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Willingness to Pay for Small Reductions in Morbidity and Mortality Risks: Canada and the United States

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ABSTRACT: Benefit-cost analysis of environmental policies frequently requires estimates of the social benefit associated with human health improvements. We assess differences between Canadian and US individuals' willingness to pay (WTP) for health risk reductions using a large stated preference survey conducted across both countries. Our utility-theoretic choice model allows different and systematically varying marginal utilities for avoided future time in different adverse health states (illness years, recovered/remission years, and lost life years). We find significant differences between Canadian and US preferences, and WTP also differs systematically with age, gender, education, and marital status, as well as a number of attitudinal and subjective health-perception variables. To permit comparison with conventional estimates of the "value of a statistical life," we focus on the special case of WTP to avoid sudden death in the current period. Age profiles for WTP are markedly different across the two countries. Canadians tend to display substantially flatter age profiles, with peak WTP realized at older ages. In some cases, differences in WTP between Canada and the US disappear for Canadians who have prior experience with going outside of their provincial health plan for medical diagnostic tests.

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I: Introduction

A large share of the social benefits stemming from environmental regulations in both the United States and Canada is derived from their effect on human health outcomes. Alberini (2005) reports that more than eighty percent of monetary benefits supporting clean water legislation in the US are derived from associated reductions in human mortality. The standard measure of mortality risk reduction benefits in the literature has been the Value of a Statistical Life (VSL). This statistic measures the marginal rate of substitution between mortality risk and income or wealth. It is common to estimate wage-risk or wealth-risk tradeoffs (Viscusi (1993)) by assuming that the individual considers just a single health threat, for which the risk is reduced by a small amount in the current period (Dreze (1962), Jones-Lee (1974)). For example, based in part upon a series of these wage-related revealed preference (RP) studies, the U.S. Environmental Protection Agency uses a one-size-fits-all VSL estimate of roughly $6-7 million. Two recent meta-analyses for wage-risk tradeoff studies have found mean VSL estimates from $3.7 million (Mrozek and Taylor (2002)) to $10.8 million (Viscusi and Aldy (2003)), while in Canada the figure has ranged from $6.2 to $9.9 million (Chestnut, 2007).

Several shortcomings of wage-risk VSL studies have been highlighted in the literature. First, they are limited to workplace risks, while environmental and public safety and health policies often pertain to risks outside the workplace. Second, these studies implicitly assume full information concerning the relevant risks both within and across occupations underlying the work choice decision. Finally, it is often difficult to isolate the risk premium of a particular occupation from other non-pecuniary attributes of a job (time-flexibility, workplace setting, etc.). As an alternative, stated preference (SP) studies allow for risks to differ across populations by the use of hypothetical choice scenarios. Survey respondents are typically asked to choose among alternative types of risk reductions at differing costs. Their choices reveal their implied willingness to pay (WTP) for specific risk reductions which lie within the range of the scenarios posed in the choice questions. The survey instruments used in SP choice studies are designed to educate respondents about all of the information pertinent to their decisions, and the survey's choice contexts can be designed to isolate the effect of a specific risk reduction associated with a given policy choice. These studies tend to find smaller VSL figures (Kochi et al. (2006)). Yet, while SP studies ameliorate a number of problems with the revealed-preference wage-risk studies, they rely on what an individual says he or she would do, rather than actual economic choices. Thus there are several important protocols which must be observed so that the researcher can argue for the so-called construct validity of the resulting willingness-to-pay estimates. These measures are described in detail in Cameron and DeShazo (2006) and will not be reiterated here.

It has been common in both the RP and SP literatures on the valuation of mortality risk reductions to point out the limitations of a one-size-fits-all measure.[1] Suppose a policy or regulation targets an environmental threat that bears most heavily upon the health of a particular sub-population (say, the elderly). VSL metrics derived primarily from the contemporaneous employment decisions of prime-aged white males in blue-collar occupations are not necessarily appropriate for estimating the willingness to pay of the elderly to reduce their risk of death in the current period or in future periods. In a recent Associated Press article entitled "In the numbers game of life, we're cheaper than we used to be," Seth Borenstein raised questions (and the ire of many readers) about the fact that the US EPA has used different VSL numbers over time. This flurry of outrage in the US press again underscores the difficulty of interpretation and potential for misunderstanding with respect to the benefits of mortality risk reductions within the policy arena.

As an alternative to the standard VSL measure, Cameron and DeShazo (2006) build a utility-theoretic model for the Value of a Statistical Illness Profile (VSIP). This measure allows for different valuations of health risk reductions across a variety of health states that make up a future "illness profile" (including a pre-illness current health state, illness-years, post-illness recovered/remission years, and lost life-years). By allowing marginal utilities to vary across the different phases of an entire illness profile, the model integrates health states that have previously been valued in separate models or separate studies. It recognizes that "sudden death in the current period" is not the typical illness profile for most environmentally induced illnesses. Most such deaths are preceded by a period of pre-mortality morbidity that may have a substantial effect on individuals' willingness to pay to reduce their risk of suffering from such a health threat. Starting from this more-general concept of the VSIP, it is possible to extract a special case that is close to the more-conventional VSL measure (i.e. reducing the risk of sudden death in the

[1] Baker et al. (2008) consider the conditions on the underlying social welfare function that would be necessary to justify the application of a single VSL estimate. They also address whether discounts or premia might be applied to take account of age or vulnerability of the population exposed to the risk. Sunstein (2004) raises the issue in the legal literature that VSL estimates should vary across individuals.

current period). However, the new construct allows for illness profiles which involve latency periods and protracted periods of pre-mortality morbidity (illness-years). It depends fundamentally upon the individual's current age and income. It is also a natively per-year measure, obviating the need for ad hoc calculation of the "value of a statistical life-year" (VSLY) based on dividing a conventional VSL by the average remaining life expectancy in the population.[2]

Utilizing individual stated-preference data from matching surveys conducted in both Canada and the United States, we utilize the VSIP framework to investigate differences in average WTP to pay for health risk reductions across the two different cultures. To our knowledge, only one recent study has directly compared WTP for health risk reductions between the US and Canada. Alberini et al. (2004) studied a sample of respondents from Hamilton, Ontario, and compared them to another sample from the US. They find that Canadians have lower WTP, at least for those aged forty years and older. Although the study allows for systematic variation with age, the differences in WTP are not explained through systematic variation across other sociodemographic characteristics, subjective risks of the diseases in question, or differences between the Canadian and US health care systems. We extend the cross-national literature to explain observed differences in individual WTP for health risk reduction programs by individual heterogeneity in each of these factors.[3]

This individual heterogeneity is important. First, controls for these individual characteristics are necessary to prevent cross-national heterogeneity from showing up as spurious generic cross-national differences (or lack thereof) in health preferences. Second, from a policy perspective, any WTP number used for benefit-cost analysis should probably reflect the actual distribution of characteristics in the at-risk population for a particular policy or regulation. Based on the detailed attitudinal and subjective health perception variables collected in our survey, we have identified a number of variables for which the distribution (especially by age) differs

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[2] Sunstein (2003) addresses the question of whether benefit-cost analysis should employ the value of statistical lives, or statistical life-years.

[3] See Hammitt (2007) for an exposition on the opportunity for inclusion of systematic variation in WTP studies. In addition to Alberini et al. (2004), Krupnick et al. (2002) identify variation in WTP across age of the individuals, showing weak support for the notion that WTP for health risk reductions declines with age, which is evidence of a "life-cycle effect," where individuals expect to derive increasing marginal utility from reducing health risks that come to bear later in their lives. In addition to the "life cycle effect," DeShazo and Cameron (2005) find statistical evidence that as people age, there is a systematic downward shift in their anticipated schedule of marginal utility for risk reduction a future ages. Taken together, these two effects offer evidence of time inconsistency: at younger ages, individuals seem to value future health more, however, as they get older, they value future health less.

between the US and Canada. For example, members of our Canadian sample appear to express higher subjective probabilities associated with the risk of heart disease, cancers, respiratory disease, diabetes, and Alzheimer's disease. They are also more inclined to say they could improve their health by cutting back on smoking and improving their diet, but are less inclined to believe they can reduce their risk of traffic accidents through increased use of seat belts. Depending on age, they feel they have more or less opportunity to improve their health through additional exercise.

Given the universal payer system in Canada and the private-payer system in the United States, individual perceptions can presumably differ about the efficacy of health care and its overall accessibility. Our survey elicits information about each individual's confidence in diagnosis and treatment under their respective health care systems. Moreover, the health risk reduction programs used in our stated choice scenarios for Canadians were stipulated as being outside the normal course of care under the universal health system, so information was also collected about their personal experience with instances where they may have gone outside their provincial health plan for prior medical diagnostic and testing services.

In general, we find evidence that US and Canadian preferences differ, with the differences largely explained by non-jurisdictional individual heterogeneity. We find substantial evidence of age profile effects which are generally consistent with other studies. However, age profiles with respect to WTP to avoid adverse health states is markedly different between Canadians and US residents. In general, Canadians have a much flatter age profile for WTP, and this profile appear to peak at a substantially older age.

Section II describes the stated preference survey used in this analysis. Section III details a number of differences across countries in the attitudinal and behavioral characteristics of survey respondents. Section IV sketches the basic utility theoretic model used in the empirical estimation, while Section V presents empirical results. Section VI discusses the results, focusing on the sudden death scenario in the WTP simulations to facilitate the most-direct comparisons with the extant literature on VSLs. Section VII concludes.

II. Survey Design and Data

The data collected for Cameron and DeShazo (2006) provide a unique opportunity to identify cross-national differences in preferences to avoid adverse health states. The stated preference dataset was conducted twice—first for Canadian residents using the internet consumer panel maintained by Ipsos Reid (selected so that the proportions of the sample in different sociodemographic groups mimic the general population), and a few months later for the United States using the representative consumer panel maintained by Knowledge Networks, Inc. Careful administration of the Canadian survey allowed for collection of key demographic information for Canadians mirroring demographic characteristics included in Knowledge Network's standing consumer panel for the United States. Information on the age, income, educational attainment, marital status, gender, and race/ethnicity are available for both samples.

In addition to collection of demographic characteristics, the survey collected four other categories of information from each respondent. First, information was collected concerning the individual's personal health history and their perceptions of their likely susceptibility to specific categories of major health risks. These questions asked about the respondent's own prior experience with the specific classes of disease that they would subsequently be asked to consider in our conjoint choice experiments. They were also asked about the prior experiences of friends and family members with these illnesses, about the extent to which they believe these disease risks can be controlled through health habits and life-style choices, and about their personal room to improve their health habits along seven dimensions, including opportunities to see the doctor more regularly, lose weight, exercise more, cut down on alcohol consumption, use a seat belt more regularly, improve their diet, and cut back on smoking.[4]

The second part of the survey provided a risk tutorial and trained respondents carefully about how to interpret each of the attributes of the different risk reduction programs that form the core of the survey. Respondents were required to answer a simple skill-testing question to evaluate their comprehension of the notion of risk, since risk comprehension is crucial to the choice tasks.

[4] Although the nominal life expectancies used in the illness profiles for the survey's choice experiments were based upon actuarial life expectancies, respondents were asked at the end of the survey to report their individual subjective life expectancy based on their health and family history.

After about 25 pages of preparation, in the third and main section of the survey, each respondent is faced with the first of five independent choice scenarios. The first choice scenario presents all of the quantitative information used in the tutorial section in a simplified one-page "choice table." See Figure 1 for an example. The individual is asked to evaluate two health programs offering a reduction in health risk at a monthly cost against the status quo alternative (i.e. no health risk reduction program, but no expense either). The respondent was then asked to choose their most preferred option among the three options available. Each of the two health programs offered randomly assigned reductions in the probability of getting sick or injured, and described the expected time-to-onset, duration, and potential for recovery from the illness or injury, as well as the extent to which this health threat would shorten their expected lifespan. The each illness profile was randomly assigned a disease name, subject to a few exclusions for plausibility (e.g. no recovery from diabetes or Alzheimer's disease).[5]

For all disease risks (other than the traffic accidents) each program reduces the risk of disease incidence via a diagnostic pin-prick blood test administered once per year by the individual's doctor. The test would indicate whether the individual is at risk of developing the illness in question. If so, the individual would be prescribed medication and/or lifestyle changes to reduce the chance of suffering the illness profile in question.[6] Each illness profile consists of a brief description of the approximate age at which the individual would get sick, the duration of sickness, symptoms, treatments and prognosis, and anticipated effects on overall life expectancy. The health programs offered where characterized by both a reduction in the probability of illness, and associated cost of the program in both annual terms and as monthly payments.

The final section of the survey consisted of debriefing questions. Some of these were posed directly after each choice scenario. Another was a general question about the respondent's confidence in the ability of health care providers to diagnose and treat illnesses under their respective health care systems. Debriefing questions also included assessments of scenario "buy-in," such as whether or not the individual personally believed they would benefit from the risk

[5] In other work, we have found that the disease labels (regardless of the underlying illness profile) do affect individual preferences to avoid adverse health states. These differences are addressed in Cameron, DeShazo, and Johnson (2008). However, the randomization of disease labels across illness profiles the respondent is asked to consider assures that point estimates remain unbiased. Any variation induced by subjective beliefs about specific disease names would be orthogonal to the illness profiles considered in each scenario.

[6] For traffic accident scenarios, the program was described as car equipment such as new airbags, braking systems, and impact reduction technologies which could be retrofitted to existing vehicles, on included as an option on new vehicle purchases, with capital costs amortized into monthly payments.

reduction program, and the age at which the individual subjectively believed they would benefit from the program. For the Canadian respondents, information on the number of times each respondent sought care outside of their universal health plan was solicited, since the health programs used in the choice scenarios were described as extra-ordinary care which would not be covered under their provincial health plan.[7]

The survey was administered to 2,439 respondents from the United States and 1,109 Canadians.[8] Certain Canadian and US respondents were excluded for three main reasons. First, if the respondent did not correctly answer the risk comprehension question, he or she was excluded from the analysis. Second, if the respondent rejected both programs in a particular choice scenario solely because they did not believe the program would work, the respondent's choice under that scenario was dropped from the analysis. Finally, randomization of illness profiles inadvertently resulted in a small number of implausible health profiles (about 1%), and these were dropped to preclude any biases stemming from how they might have been interpreted.[9]

Although the Canadian survey was administered to the exclusively computer-literate Ipsos Reid consumer panel, the sample is reasonably similar to the Canadian population on several observable dimensions. Table 1 presents a comparison of the Canadian sample to the US sample and the Canadian population. Particularly with respect to the age distribution, the Canadian sample closely mirrors the Canadian population as a whole. Although the sample has fewer elderly (2% compared to 8% in the population), this is expected from a survey administered over the internet. The income distribution for the sample is skewed towards lower incomes compared to the population as a whole. The sample has a greater proportion of females to males, and a slightly greater proportion of the sample is married. Finally, although there are fewer nonwhites in the sample, the educational attainment (those earning a college degree of more) is similar between the sample and the Canadian population as a whole. These differences highlight the importance of allowing for the possibility of systematic variation in WTP across

[7] Through debriefing questions following each stated choice, respondents who said they would not choose either offered program had the option to indicate that this was because their provincial health plan should cover those tests.
[8] The response rate for the US survey was 79% (out of 3000 initially solicited). The Canadian survey was administered over the internet by Ipsos Reid.
[9] For the US sample, this resulted in dropping 1,236 choices from the US sample and 1,040 choices from the Canadian sample due to risk comprehension failure, 2,236 choices from the US sample and 393 choices from the Canadian sample due to scenario rejection, and 332 choices from the US sample and 81 choices from the Canadian sample due to randomization error.

observable characteristics, so that differences in the types of people in the sample are not interpreted as differences in preferences for similar types of individuals.

