} \log(pdv_i') + 1) \)

-0.285

(4.23)***

Lost life-years squared terms

\( (\alpha_{40}) \Delta \Pi_i^{\beta} \left[ \log(pdv_i') + 1 \right]^2 \)

212.4

(2.35)***

\( (\alpha_{41}) \text{age}_{i0} \cdot \Delta \Pi_i^{\beta} \left[ \log(pdv_i') + 1 \right]^2 \)

-13.12

(3.63)***

\( (\alpha_{42}) \text{age}_{i0}^2 \cdot \Delta \Pi_i^{\beta} \left[ \log(pdv_i') + 1 \right]^2 \)

0.113

(3.28)***

Sick-years, Lost life-years interaction terms

\( (\alpha_{50}) \Delta \Pi_i^{\beta} \left[ \log(pdv_i') + 1 \right] \times \left[ \log(pdv_i') + 1 \right] \)

-44.59

(4.18)***

... \times l(child at onset_i)

555.5

(2.39)**

\( (\alpha_{51}) \text{age}_{i0} \cdot \Delta \Pi_i^{\beta} \left[ \log(pdv_i') + 1 \right] \times \left[ \log(pdv_i') + 1 \right] \)

0

(2.17)**

\( (\alpha_{52}) \text{age}_{i0}^2 \cdot \Delta \Pi_i^{\beta} \left[ \log(pdv_i') + 1 \right] \times \left[ \log(pdv_i') + 1 \right] \)

0

(2.20)**
Nuisance parameters (Continued)
- shift if respondent believes “will never benefit”

\[
(\beta_0 \times 10^9)[\text{second income term}] \times 1(\text{never}_i)
\]

\[
(\alpha_{10})\Delta \Pi_i^{\beta} \log(p_{dvi_i}/ + 1) \times 1(\text{never}_i)
\]

\[
(\alpha_{40})\Delta \Pi_i^{\beta} \left[\log(p_{dvl_i}/ + 1)\right]^2 \times 1(\text{never}_i)
\]

\[
(\alpha_{41})\text{age}_i \cdot \Delta \Pi_i^{\beta} \left[\log(p_{dvl_i}/ + 1)\right]^2 \times 1(\text{never}_i)
\]

\[
(\alpha_{50})\Delta \Pi_i^{\beta} \left[\log(p_{dvi_i}/ + 1)\right] \cdot \left[\log(p_{dvl_i}/ + 1)\right] \times 1(\text{never}_i)
\]

\[
(\alpha_{52})\text{age}_i \cdot \Delta \Pi_i^{\beta} \left[\log(p_{dvi_i}/ + 1)\right] \cdot \left[\log(p_{dvl_i}/ + 1)\right] \times 1(\text{never}_i)
\]

- shift with minimum overestimate of latency

\[
(\beta_{30} \times 10^9)[\text{first income term}] \times \text{bendiff}_i
\]

\[
(\alpha_{10})\Delta \Pi_i^{\beta} \log(p_{dvi_i}/ + 1) \times \text{bendiff}_i
\]

\[
(\alpha_{30})\Delta \Pi_i^{\beta} \log(p_{dvl_i}/ + 1) \times \text{bendiff}_i
\]

\[
(\alpha_{32})\text{age}_i \cdot \Delta \Pi_i^{\beta} \log(p_{dvl_i}/ + 1) \times \text{bendiff}_i
\]

\[
(\alpha_{42})\text{age}_i \cdot \Delta \Pi_i^{\beta} \left[\log(p_{dvl_i}/ + 1)\right]^2 \times \text{bendiff}_i
\]

\[
(\alpha_{50})\Delta \Pi_i^{\beta} \left[\log(p_{dvi_i}/ + 1)\right] \cdot \left[\log(p_{dvl_i}/ + 1)\right] \times \text{bendiff}_i
\]

- shift with difference from mean participation probability

\[
(\alpha_{13})\left[P(\text{sel}_i) - \overline{P}\right] \Delta \Pi_i^{\beta} \left[\log(p_{dvi_i}/ + 1)\right]
\]

Observations: 22560
Log L: -10901.417

Absolute value of z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%
### Table 3: Discernible heterogeneity with respect to household structure$^a$ (n = 1801 individuals, 7520 choices, 22560 alternatives)

<table>
<thead>
<tr>
<th>Shifters for gender and household structure</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline: male, no kids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\times l(female)$</td>
<td></td>
<td>6.24</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-2.27</td>
<td>2.14</td>
<td>0</td>
<td>-1.65</td>
<td>0</td>
</tr>
<tr>
<td>$\times nkids01$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.02)</td>
<td>(2.31)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\times nkids25$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\times nkids612$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\times nkids1317$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\times l(child at onset)$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\times l(married)$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Marginal utility of net income:

- $\beta_{10} \times 10^5 \times [\text{linear income term}]$ with asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

- $\beta_{10} \times 10^5 \times [\text{quadratic income term}]$ with asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

#### Marginal utility of health states:

- $\alpha_{i0} \Delta \Pi_{i} \times \log(pdv_{i}+1)$ with asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

- $\alpha_{i0} \Delta \Pi_{i} \times \log(pdv_{i}+1)$ with asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

- $\alpha_{i0} \Delta \Pi_{i} \times \log(pdv_{i}+1)$ with asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

- $\alpha_{i0} \Delta \Pi_{i} \times \log(pdv_{i}+1)$ with asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

**Log L** = -10901.417

---

$^a$ Other parameters which do not vary with household structure are reported in full in Table 2. Zero restrictions in this table cannot be rejected by the data.