III. Differential Patterns in Health Beliefs and Health Care Systems

Descriptive statistics presented in Table 2 show differences between Canadian and US respondents in attitudes and beliefs about illness exposure risks, subjective beliefs about behavior and its effects on health, as well as different levels of confidence in the timeliness and quality of health care in the event that the individual contracts a major illness or suffers a major injury. Canadian respondents perceive themselves to be less at risk of acquiring a disease or being in a traffic accident. Moreover, they believe there is less opportunity for lifestyle improvements through seeing a doctor more regularly, wearing a seatbelt more often, or reducing their consumption of alcohol. However, they show more opportunity to moderate their weight, exercise more, and smoke less. They are generally less confident that their health care system will allow them to obtain timely and effective diagnosis and treatment, and only about sixteen percent of the Canadian subsample has gone outside their provincial health plan to obtain diagnostic tests.

However, the differences in health-related attitudes and beliefs between Canadian and US respondents differ with the age of the individual. Appendix I provides and assortment of figures illustrating differences across countries, by age, in a variety of different measures. These graphs depict age-wise means and intervals defined by plus and minus two standard deviations, where the standard deviations are adjusted to reflect sample size in the age group in question. To enhance the main trends, these three age-wise statistics are presented as twenty-year moving averages. In each figure, the triple of solid lines applies to the US sample and the triple of dashed lines applies to the Canadian sample.

The figures in Appendix I reveal differences in subjectively reported risks of suffering from heart disease, respiratory disease, and traffic accidents, as well as differences in subjectively reported room for improvement in personal health behaviors. Perceived risk for Alzheimer's disease and diabetes is generally higher for younger and lower for older Canadian respondents compared to individuals from the US. Perceived risk of acquiring one of five cancers (prostate, breast, colon, lung or skin) was lower for Canadian respondents. For the risk of heart disease, younger and middle-aged Canadians reported higher subjective risks, while older Canadians (75 years and up) reported lower subjective risks (although this may reflect self-selection into the possibly healthier older internet-using sample in Canada). Canadian respondents reported substantially higher risks of acquiring respiratory disease for nearly all age groups, with the differential inverting only for those 75 and older. A similar pattern is seen for risk of strokes, while little difference is seen in perceived risk of traffic accidents up until the age of retirement, whereupon Canadians generally begin to report lower risks. Again, this could reflect selection biases in the older internet sample in Canada.

While Canadian respondents report similar ability to improve lifestyle habits with respect to losing weight and improving their diet, they report generally less opportunity at all ages to wear a seat belt more regularly, or see a doctor more frequently. Respondents from both samples reported similar opportunities to cut back on smoking in general, but Canadian respondents between the ages 35 and 45 reported substantially greater opportunities to cut back, compared to respondents from the US. Younger Canadian respondents reported less opportunity to reduce alcohol consumption, with the relationship reversing at about age sixty, at which point older Canadians report significantly more opportunity to cut back on alcohol consumption.

It is worth noting that these age-specific and disease-specific profiles reveal some degree of correlation between subjective beliefs about health risks and associated lifestyle behaviors. The higher perception of risk for diabetes and heart disease among Canadian respondents is correlated with a greater propensity to see more opportunity for exercise. Similarly, the higher reported risk among Canadians for respiratory disease is correlated with reports of more opportunity to cut back on smoking. We might expect that Canadians with higher risk perceptions of respiratory disease are more willing to pay for health risk reductions. Likewise, the higher perceived risk of heart disease and diabetes suggests that Canadian respondents may be more willing to pay for health risk reductions for these diseases. On the other hand, Canadians who report more opportunity to cut back on smoking or exercise may prefer either cutting back or exercising more to paying for health risk reductions. The risk reduction programs to be offered in our stated choice scenarios may be perceived as substitutes for these other health enhancement activities, or a complementary measures.

Finally, there are stark differences in the confidence of diagnosis and treatment of health problems across the two systems. Canadian respondents are generally less confident in the timeliness and quality of diagnosis and treatment until about age seventy, beyond which there is little difference in the perceived efficacy of care. Regarding experience with going outside of their provincial health plan for medical services, Canadian respondents have, on average, gone outside of their plan for about one in five of the procedures mentioned in the survey.[10] However, only about 16 percent of the Canadian sample had gone outside of their health plan for diagnostic testing (analogous to the risk reduction program used to elicit willingness to pay information in our survey's choice scenarios).

IV: Structural Utility-Theoretic Model

This utility-theoretic choice model is described in detail in Cameron and DeShazo (2006), but we offer a brief explanation of the model in this paper. We denote the two risk reduction programs in each choice set as A and B, and the status quo alternative for "neither program" as N. Each program reduces the risk of facing a specified illness profile, but involves a specified annual cost. The program cost is assumed to apply only during pre-illness years and recovered years, so the individual would not pay for the program while sick (or dead) if he or she were to fall victim to the illness or injury. An illness profile is a sequence of future health states that includes a mutually exclusive and exhaustive combination of pre-illness years, sick years, post-illness recovered/remission years and lost-life years, and only single spells of any given illness. Respondents are assumed to maximize utility subject to their budget constraint, and thus to choose the alternative that gives them the highest level of utility.

For simplicity, consider just the pair-wise choice between program A and N.[11] We assume that the utility of an individual, *i*, at time, *t*, depends upon net income in that period, Y_{it} minus the cost of any program, c_{it}, and the health state they experience in that period. In any given period, the individual will be in one of the four possible health states, which are captured using four indicator variables: $1(pre_{it})$ for pre-illness years, $1(ill_{it})$ for illness-years, $1(rcv_{it})$ for post-illness recovered/remission years, and $1(lyl_{it})$ for lost-life years. We can write the individual's indirect utility function in each time period, t, as:

[10] In addition to diagnostic tests, these medical services included physical exams, flu shots, major surgery, cosmetic surgery, immunizations for children or for travel, and "other."
[11] The three-way choice between two programs and neither program is analogous.

$$V_{it} \;=\; f\left(Y_{it} - c_{it}\right) \;+\; \alpha_0 1(pre_{it}) \;+\; \alpha_1 1(ill_{it}) \;+\; \alpha_2 1(rcv_{it}) \;+\; \alpha_3 1(lyl_{it}) \;+\; \eta_{it} \qquad (1)$$

There is uncertainty about whether the individual will actually fall sick from the disease, so we model each choice as depending upon expected indirect utility, with the expectation taken across the sick (S) and healthy (H) outcomes. Participation in program A vs. N is described as altering the probability of getting sick from Π_i^{NS} to Π_i^{AS}. Furthermore, each illness profile extends through the remainder of the individual's life expectancy, so we discount future time periods using a constant discount rate *r* and discount factor $\delta^t = \left(1+r\right)^{-t}$ to get the present discounted value (PDV) of expected indirect utility for individual *i*. The individual is assumed to choose program A over N if his or her discounted expected utility is greater under A:

$$PDV\left(\Pi_i^{AS} V_i^{AS} + \left(1-\Pi_i^{AS}\right) V_i^{AH}\right) - PDV\left(\Pi_i^{NS} V_i^{NS} + \left(1-\Pi_i^{NS}\right) V_i^{NH}\right) > 0 \qquad (2)$$

The present discounted number of years making up the remainder of the individual's nominal life expectancy, T_i, is given by $pdvc_i^A = \sum_{t=1}^{T_i} \delta^t$. Discounted time periods spent in the pre-illness state, the recovered/remission state, and as lost life-years from $t=1$ to $t=T_i$ are given by:

$$pdve_i^A = \sum \delta^t 1\left(pre_{it}^A\right), \;\; pdvi_i^A = \sum \delta^t 1\left(ill_{it}^A\right),$$

$$pdvr_i^A = \sum \delta^t 1\left(rcv_{it}^A\right), \text{ and } \; pdvl_i^A = \sum \delta^t 1\left(lyl_{it}^A\right).$$

Since the different health states exhaust the individual's nominal life expectancy, $pdve_i^A + pdvi_i^A + pdvr_i^A + pdvl_i^A = pdvc_i^A$. Finally, to accommodate the assumption that each individual expects to pay program costs only during the pre-illness or recovered post-illness periods, $pdvp_i^A = pdve_i^A + pdvr_i^A$ is defined as the present discounted time over which payments must be made.

To further simplify notation, let:

$$cterm_i^A = \left(1-\Pi_i^{AS}\right) pdvc_i^A + \Pi_i^{AS}\, pdvp_i^A$$

$$yterm_i^A = \left[\, pdvc_i^A - \left(\Pi_i^{AS}\, pdvi_i^A + \Pi_i^{NS}\, pdvl_i^A\right)\right], \text{ and}$$

$$pterm_i^A = \Pi_i^{AS}\left[\alpha_1 pdvi_i^A + \alpha_2 pdvr_i^A + \alpha_3 pdvl_i^A\right].$$

The complexity of $cterm_i^A$ and $yterm_i^A$ merely reflect the fact that net income over the future will depend on whether the individual will be sick or dead, with probabilities depending upon the chance of getting sick, with and without the testing program.

Then the expected utility-difference that drives the individual's choice between program A and N can then be defined as follows:

$$\Delta PDV\left(E_{S,H}\left[V_i\right]\right)=\left\{f\left(Y_i-c_i^A\right)cterm_i^A-f(Y_i)yterm_i^A\right\}+pterm_i^A+\varepsilon_i^A \tag{3}$$

The option price, in the sense of Graham (1981), is the common maximum certain payment that makes an individual indifferent between paying for the program and having the risk reduction, or not paying for the program and not having the risk reduction. Here, we solve for the common payment which makes the difference in discounted expected utility between program A and N equal to zero:

$$\hat{c}_i^A=Y_i-\left(\frac{\beta\sqrt{Y_i}\,yterm_i^A-pterm_i^A-\varepsilon_i^A}{\beta cterm_i^A}\right)^2 \tag{4}$$

where $f(Y)=\beta\sqrt{Y_i}$ has been selected as the best-fitting simple functional form.[12] The square root form introduces some curvature with respect to net income, yet preserves the monotonic form. The expected present value of this common certain payment can then be calculated for the individual's remaining lifetime and can be written as:

$$E_{S,H}\left[PV\left(\hat{c}_i^A\right)\right]=cterm_i^A\left[\hat{c}_i^A\right] \tag{5}$$

We can divide $E_{S,H}\left[PV\left(\hat{c}_i^A\right)\right]$ by the size of the risk reduction, $\left|\Delta\Pi_i^A\right|$ to get a construct we can call the Value of a Statistical Illness Profile (*VSIP*):

$$VSIP=E_{S,H}\left[PV\left(\hat{c}_i^A\right)\right]\Big/\left|\Delta\Pi_i^A\right| \tag{6}$$

This *VSIP* is a roughly a generalization of the more-familiar *VSL*. The *VSIP* is a marginal rate of substitution (the ratio of the marginal utility of the sequence of health states to the marginal utility of income) scaled arbitrarily to correspond, like a VSL, to a risk change of 1.0. Due to the

[12] Suggested by a line-search across Box-Cox transformation parameters.

reaction to this metric (as seen with Seth Bornstein's AP article), we might alternatively normalize upon an equally arbitrary 1/1,000,000 risk reduction, which is expressed as the value an individual's WTP for a risk reduction that is more in the range of many policies. This normalization might spare uninitiated readers from the idea that economists are unilaterally deciding upon the worth of a human being.

The marginal utility of an adverse illness profile is in the numerator of the *VSIP*, so an increase in the marginal disutility of any component of an illness/injury profile of health states—illness years, recovered/remission years, and lost life-years—will increase the *VSIP*. Since the marginal utility of income is in the denominator, an increase in the marginal utility of income will decrease the *VSIP*.

To illustrate the implications of our fitted model for willingness to pay for health risk reductions, it is necessary to choose a particular individual and a particular illness profile. In this paper, we will focus on the illness profile that is assumed in most wage-risk *VSL* studies—sudden death in the current period. However, the VSIP framework allows one to simulate willingness to pay to reduce the risk of a vast array of different illness profiles: with or without latency, with different lengths of illness, with or without recovery, and with or without any decrease in life expectancy.

To build a distribution of WTP values for a particular type of environmental risk for a particular population, broader simulations would be used. It would be necessary to specify the distribution of illness profiles that is likely to result from the health threat, the magnitudes of the risk reductions, and the types of individuals (ages, genders, incomes) who would be affected by these risk reductions. WTP estimates could then be simulated for each of a large number of random draws from the distributions of risks (possible illness profiles) and affected individuals to produce a distribution of WTP estimates for the policy in question. In this paper, however, we will simply illustrate the disparities in predicted willingness to pay for a standardized illness profile, emphasizing the interpersonal and international differences in WTP for this standard profile.

V: Empirical Analysis

In Table 3, we begin with a simple four-parameter model (Model 1) which allows for differences between US and Canadian preferences by interacting each baseline variable with an indicator for the Canadian subsample. Rather than simply maintaining the hypothesis that marginal utilities from each health state are independent of the duration of that state and the accompanying durations of other health states that characterize each profile in question, a shifted log functional form allows for diminishing marginal (dis)utilities for increased lengths of time in each adverse health state (Cameron and DeShazo, 2007). This basic model, therefore, includes a net income term (net of program cost, if risk reduction program is selected) along with terms for illness years, $\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)$, recovered/remission years, $\Delta\Pi_i^{AS}\log\left(pdvr_i^A+1\right)$, and lost life-years $\Delta\Pi_i^{AS}\log\left(pdvl_i^A+1\right)$.

The results for Model 1 suggest a higher marginal utility of income and considerably less disutility from lost life years for Canadians. As expected, for individuals from both countries, the marginal utility of net income (i.e. other consumption) is positive (but diminishing, given the square root functional form). The marginal utilities associated with each of the three health states are negative (and diminishing, given the log functional form).[13]

Model 2 in Table 3 presents the results of a utility specification with ten parameters which allows for systematic variation by age in the marginal (dis)utility from lost-life years. We adopt the model specified in Cameron and DeShazo (2006), which is the parsimonious version including just the statistically significant terms in a fully translog model (including all squares and pairwise interaction terms for the three log terms). The construct called $pterm_i^A$ becomes:

$$\Delta\Pi_i^{AS}\begin{bmatrix}\alpha_1\log\left(pdvi_i^A+1\right)+\alpha_2\log\left(pdvr_i^A+1\right)+\alpha_3\log\left(pdvl_i^A+1\right)\\ +\alpha_4\left\{\log\left(pdvl_i^A+1\right)\right\}^2+\alpha_5\left\{\log\left(pdvi_i^A+1\right)\log\left(pdvl_i^A+1\right)\right\}\end{bmatrix} \tag{7}$$

[13] We initially considered use of a quadratic-in-income model specification in conjunction with the shifted-log functional form for health states. Parameter estimates from the quadratic-in-income model are consistent with all expectations: positive and decreasing marginal utilities of income, which are positive over the range of incomes included in the sample. However, moving to a square root functional form for preferences over income had two advantages: 1) it improves tractability of the model results (especially when all covariates are included), and 2) produced superior log-likelihood statistics. We therefore retain this restriction throughout the analysis.

To accommodate age, the α coefficients are allowed to differ systematically with the respondent's current age wherever this generalization is warranted by the data. This leads to a model where $\alpha_3 = \alpha_{30} + \alpha_{31} age_i + \alpha_{31} age_i^2$, and analogously for α_4 and α_5.[14]

Inclusion of age heterogeneity and more flexible functional form assumptions certainly improves the explanatory power of our model. However, many of the apparent differences between the Canadian and US parameters disappear in Model 2. A number of important attitudinal differences remain unexplained in this model. Canadian and US individuals have very different age profiles for exercise and smoking behaviors, as well as in perceived opportunities to see a doctor (among the other attitudinal variables discussed previously). These differences in the two samples could obscure genuine differences in preferences for people who might otherwise seem very similar. Since the Canadian and US samples differ along a number of demographics (such as marital status, education, and gender), it is reasonable to assume that controlling for these differences matters.

Finally, as addressed in Cameron et al. (2007), our survey was designed carefully to illicit preferences over the stated health scenarios through tutorials and explicit statements. However, the potential for respondents to subjectively adjust the choice scenarios to more closely reflect their own situation was assessed through follow-up questions. A share of our sample either over- or under-estimates the illness latency, and/or reports a different estimate of their own life expectancy than was specified in their (age- and gender-indexed) copy of the survey. If these extra-scenario beliefs factor into the respondent's selection of a most-preferred alternative, then the effect of these scenario adjustments could yield biases in the most important parameter estimates. Our final model therefore includes a number of nuisance variables to control for possible "scenario adjustment" by respondents.

[14] Inclusion of the squared lost life-years term allows for the marginal utility of the lost life-years term to depend on the point of reference for lost life-years. This model also allows the marginal disutility from a discounted lost life-year to depend upon the number of preceding sick-years. Heterogeneity in preferences over health risk reductions has documented both an increasing and a decreasing willingness to pay for lost life years with age. ((Alberini, Cropper et al. 2004); (Cameron and DeShazo 2006)). Initially, willingness to pay seems to increase with age (perhaps as the prospects for illness or death become more salient). Beyond a certain age, however, it declines (as experience with the aging process lends recognition that life years at older ages are somehow diminished in value through reduced mobility, aches and pains, loss of self-sufficiency, loss of loved ones and family, etc.). And inclusion of an interaction term with the number of years spent sick and the number of life years lost allows for the plausible effect that, the greater the number of years spent ill, the less value attached to lost life years. There may be fates worse than death.

First, following each choice task, respondents were asked about their personal expected latency for each of the health threats in question. If the respondent expected never to benefit from a program, or expected the latency of the illness to be longer or shorter than what was described in the illness profile, we used this information to construct shift variables to accommodate over- or under-estimation of the latency. Second, at the end of the survey, we questioned respondents directly about their individual subjective life expectancy. If this life expectancy differed from the nominal life expectancy in the choice scenarios, this discrepancy was similarly allowed to shift the utility parameters in the model.

Full-fledged selectivity correction models in multiple-choice conditional logit models are challenging, so we do not attempt them here. Moreover, nonresponse modeling data are not available for the Canadian sample. Here, we do have the data needed to estimate a response/nonresponse model that produces fitted response probabilities for each individual in the US sample. For each US respondent, we use the deviation of this fitted response propensity from the median response propensity among all 500,000-plus members of Knowledge Network, Inc.'s initial random-digit-dialed recruiting sample. For Canadian respondents, the variable takes on a value of zero, such that no "correction" is made for deviation between predicted response propensity and average response propensity.[15]

Under ideal circumstances, every respondent would reveal subjective latencies that match the ones used in the choice scenarios. They would each have a subjective life expectancy that matched the nominal life expectancy for someone their age and gender that was used in their copy of the survey instrument. Finally, all members of the recruitment pool would have equal propensities to show up in the estimating sample. Under these conditions, all of our nuisance variables (expressed as deviations from their intended values) would be zero, so we use zero values for these variables in our simulations.

Model 3 in Table 3 presents a parsimonious specification of the expanded ten parameter model when additional covariates are interacted with income and illness-state variables, and scenario adjustment and sample selection controls are included, in addition to selected significant interaction terms involving the Canadian-sample indicator variable. The results clearly show that differences between Canadians and US individuals are apparent across illness state profiles.

[15] While Canadian response/nonresponse propensities are left uncorrected, we note that our models control for all the observables upon which the Canada and US samples differ in terms of the marginal distributions, and this strategy will minimize the impact of selection bias on the basic coefficients.

Perceived risk of disease affects the marginal utility of income differently for Canadians and US individuals. While high perceived risk results in a lower marginal utility of income for all respondents (and hence higher marginal rate of substitution between income and illness states), low perceived risk results in a higher marginal utility of income for Canadians (and therefore a lower marginal rate of substitution between income and illness states).[16]

Individuals from both countries who are highly confident in the diagnosis and treatment efficacy of their respective health care system have a higher marginal utility of income and lower marginal rate of substitution, while Canadians who are less confident in care efficacy have a higher marginal utility of income, and lower marginal rate of substitution. This effect was only for those reporting a low (-1) but not the lowest (-2) level of confidence. Therefore, Canadians who rank their health care system below average, but have at least some confidence in the health care system seem to have different health-income preferences than individuals from the US.

Canadians in general value avoided sickness years more than individuals from the US. For both countries, however, subjectively reported risk of disease had a positive effect on the marginal disutility of illness years (low risk has a positive effect on the marginal utility of illness years, and high risk has a negative effect, whilst illness is provides negative utility). Females for both countries have lower aversion to sick years, while those who have significant opportunity to exercise more also fear illness more. However, for Canadians, smoking has a strong effect on the marginal disutility of becoming sick. Non-smokers, or those who have very little opportunity to reduce smoking, have substantially smaller disutilities associated with sick years.

For both countries, males tend to place little marginal value to reducing the number of recovered/remission years, while women from both countries (and the US in particular) are willing to pay to avoid recovered/remission years. This provides an interesting contrast: for women, the morbidity still present in the recovered/remission state seems to matter, whereas men appear to perceive recovered/remission years as fully recovered and providing a level of utility equivalent to their pre-illness state. Men appear to attach value only to avoided illness-years and avoided lost life-years.

Results for preferences over lost life years are particularly interesting (and comprise the most significant part of overall willingness to pay for health risk reductions). In general, age

[16] Van Houtven et al. (2008) offer a recent national survey that distinguishes between accident-related deaths and cancer deaths, noting the presence of a cancer premium. Different types of health threats may be more or less salient to different respondents.

effects are substantially smaller for Canadians, and relatively pronounced for US individuals. Age affects both the baseline marginal utility of lost life years (the log-term) as well as the degree of diminishing marginal utility over the number of lost life years *across* the number of life years lost. Put simply, older individuals seem to value lost life years less, with the value of any individual lost life year decreasing more with the number of years lost overall. However, this age effect is almost (though not completely) offset by the opposite sign for Canadians, suggesting that at least for our sample, Canadians exhibit smaller age effects.

Having a college degree increases the marginal value attached to lost life years, while being non-married reduces it; however, this effect is present only for US respondents, with the point estimates on the Canadian interaction terms almost exactly offsetting the effect. For Canadians, having had experience with going outside of the provincial health plan for diagnostic testing has a weakly significant and positive effect on the disutility of dying early. Having confidence in the timeliness and quality of diagnosis and has a positive effect on the value attached to avoiding early death for US individuals, but it appears to reduce the value from avoided premature death for Canadians. For residents of both countries, a lack of confidence in the health care system seems to reduce the marginal value attached to reductions in lost life years. For the US, greater confidence in the timeliness and quality of care may translate into higher willingness to pay for avoided lost life-years, but the effect is not statistically significant. For Canadians, however, greater confidence in timely and high-quality care seems to reduce the marginal value attached to avoiding early death. And finally, for both countries, subjective perception of being at low risk for the disease considered in the choice set tends to lower the value attached to lost life year risk reduction, while perception of being at high risk increases it.

Canadians and US individuals exhibit strikingly different coefficients on the interaction term between illness-years and lost life-years. While US individuals derive greater disutility from lost life-years after a longer period of illness, the opposite effect seems to be present in Canada. For Canadians, the disutility from lost life-years is reduced as the number of preceding illness-years increases. Thus, in Canada, it may be the case that a long period of illness may evolve into a "fate worse than death."

Model 3 illustrates the importance of including a rich set of attitudinal, demographic and survey design controls in modeling differences in preferences. Failure to control for individual heterogeneity, in the presence of different types of respondents in the two countries, can easily bias the coefficients on the interaction terms involving the indicator for the Canadian subsample and imply that residence in the Canadian jurisdiction, per se, somehow accounts for different preferences.

VI: Simulation Results

Based upon our preferred specification (Model 3), we simulate WTP for 1/1,000,000 risk reduction of sudden death for Canadian and US individuals, males and females, individuals with and without a college education, and those who are married or not married. Additionally, for Canadian males, we simulate WTP for those with and without experience with out-of-plan diagnostic testing procedures.

Our simulations are benchmarked for average sample income in the US (roughly $42,000 US). We assume a discount rate of 5%, and we focus on the illness profile consisting of sudden death in the current period (i.e. death with no latency and no prior illness) so that our model's predictions can be compared to standard VSL estimates. Fitted WTP based on Model 3 is calculated with subjective and attitudinal variables simulated at their median values. These subjective and attitudinal variables include perceived risk of the illness or injury in question for the corresponding program, opportunity to increase exercise, reduce smoking, and see a doctor more regularly, and confidence in diagnosis and treatment under Canadian or US health systems.

For each type of simulation, we vary age in five year increments from 25 to 80 years to permit us to graph the implied age profile. In each case, we make 1000 random draws from the asymptotically joint normal distribution of the maximum likelihood parameter estimates. This variability in parameter values, in combination with specified values for each of the explanatory variables which appear in the model, allow us to generate a distribution for WTP that reflects the degree of precision in the estimated parameters.

Appendices II through V present graphical depictions of our simulation results across age groups—broken out by gender, educational attainment, marital status, and out-of-plan experience. Individual figures show either (a.) the median (solid line) and 5^{th} and 95^{th} percentiles (dashed lines) for 1000 draws from the estimated joint distribution of parameters calculated at each five-year age level between 25 and 80 years, or (b.) just the median simulated value, for each of several different types of individuals, to compare age profiles for WTP across groups.

The age profile of WTP for sudden death is remarkably different. Canadians, regardless of gender, education, or marital status, have a substantially flatter age profile of WTP to reduce risk of early death, with peak WTP realized at a substantially older age (60 for Canadians compared to 35-40 for individuals from the US). In general Canadians are WTP slightly more at older ages, but individuals from the US are WTP substantially more at younger ages. Across the 1000 sets of parameter draws, peak median WTP for Canadians males is $9.17 annually (age 60), compared to $10.68 for males from the US (age 35).[17] Females have substantially lower WTP for risk reduction of sudden death regardless of country of residence: a peak median WTP of $5.79 for US females (age 35), and $3.17 for Canadian females.

While males, and individuals from the US, are willing to pay more for health risk reduction programs, college education and marital status goes a long way to explain the US/Canadian gap. Those who are married and have a college degree reveal substantially higher WTP in the US, but not in Canada. Peak median WTP for college-educated males in the US is $13.59 (age 35), and for unmarried males in the US it is only $7.62 (age 35). By contrast, peak median WTP for males in Canada is $8.55 (age 55) for those with a college degree, and to $8.99 (age 55) for those who are unmarried.

Perhaps most striking result, however, is that the difference between Canadian and US male WTP values is almost entirely explained by Canadian experience with out-of-plan medical diagnostic tests. Peak median WTP for Canadians with out-of-plan experience jumps to $11.89 (age 60), with a fairly wide confidence band, and is well within the 90% interval for US males.

VII: Conclusions

We have augmented an existing analysis of roughly 1800 US survey respondents with an independent sample of roughly 1000 Canadian respondents to an analogous survey. Our goal has been to assess the extent to which preferences for measures to reduce risks to life and health might differ across the two countries. The sampling properties of the internet consumer panel used for the Canadian survey (Ipsos Reid) is of somewhat lesser quality than the consumer panel for the US survey (Knowledge Networks), but both samples exhibit distributions of age, gender,

[17] Aldy and Viscusi (2008) determine from age-specific hedonic wage equations that workers' VSLs rise from about $3.7 million between ages 18-24 to about $9.7 million in the 35-44 age bracket, then decline to about $3.4 million in the 55-62 year old bracket. The question of age profiles of WTP to reduce mortality risks is also addressed in Krupnick (2007) and Aldy and Viscusi (2007).