$^b$ Asymptotic t-test statistics suggest statistical significance at the 5% level, except as noted.

$^c$ This coefficient, while not quite significant even at the 10% level in this specification, has a similar magnitude and is statistically significant in several other specifications.
Table 4: Simulated WTP for a Microrisk Reduction (2003 SUS)  
For specified individuals (income = $42,000) of age 30 with and without children  
(median, 5th and 95th percentiles)

<table>
<thead>
<tr>
<th>Age = 30</th>
<th>Illness Profile #1</th>
<th>Illness Profile #2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sudden death</td>
<td>In 9 years, sick 1 year then death</td>
</tr>
<tr>
<td></td>
<td>this year</td>
<td>death</td>
</tr>
<tr>
<td>Married</td>
<td>Children now</td>
<td>Male</td>
</tr>
<tr>
<td>Married</td>
<td>0 children</td>
<td>8.81</td>
</tr>
<tr>
<td></td>
<td>(6.01, 12.37)</td>
<td>(2.46, 4.89)</td>
</tr>
<tr>
<td></td>
<td>1 child 2-5 yrs</td>
<td>11.01</td>
</tr>
<tr>
<td></td>
<td>(7.52, 15.42)</td>
<td>(3.22, 6.13)</td>
</tr>
<tr>
<td></td>
<td>2 children 2-5 yrs</td>
<td>13.16</td>
</tr>
<tr>
<td></td>
<td>(8.46, 19.14)</td>
<td>(3.55, 7.60)</td>
</tr>
<tr>
<td></td>
<td>2 children 2-5 yrs, dual-income</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.09, 8.85)</td>
</tr>
<tr>
<td>Unmarried</td>
<td>0 children</td>
<td>6.56</td>
</tr>
<tr>
<td></td>
<td>(3.88, 9.62)</td>
<td>(1.55, 3.83)</td>
</tr>
<tr>
<td></td>
<td>1 child 2-5 yrs</td>
<td>8.74</td>
</tr>
<tr>
<td></td>
<td>(5.53, 12.65)</td>
<td>(2.22, 5.05)</td>
</tr>
<tr>
<td></td>
<td>2 children 2-5 yrs</td>
<td>10.91</td>
</tr>
<tr>
<td></td>
<td>(6.37, 16.37)</td>
<td>(2.57, 6.58)</td>
</tr>
<tr>
<td></td>
<td>2 children 2-5 yrs, dual-income</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.85, 7.67)</td>
</tr>
</tbody>
</table>

Respondents were given no opportunity to express negative willingness to pay. Negative values for microrisk reductions (produced for some draws from the asymptotically joint normal distribution of the maximum likelihood parameters) can be interpreted as zero.
### Table 5: Simulated WTP for a Microrisk Reduction (2003 SUS)
For specified individuals (income = $42,000) of age 45 with and without children
(median, 5th and 95th percentiles)

<table>
<thead>
<tr>
<th>Age = 45</th>
<th>Illness Profile #1</th>
<th>Illness Profile #2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sudden death this year</td>
<td>In 9 years, sick 1 year then death</td>
</tr>
<tr>
<td>Married</td>
<td>Children now</td>
<td>Male</td>
</tr>
<tr>
<td>Married</td>
<td>0 children</td>
<td>$9.56 (7.29, 13.03)</td>
</tr>
<tr>
<td></td>
<td>1 child 13-17 yrs</td>
<td>5.61 (4.22, 7.60)</td>
</tr>
<tr>
<td></td>
<td>2 children 13-17 yrs</td>
<td>3.57 (2.26, 5.30)</td>
</tr>
<tr>
<td></td>
<td>2 children 13-17 yrs, dual-income</td>
<td>- (1.28, 3.11)</td>
</tr>
<tr>
<td>Unmarried</td>
<td>0 children</td>
<td>7.33 (5.31, 10.31)</td>
</tr>
<tr>
<td></td>
<td>1 child 13-17 yrs</td>
<td>4.09 (2.80, 5.84)</td>
</tr>
<tr>
<td></td>
<td>2 children 13-17 yrs</td>
<td>2.42 (1.06, 3.95)</td>
</tr>
<tr>
<td></td>
<td>2 children 13-17 yrs, dual-income</td>
<td>- (0.46, 2.33)</td>
</tr>
</tbody>
</table>

Respondents were given no opportunity to express negative willingness to pay. Negative values for microrisk reductions (produced for some draws from the asymptotically joint normal distribution of the maximum likelihood parameters) can be interpreted as zero.
Bibliography

Agee MD, Crocker TD. Parental altruism and child lead exposure - inferences from the demand for chelation therapy. *Journal of Human Resources* 1996; 31; 677-691.


Becker GS, Tomes N. Child endowments and quantity and quality of children. *Journal of Political Economy* 1976; 84; S143-S162.