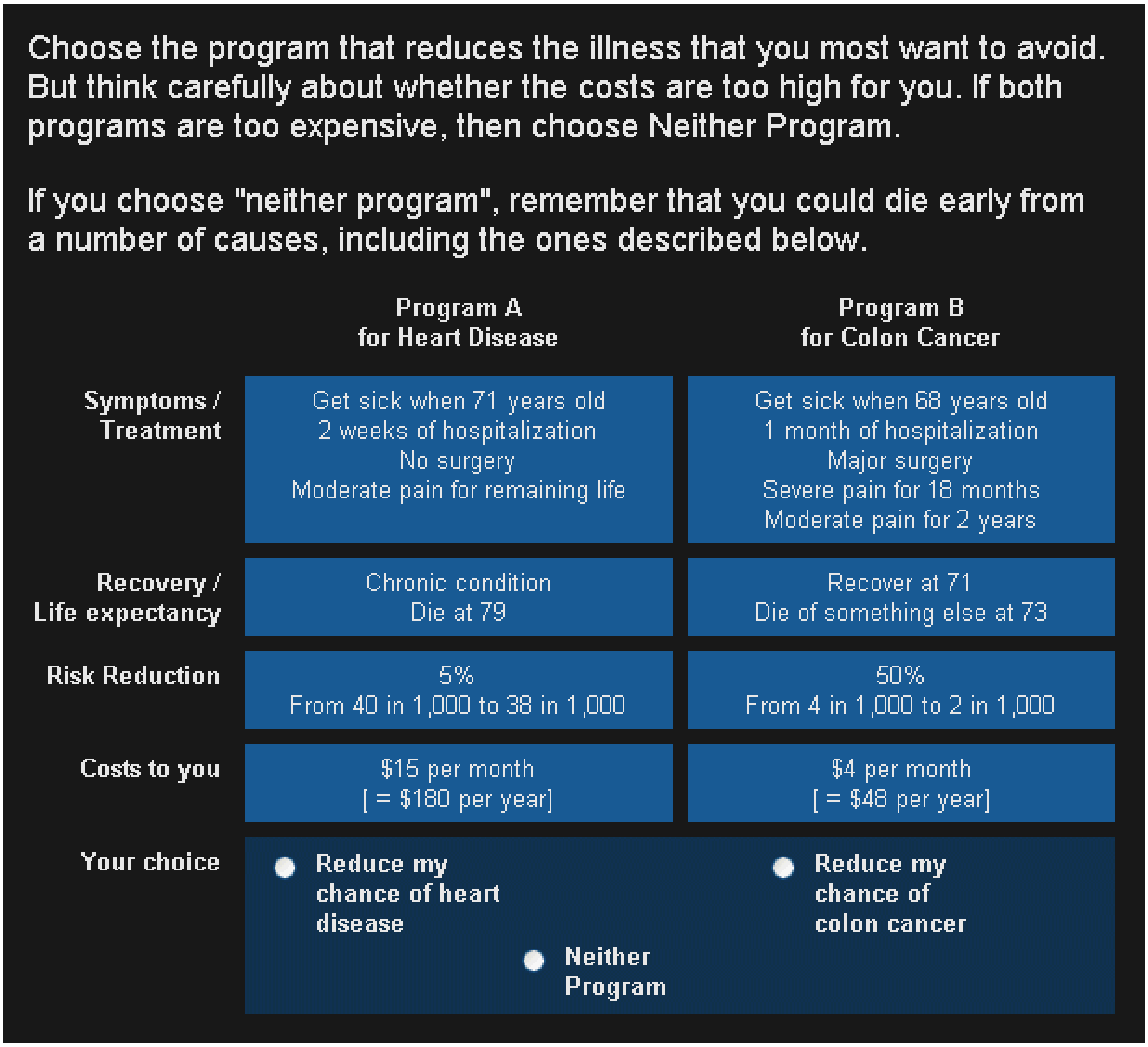
race, marital status, education and income that roughly match the population distributions in each country. Differences may exist in terms of how computer-savvy the respondents may be, especially among the older age groups. This stems from the fact that Knowledge Networks recruits panelists using random digit dialed telephone calls and equips non-internet-ready households with WebTV equipment to permit them to answer surveys, whereas the Ipsos Reid sample is recruited primarily via the internet.

We find significant differences between Canadian and US individuals in the marginal value of risk reduction programs, and these vary systematically with age, gender, education, and marital status. Moreover, differences in attitudinal and subjective health perception variables for the US and Canadian samples account for small to large differences in marginal utilities associated with health risk reduction programs. In particular, the extent to which respondents felt they could get more regular exercise, or visit the doctor more frequently, affects both US and Canadian appetites for additional programs to reduce the risks of different health threats, while being a non-smoker in Canada appears to substantially reduce the marginal value attached to avoiding illness.

The age profile of WTP to reduce the risk of sudden death in the current period (the risk reduction that maps most closely to a conventional VSL measure) is remarkably different across the two countries. Canadians, regardless of gender, education, or marital status, have a substantially flatter age profile of WTP to reduce risk of early death, with peak WTP realized at a substantially older age (60 for Canadians compared to 35-40 for individuals from the US). Important gender differences are also seen for willingness to pay to avoid recovered/remission years: women are willing to pay to avoid additional time in this state, while men are not. Men appear to view the recovered/remission state as equivalent to their current (pre-illness) state. While males and individuals from the US are willing to pay more for health risk reductions, educational attainment and marital status go a long way to explain the US/Canadian gap. Those who are married and have a college degree reveal substantially higher WTP in the US, but this is much less the case in Canada. Perhaps most strikingly, differences between Canadian and US male WTP is almost entirely explained by Canadian experience with out-of-plan diagnostic testing. Canadians who have more experience with US-style health care provision, by going outside their provincial health plan to pay for services, convey preferences with respect to health risk reductions which are more similar to those of US respondents.

This study has shown that failure to control for individual heterogeneity, in the presence of different types of respondents in the two countries, can easily bias the coefficients on the interaction terms involving the indicator for the Canadian subsample and imply that simply residence in Canada somehow accounts for different willingness to pay for health risk reductions. Different patterns in sociodemographic and attitudinal heterogeneity across the two countries account for a good deal of heterogeneity in choice behavior in our experiments, but there remain many dimensions where there are further differences that we can so far attribute only to the difference in jurisdictions. Of course, there may still be other factors which differ across jurisdictions (e.g. other cultural differences) which we have not observed in this study and are therefore unable to use as controls.

Figure 1: One Randomization of a Conjoint Choice Set



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

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

	Program A for Heart Disease	Program B for Colon Cancer
Symptoms / Treatment	Get sick when 71 years old 2 weeks of hospitalization No surgery Moderate pain for remaining life	Get sick when 68 years old 1 month of hospitalization Major surgery Severe pain for 18 months Moderate pain for 2 years
Recovery / Life expectancy	Chronic condition Die at 79	Recover at 71 Die of something else at 73
Risk Reduction	5% From 40 in 1,000 to 38 in 1,000	50% From 4 in 1,000 to 2 in 1,000
Costs to you	$15 per month [= $180 per year]	$4 per month [= $48 per year]
Your choice	Reduce my chance of heart disease	Reduce my chance of colon cancer

Neither Program

Table 1: Demographic Statistics by Population and Sample - Canada and US

	Canada		US	
	Population	Sample	Population	Sample
Age (years)				
25-44	45%	45%	47%	40%
45-64	36	41	34	39
65-74	11	12	10	14
75+	8	2	9	7
Gender				
Male	50	41	49	49
Female	50	59	51	51
Race				
White	87	96	77	80
Nonwhite	13	4	23	20
Marital Status				
Married	48	56	54	69
Non-married	52	44	46	31
Education				
High school or less	56	58	69	70
College Degree +	44	42	31	30
Income (US$1000)				
10-	3	14	10	6
10-25	20	31	19	17
25-45	35	36	24	23
45-65	21	12	21	24
65-100	14	5	14	21
125+	7	2	12	9

Source: Statistics Canada, US Census Bureau, and survey data (after exclusions). Interpolation required for income brackets (equal weight given to $5000 increments). Domestic partners in Canada counted as married.

Table 2: Health Risk & Behavior Beliefs, and Health Care System Controls

	US Sample			Canadian Sample				
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Min	Max
Health (self-reported illness risk)								
average subjective risk	22,283	-0.16	1.03	9,390	-0.05	1.06	-2	2
Behavior (opportunity to improve on:)								
see doctor	22,368	-0.46	1.36	9,486	-0.65	1.27	-2	2
control weight	22,464	0.13	1.41	9,504	0.24	1.37	-2	2
exercise	22,464	0.65	1.15	9,486	0.70	1.11	-2	2
healthy diet	22,467	0.33	1.15	9,447	0.32	1.10	-2	2
seatbelt use	22,410	-1.24	1.30	9,414	-1.66	0.91	-2	2
smoking	21,972	-1.00	1.64	9,264	-0.70	1.80	-2	2
acohol consumption	22,170	-1.24	1.18	9,336	-1.35	1.04	-2	2
System Controls								
confidence	22,560	0.16	0.67	9,519	0.02	0.66	-1	1
out-of-plan (absolute)				9,519	0.89	1.07	0	5
out-of-plan (binary)				9,519	0.16		0	1

Average subjective risk taken as the average of subjectively reported risks for diseases randomly selected in all five choice scenarios. Statistics after exclusion criteria. Out-of-plan variables reflect either the absolute number of times the respondent sought care outside the Canadian universal health plan, or a binary variable for whether or not the patient sought care outside the universal plan.

Table 3: Empirical Results (point estimates and statistical significance only)

	Model 1		Model 2		Model 3	
	US	CDN Δ	US	CDN Δ	US	CDN Δ
Net income term (complex formula)	.01285***	.01258***	.01287***	.01031***	.01429***	-
× 1(female)	-	-	-	-	.01047***	-
× 1(mod low risk of this illness)	-	-	-	-	-	.01572**
× 1(high risk of this illness)	-	-	-	-	-.00761**	
× 1(not confident in health care)	-	-	-	-	-	.0185**
× 1(confident in health care)	-	-	-	-	.004833**	-
Illness Years: $\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)$	-27.13***	-2.493	-47.37***	-23.68	-57.53***	-57.8***
× 1(female)	-	-	-	-	32.87***	-
× 1(low risk of this illness)	-	-	-	-	35.98**	-
× 1(mod low risk of this illness)	-	-	-	-	24.63*	-
× 1(mod high risk of this illness)	-	-	-	-	-14.48	-
× 1(high risk of this illness)	-	-	-	-	-33.71**	-
× 1(mod. high opp. impr exercise)	-	-	-	-	-30.87***	-
× 1(high opp. impr exercise)	-	-	-	-	-41.16***	-
× 1(very low opp. impr smoking)	-	-	-	-	-	43.83***
× 1(mod low opp. impr smoking)	-	-	-	-	-	187.3**
Recovered Years: $\Delta\Pi_i^{AS}\log\left(pdvr_i^A+1\right)$	-22.81**	-7.764	-17.54*	-7.952	-	-
× 1(female)	-	-	-	-	-67.88***	44.76*
Lost Life Years: $\Delta\Pi_i^{AS}\log\left(pdvl_i^A+1\right)$	-29.23***	20.01**	-428.1***	-27.75	-443.5***	-
× age	-	-	12.04*	-5.734	27.48***	-24.77***
× age^2	-	-	-.08826	.1363	-.2769***	.3654***
× 1(female)	-	-	-	-	22.82**	36.44*
× 1(college degree or more)	-	-	-	-	-32.5***	37.11**
× 1(non-married)	-	-	-	-	35.94***	-34.01*
× 1(low risk of this illness)	-	-	-	-	66.8***	-
× 1(mod low risk of this illness)	-	-	-	-	31.08**	-
× 1(mod high risk of this illness)	-	-	-	-	-44.3***	-
× 1(high risk of this illness)	-	-	-	-	-70.09***	-
× 1(not confident in health care)	-	-	-	-	26.03**	-
× 1(confident in health care)	-	-	-	-	-17.74	46.32**
× 1(have gone outside CDN plan)	-	-	-	-	-	-34.57*
× 1(very low opp. impr. doct. visits)	-	-	-	-	-17.22*	-
Squared: $\left[\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\right]^2$	-	-	145.1*	60.41	149.1*	-
× age	-	-	-4.919	.7678	-10.89***	9.454***
× age^2	-	-	.04097	-.04427	.1123***	-.1426***
Interaction: $\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\times\log\left(pdvl_i^A+1\right)$	-	-	31.14***	28.06*	-30.29***	93.07***
Scenario Adjustment Controls	No		No		Yes	
US Sample Selection Controls	Yes		Yes		Yes	
Observations	32079		32079		31836	
Log-Likelihood	-16707		-16644		-15617	

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Appendix I: Attitudinal and Subjective Beliefs by Age (moving average of age-wise medians,5th and 95th percentiles in the raw data)

KEY: solid lines = US sample; dashed lines = Canadian sample

Figure I.1 Subjective risk of Alzheimer's Disease

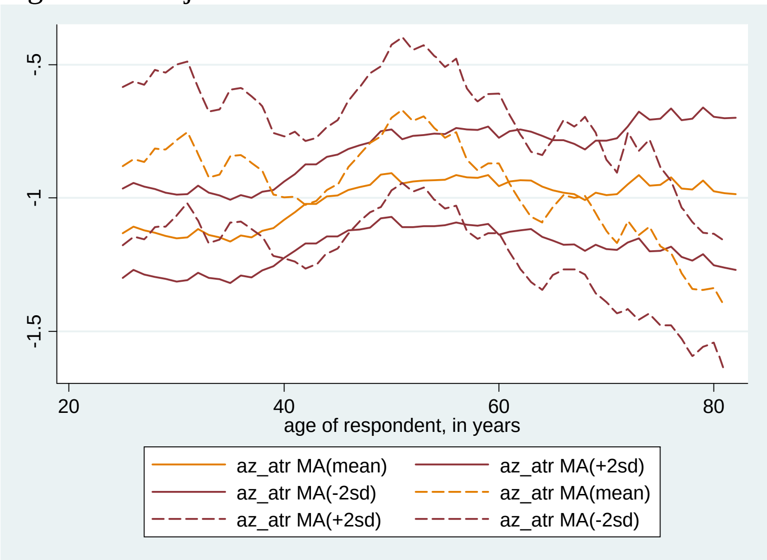


Figure I.2 Subjective risk of Cancer (all cancers grouped)

Figure I.3 Subjective risk of Diabetes

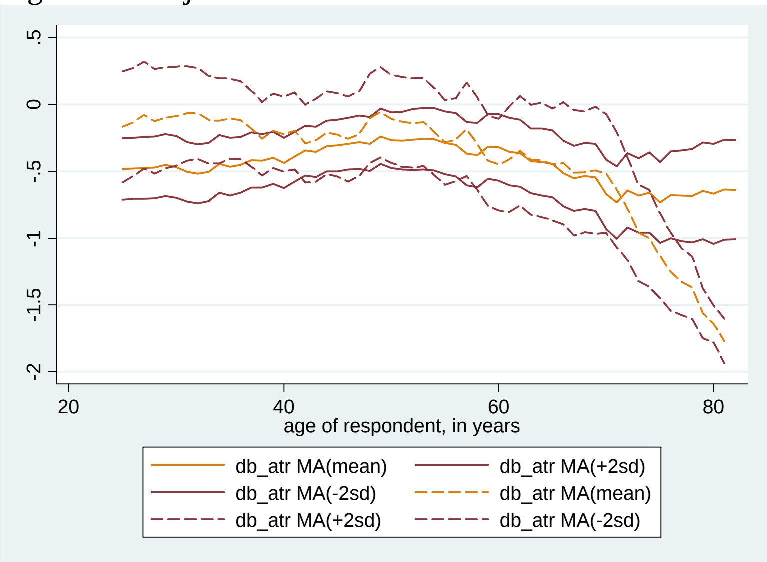


Figure I.4 Subjective risk of Heart Attack/Disease

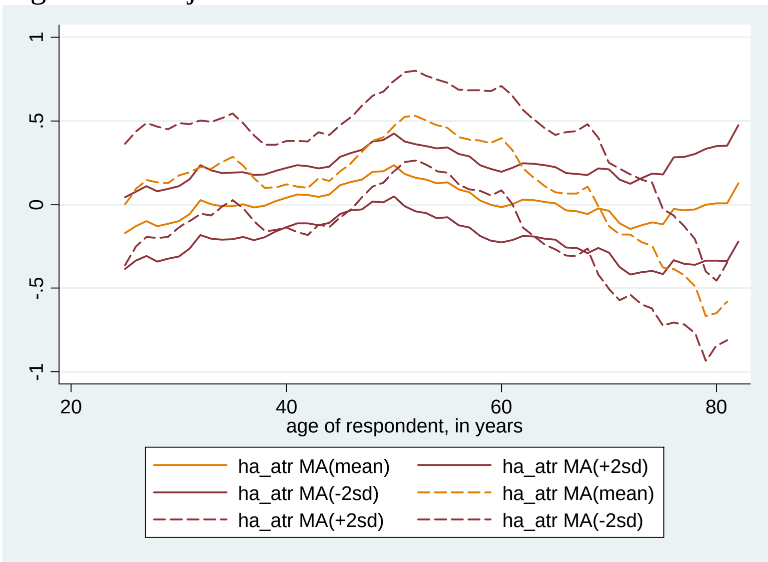


Figure I.5 Subjective risk of Respiratory Disease

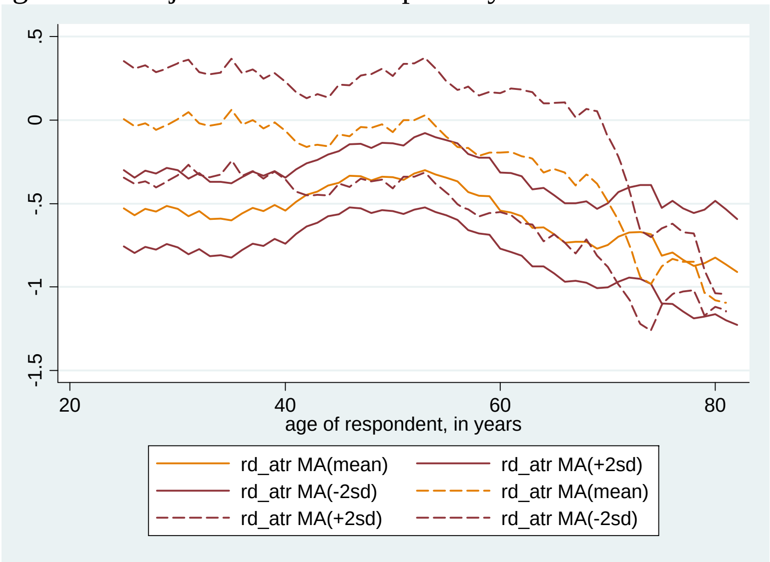


Figure I.6 Subjective risk of Stroke

Figure I.7 Subjective risk of Traffic Accident

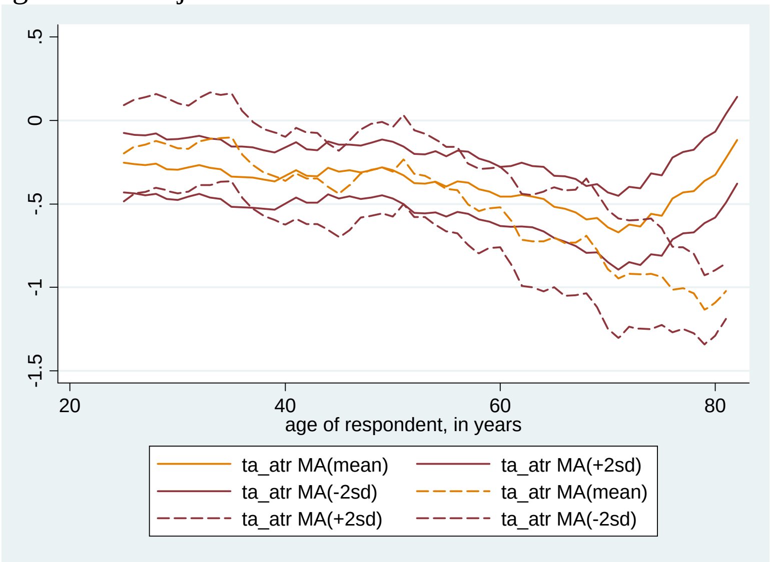


Figure I.8 Room to Improve on Doctor Visits

Figure I.9 Room to Improve on Seat Belt Use

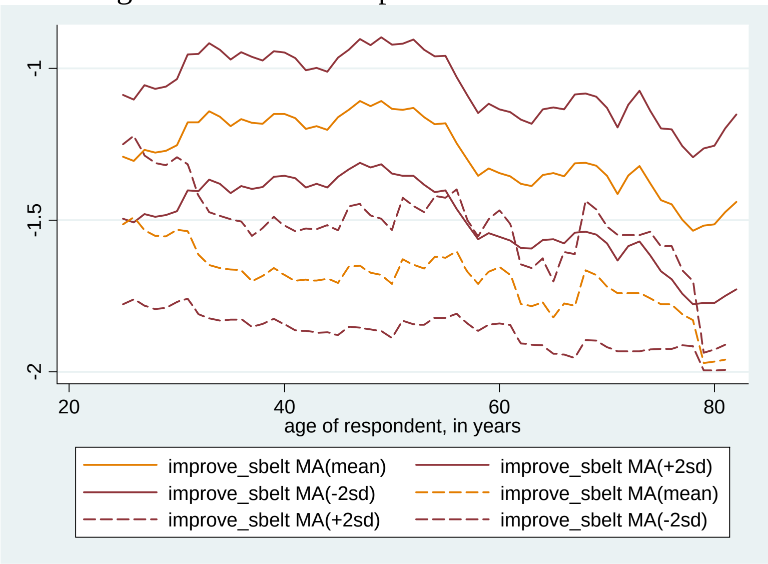


Figure I.10 Room to Improve on Smoking (cut back)

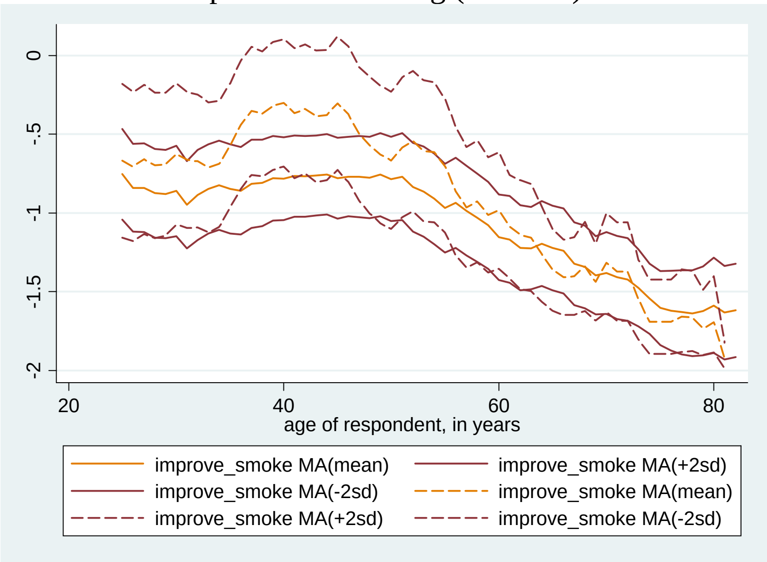


Figure I.11 Room to Improve on Weight (lose weight)

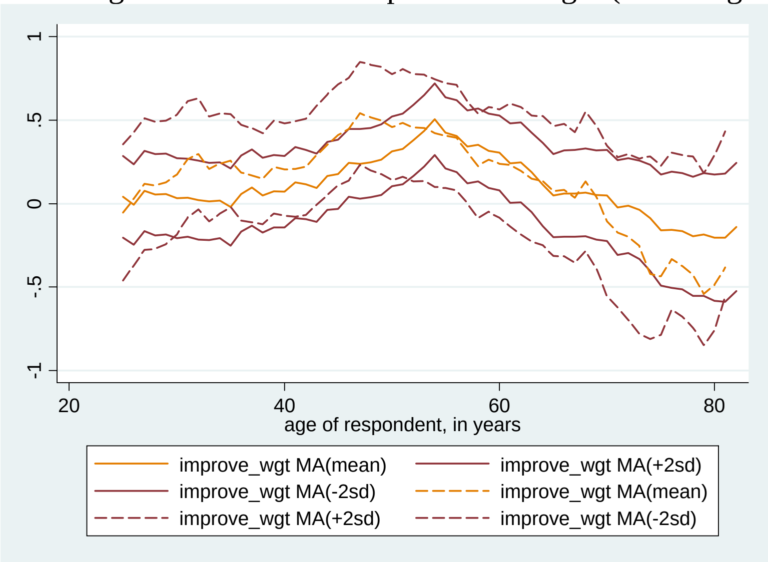


Figure I.12 Room to Improve on Diet (eat healthier)

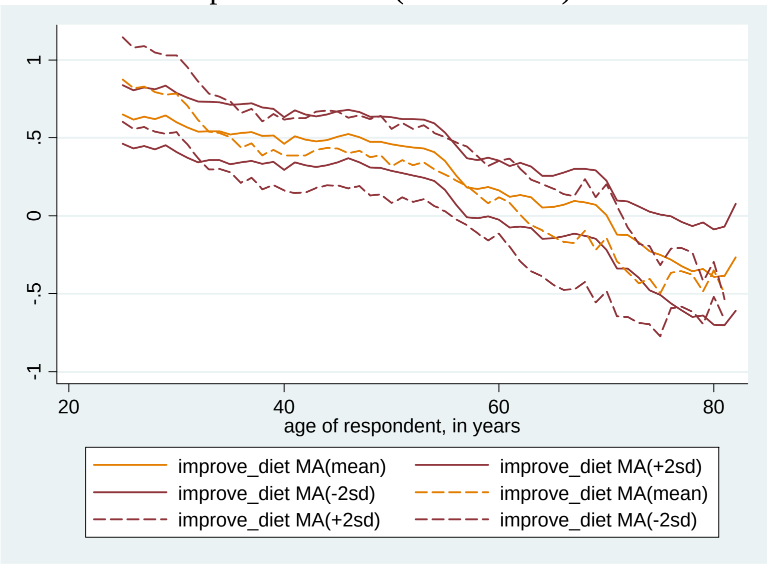


Figure I.13 Room to Improve on Exercise (more)

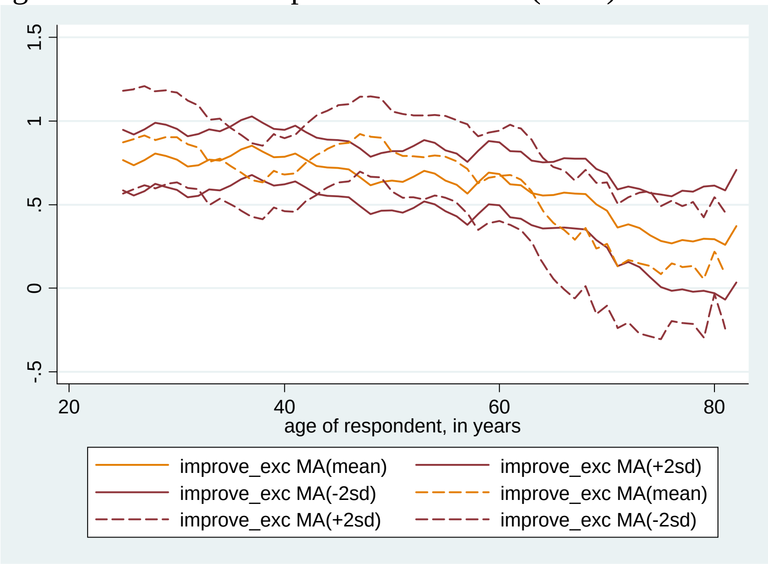


Figure I.14 Room to Improve on Alcohol (drink less)

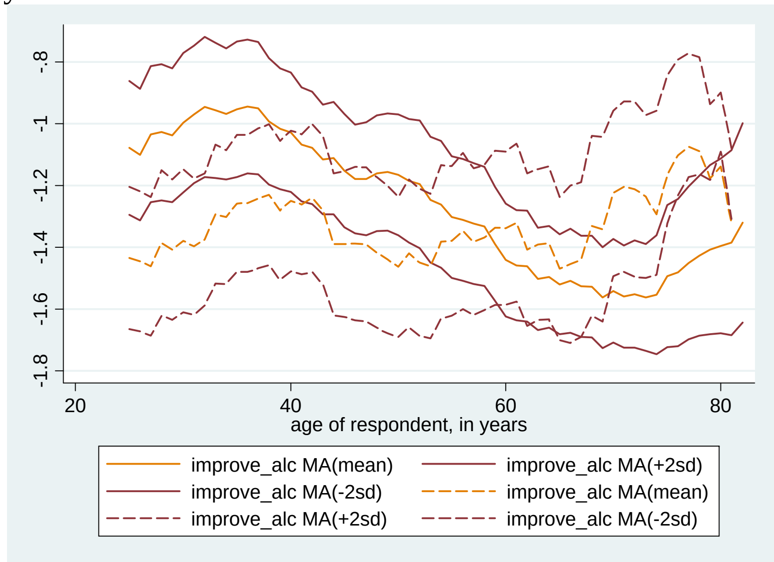
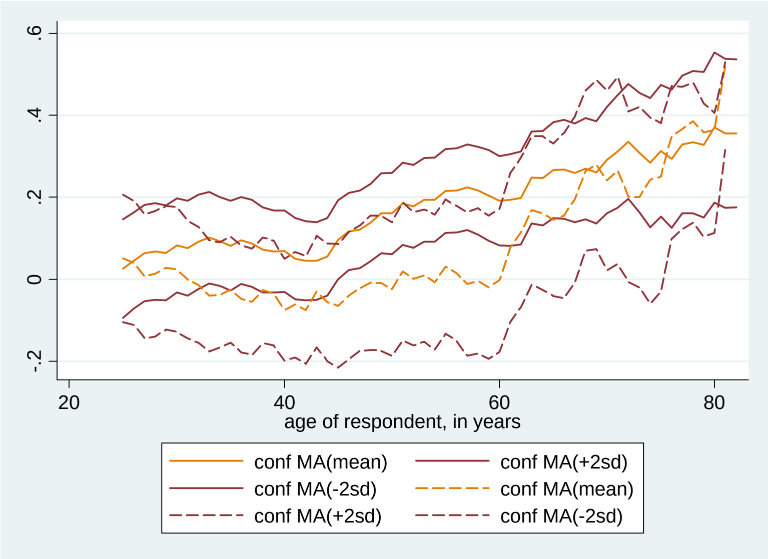


Figure I.15 Confidence in Diagnosis and Treatment Efficacy



Appendix II: Fitted distribution of WTP estimates by <u>gender</u> (median, 5th and 95th percentiles; 1000 random draws of parameters)

Figure II.1

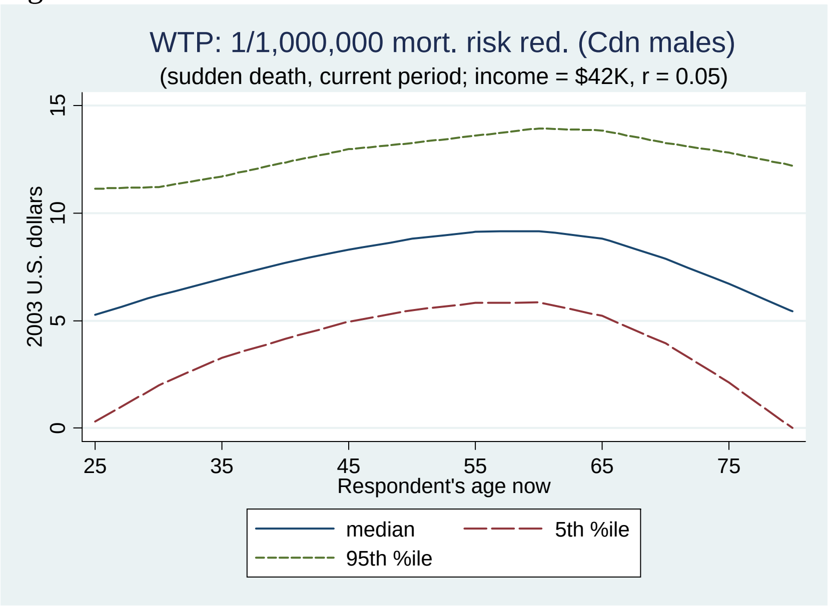


Figure II.2

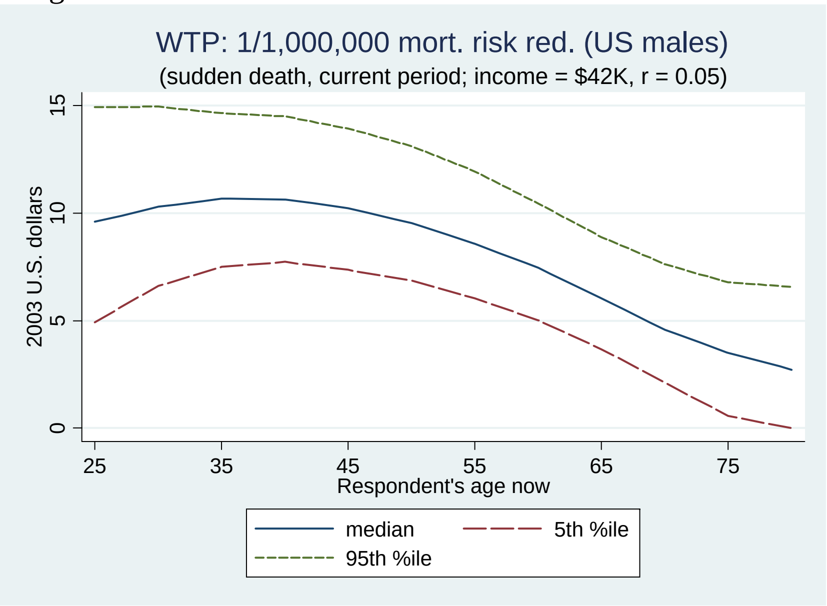


Figure II.3

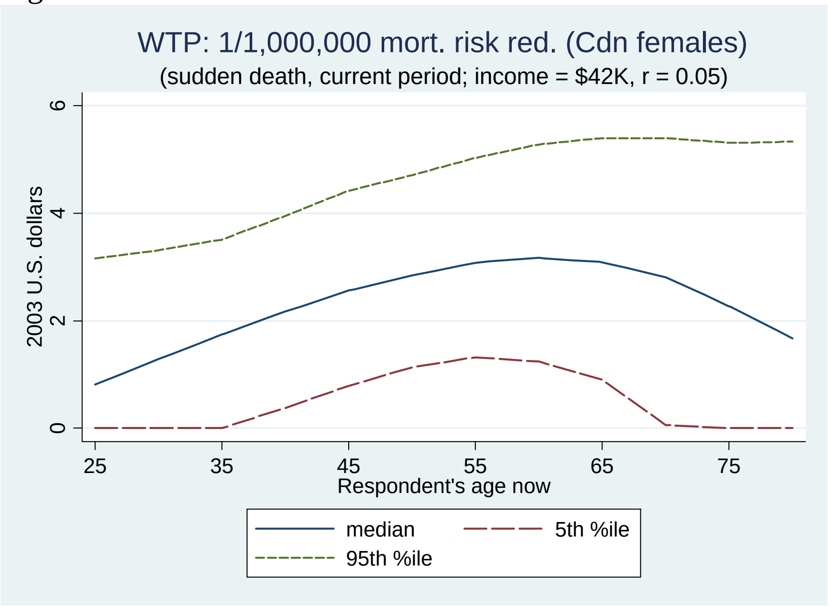


Figure II.5

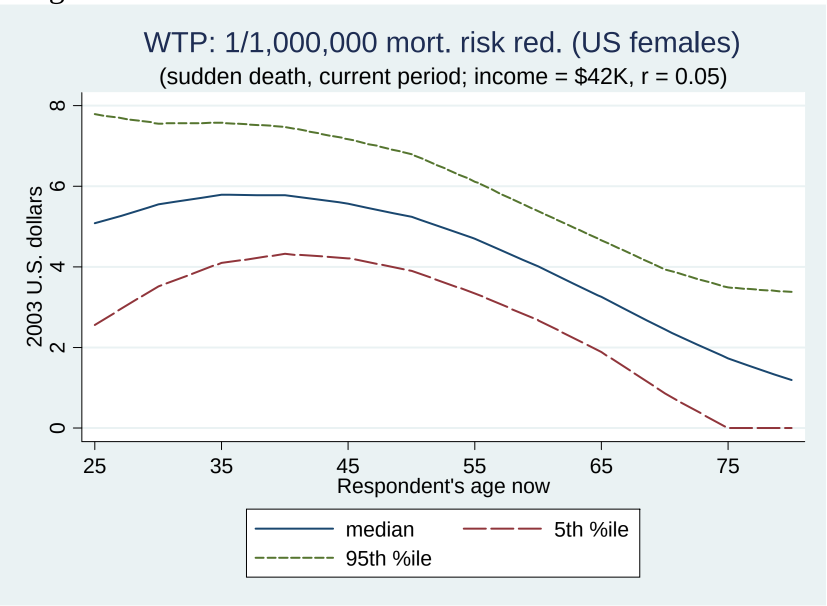


Figure II.5

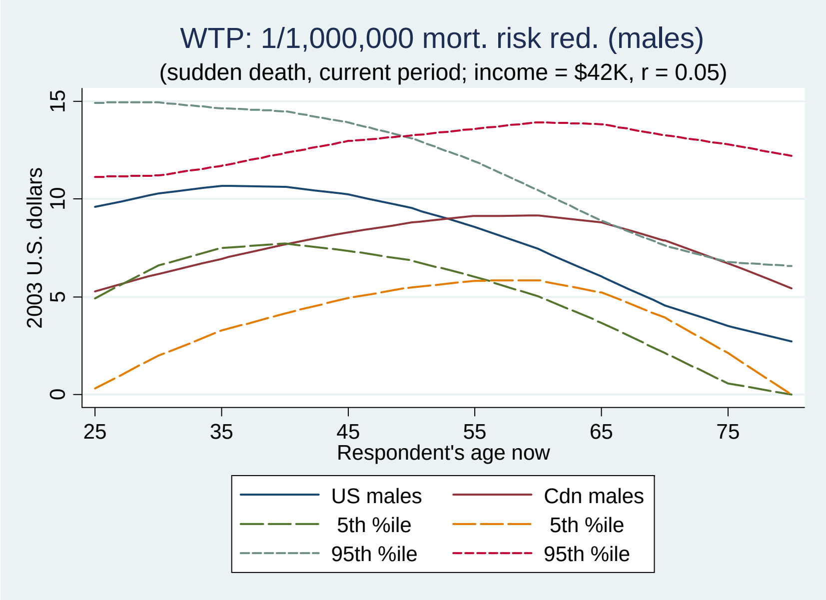


Figure II.6

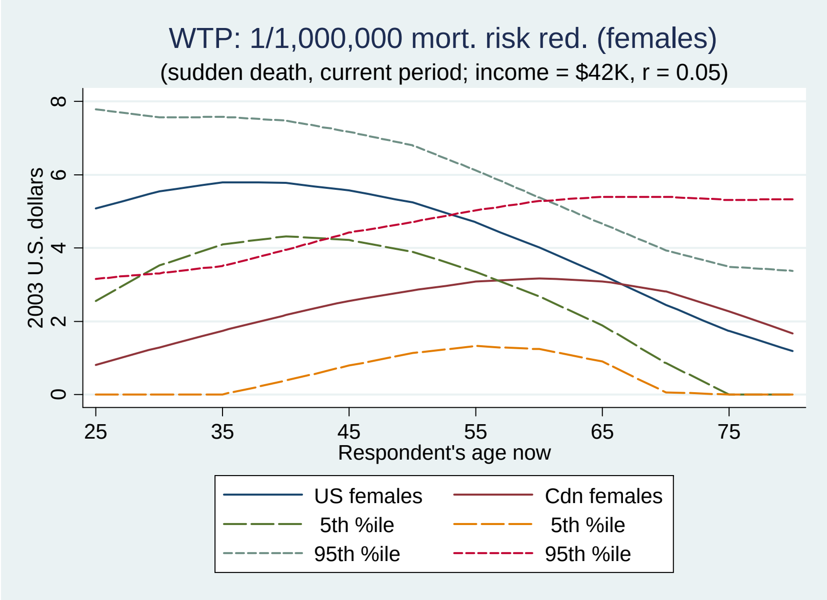
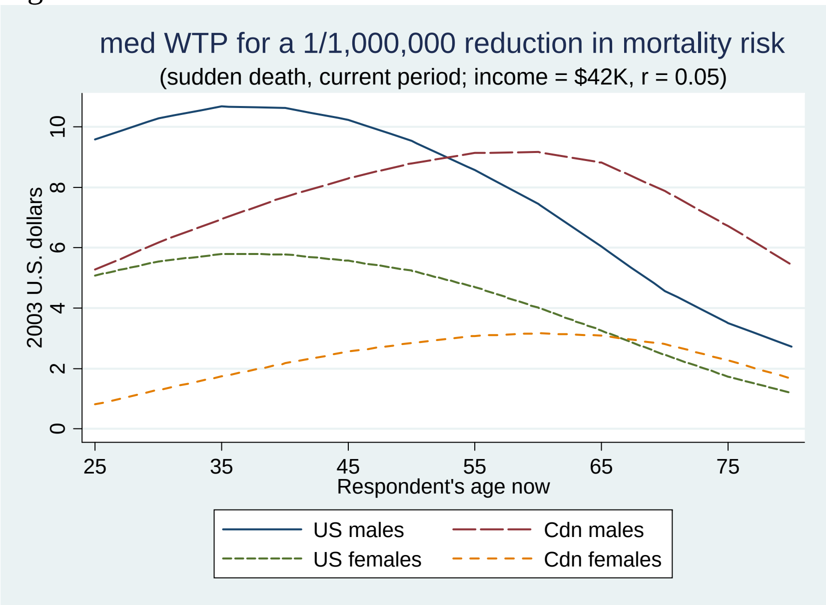


Figure II.7



Appendix III: Fitted distribution of WTP by <u>education</u> (median, 5th and 95th percentiles across 1000 random draws of parameters)

Figure III.1

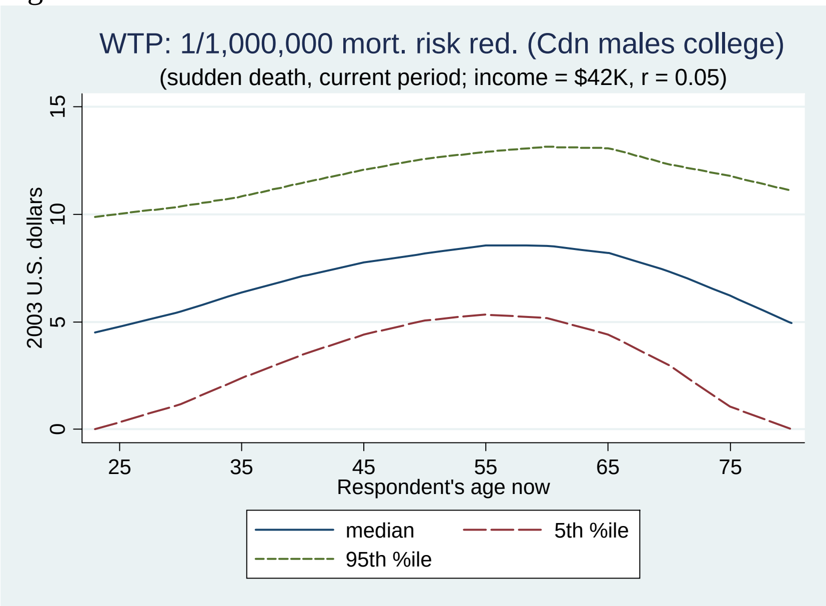


Figure III.2

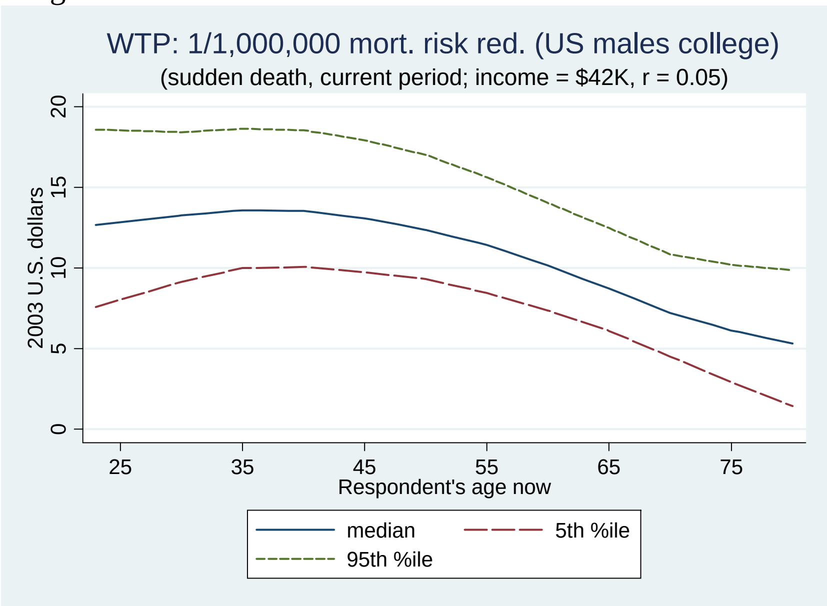


Figure III.3

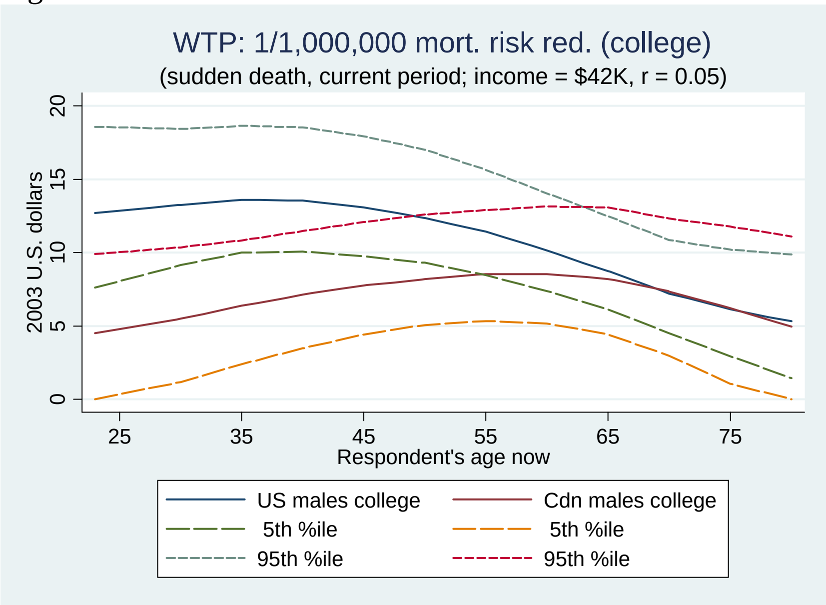


Figure III.4

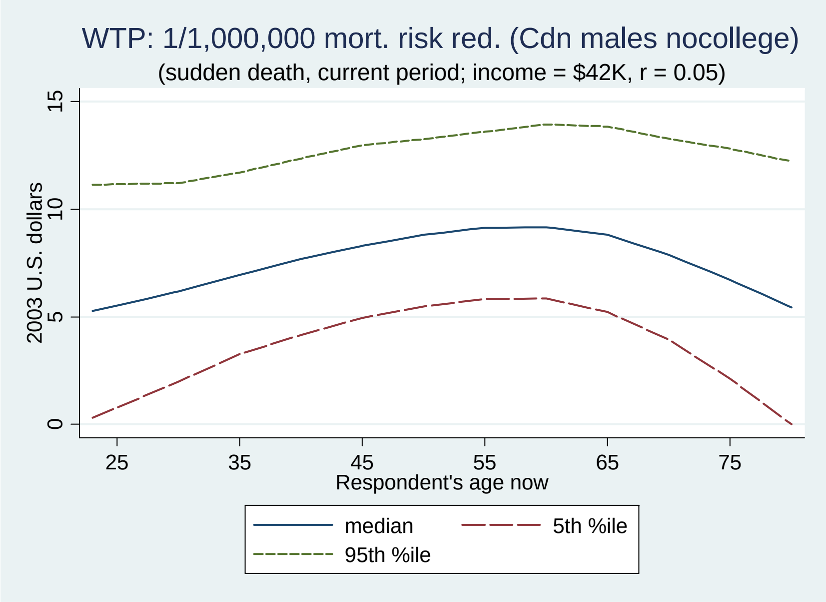


Figure III.5

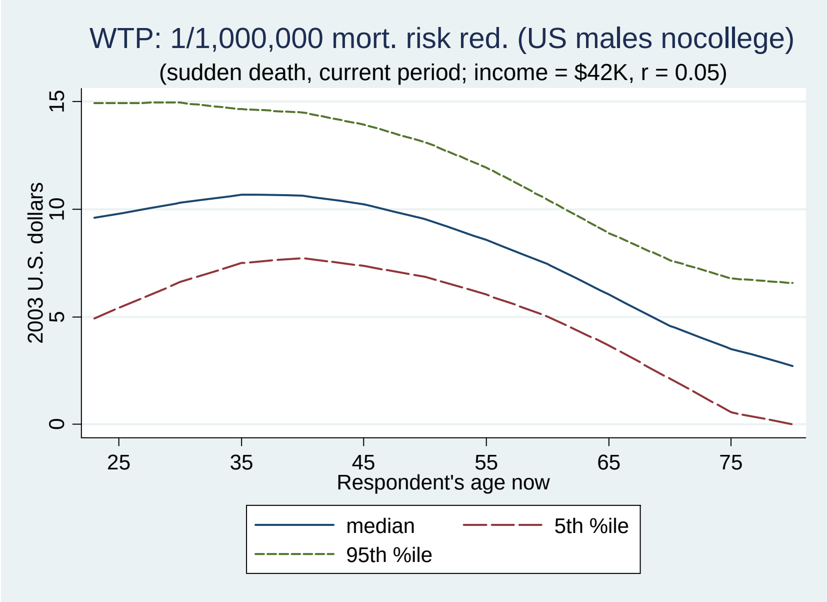


Figure III.6

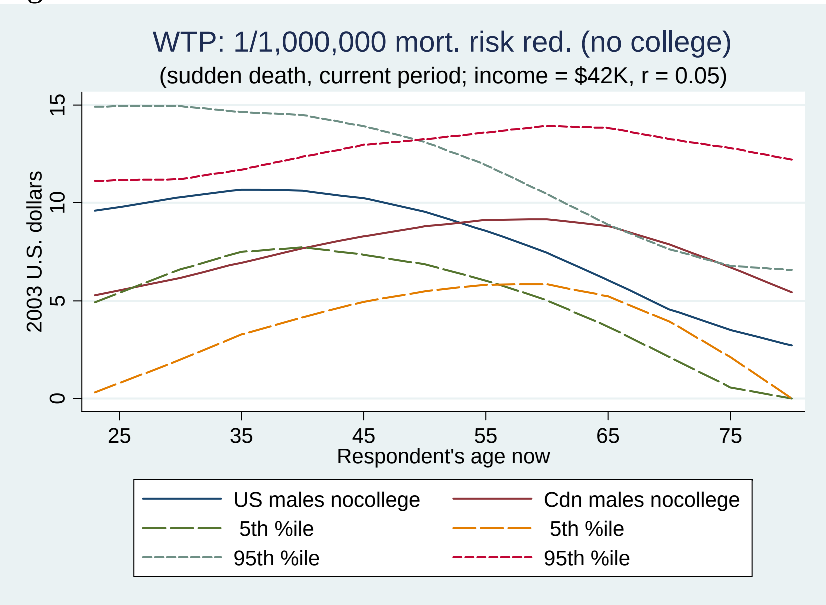


Figure III.7

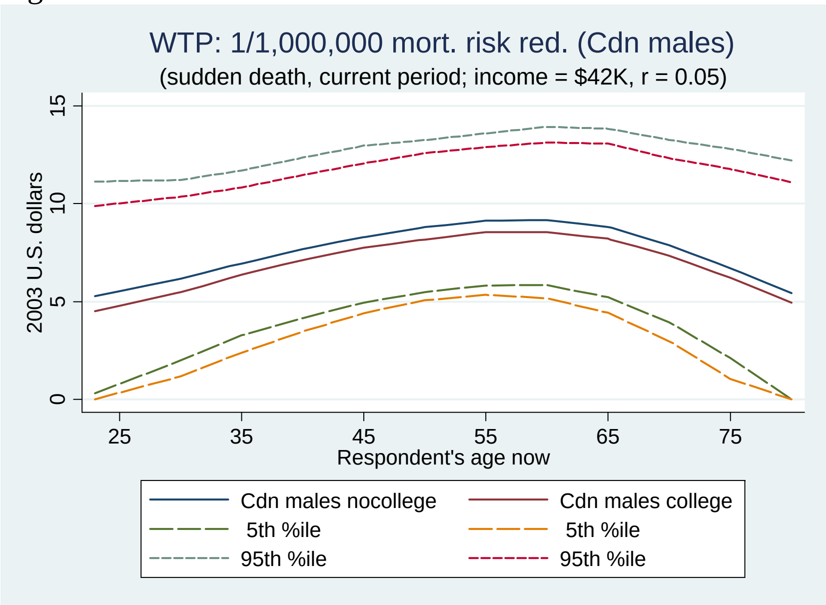


Figure III.8

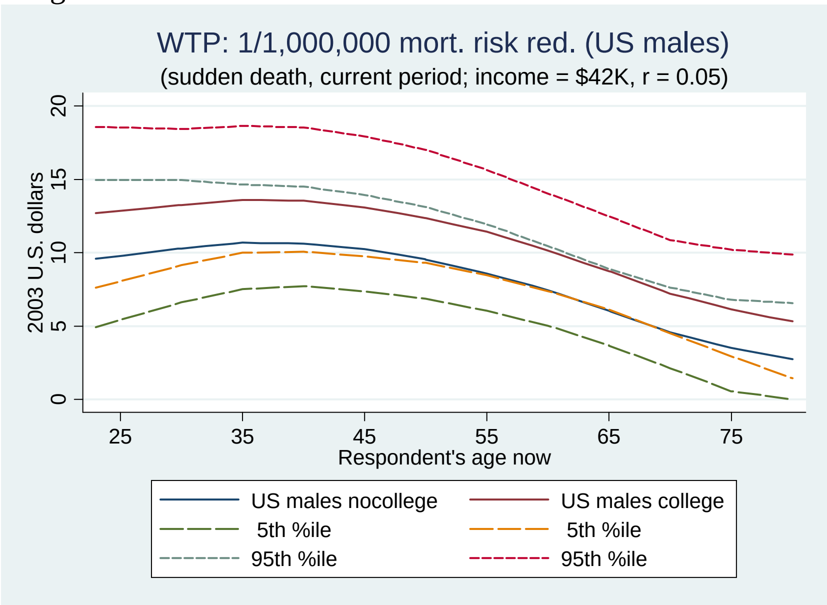
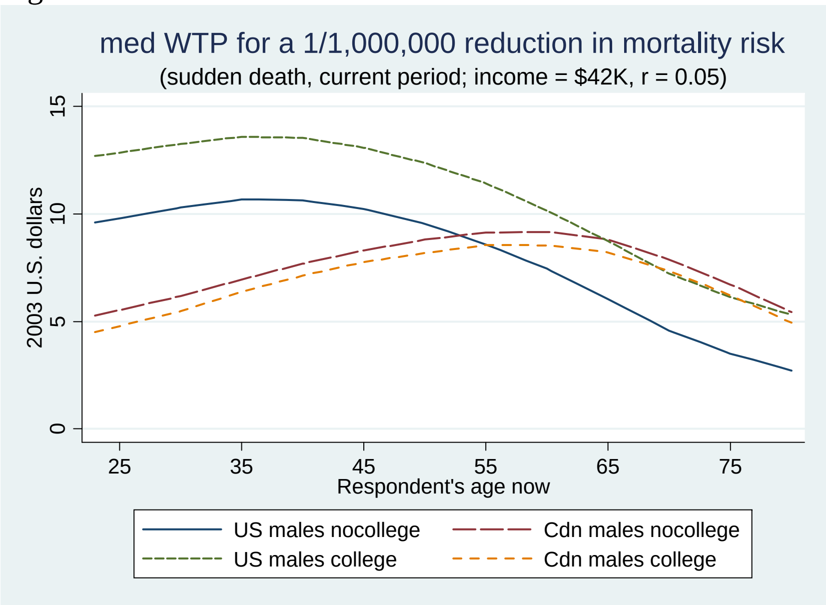


Figure III.9



Appendix IV: Fitted distribution of WTP by marital status (median, 5th and 95th percentiles across 1000 random draws of parameters)

Figure IV.1

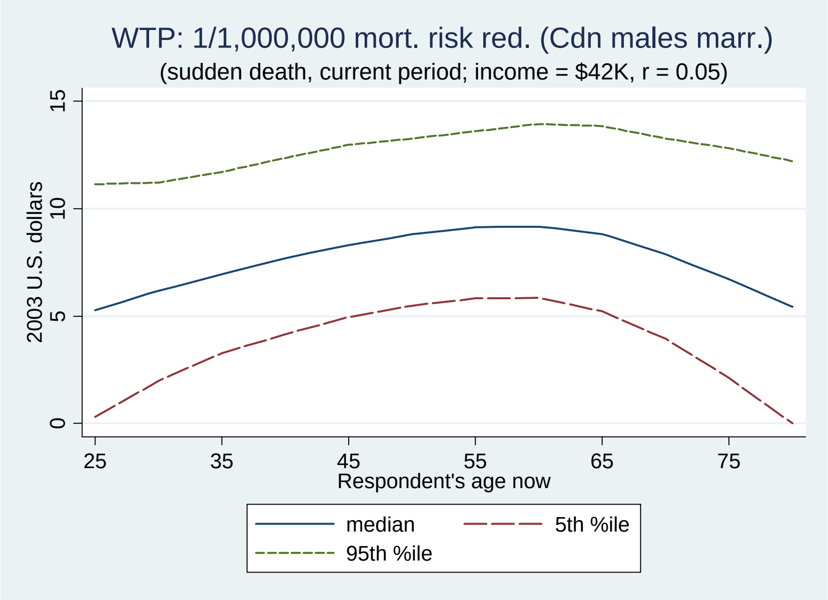


Figure IV.2

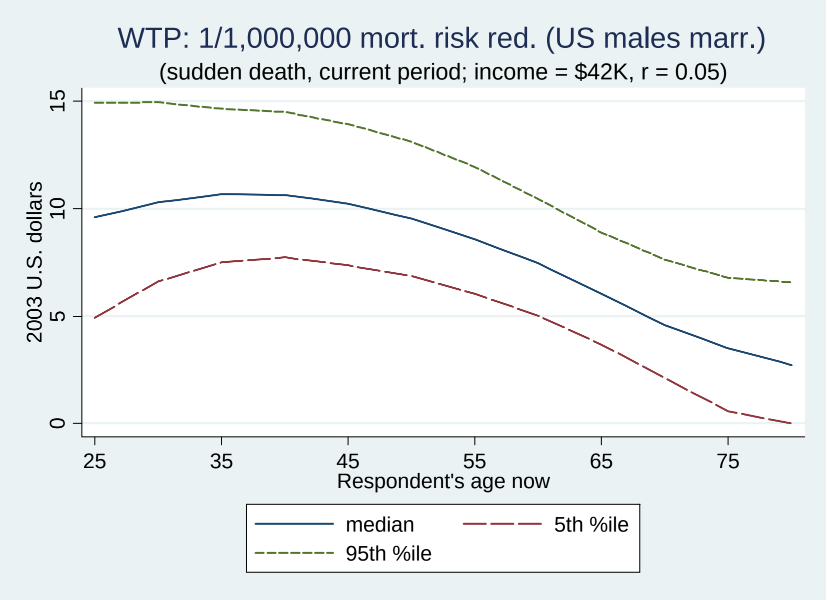


Figure IV.3

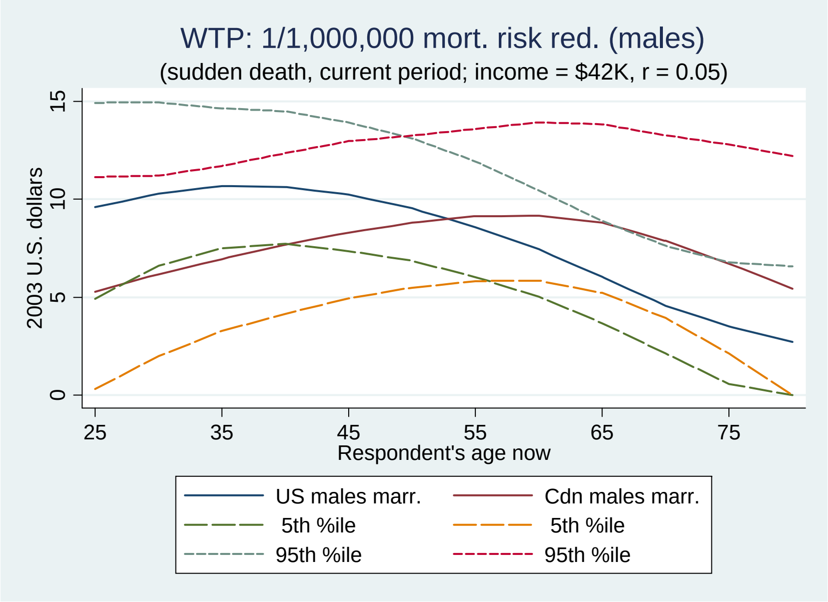


Figure IV.4

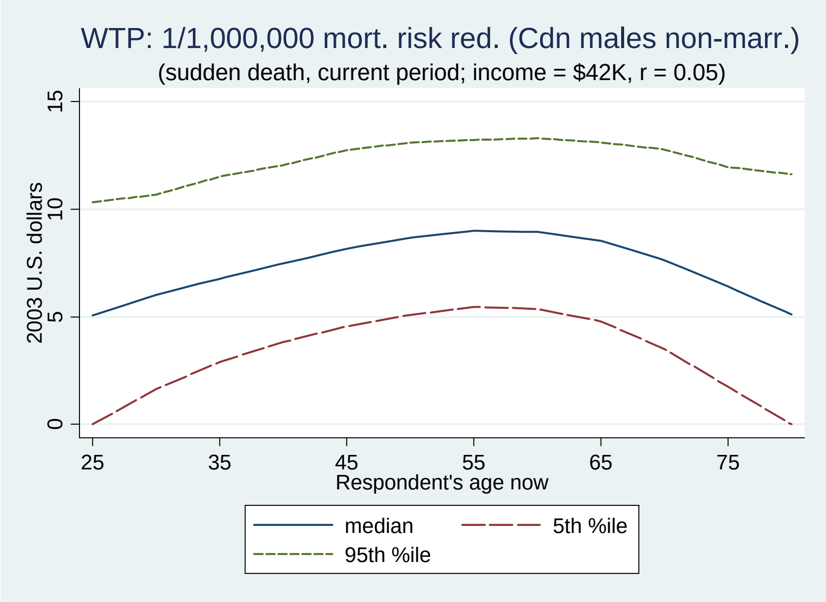


Figure IV.5

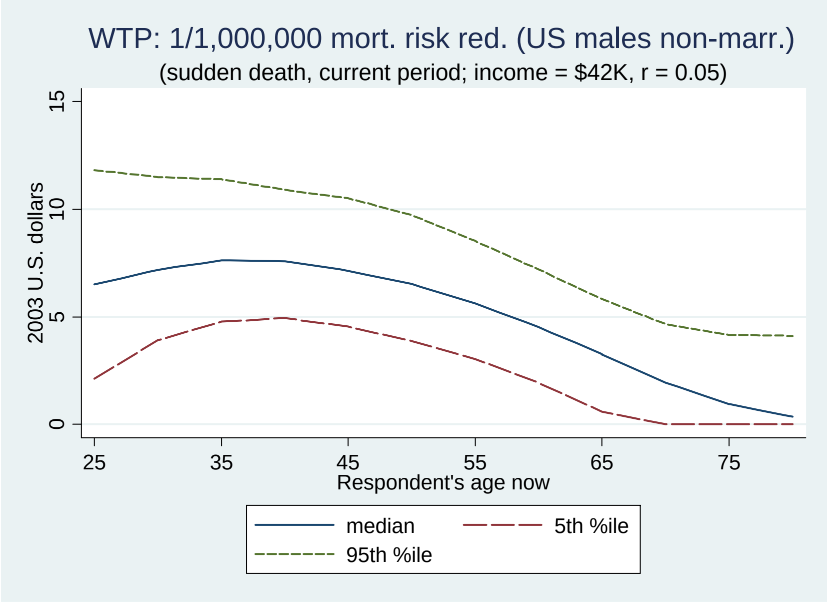


Figure IV.6

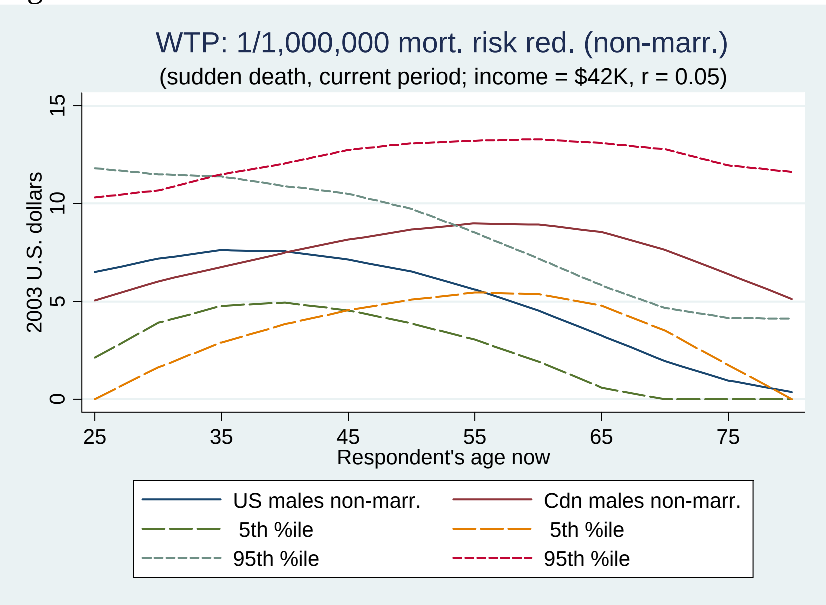


Figure IV.7

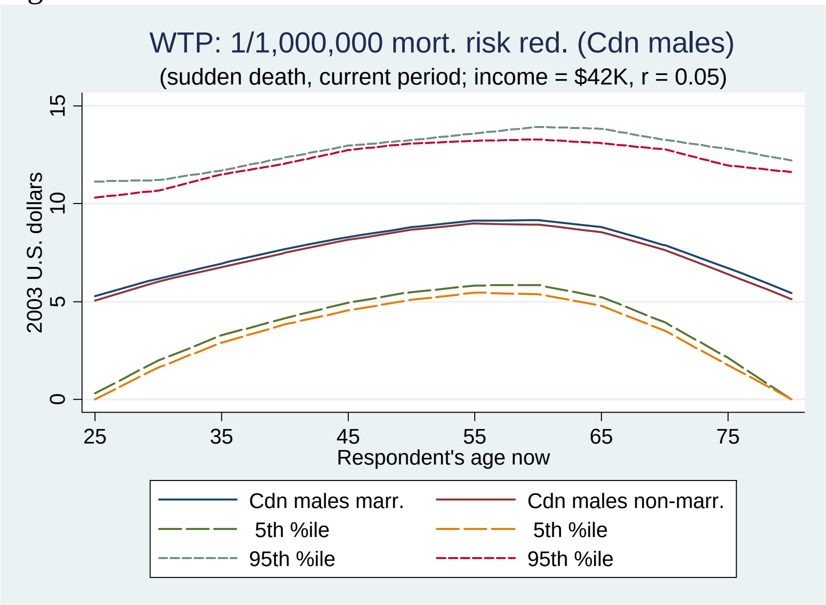


Figure IV.8

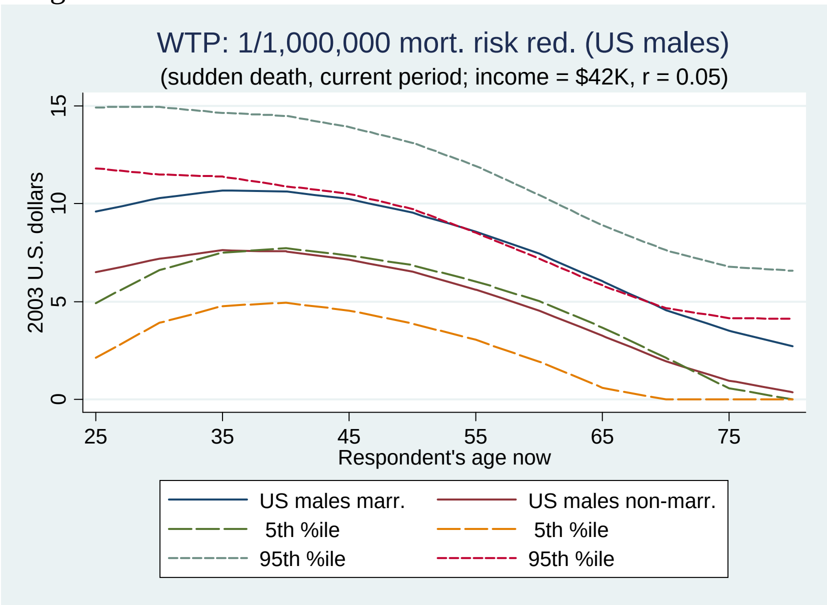
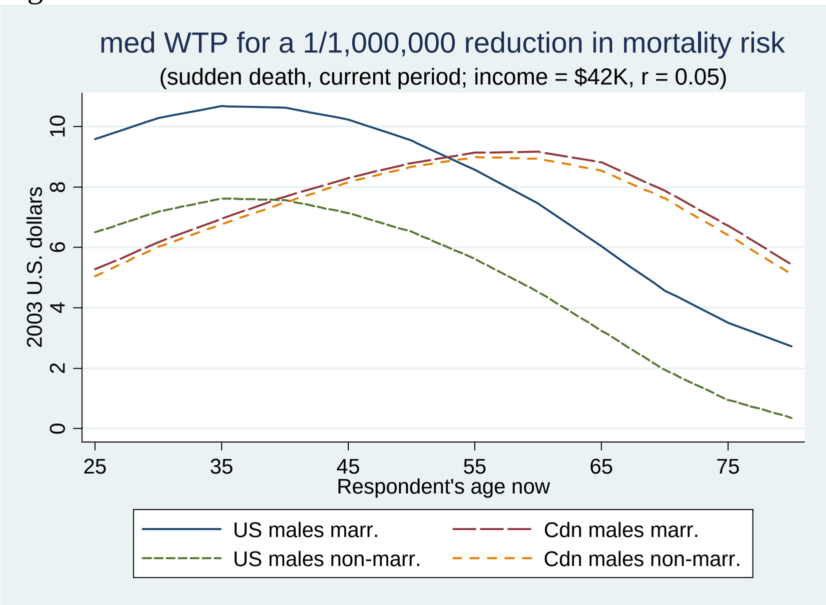


Figure IV.9



Appendix V: Fitted distribution of WTP by experience with out-of-plan medical tests (median, 5th and 95th %-iles; 1000 random draws)

Figure V.1

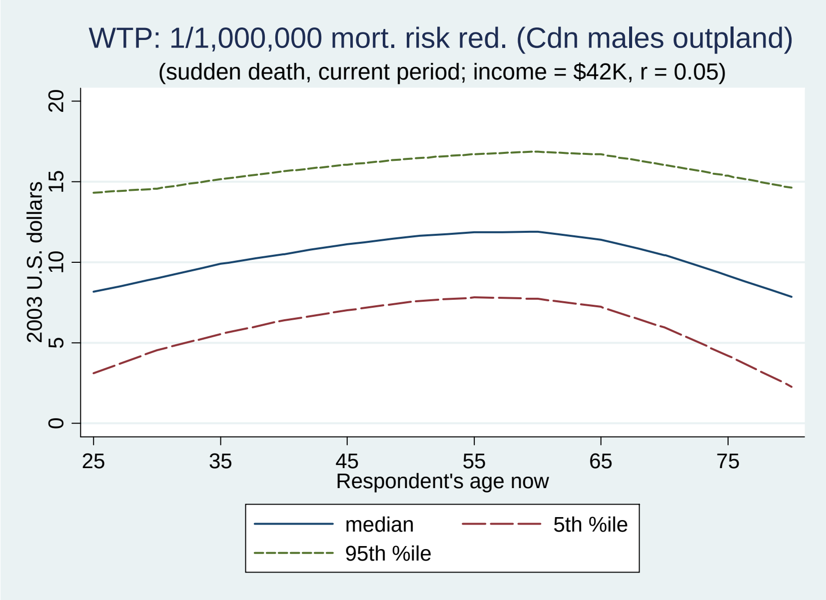


Figure V.2

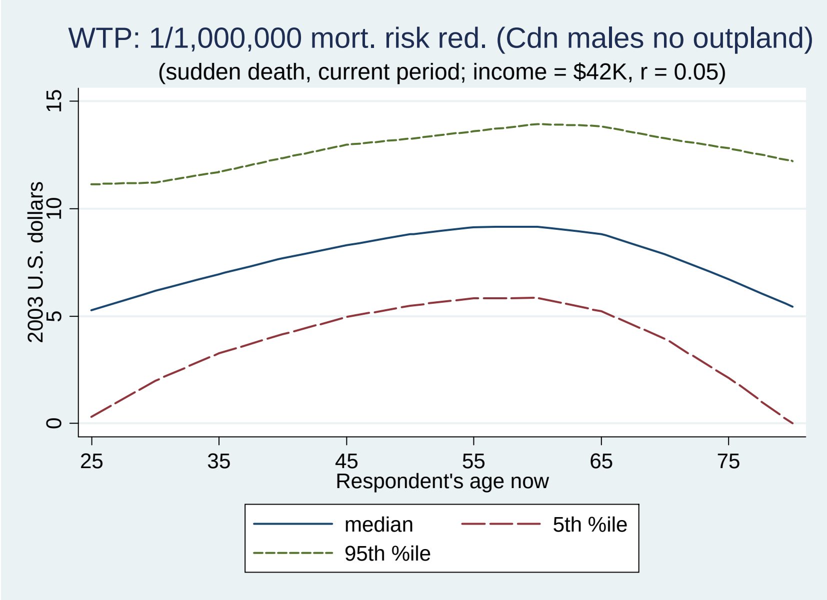


Figure V.3

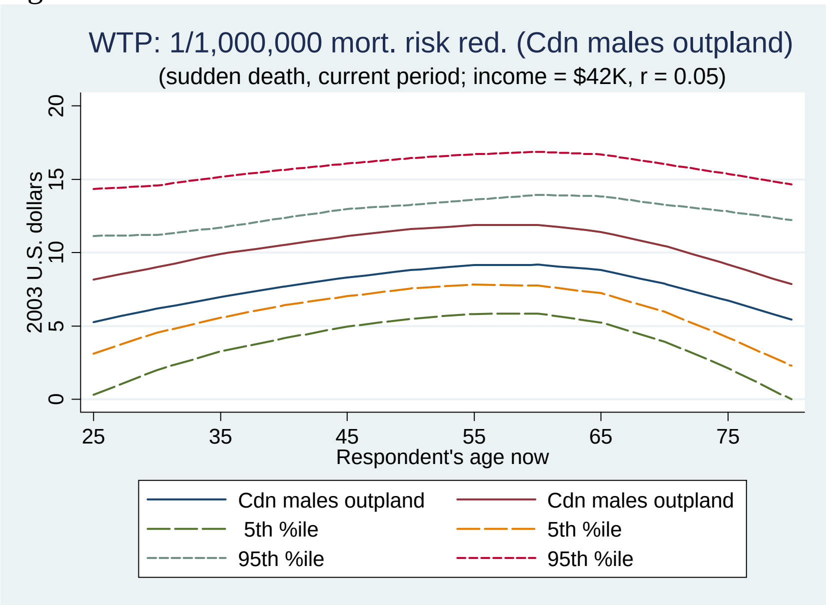
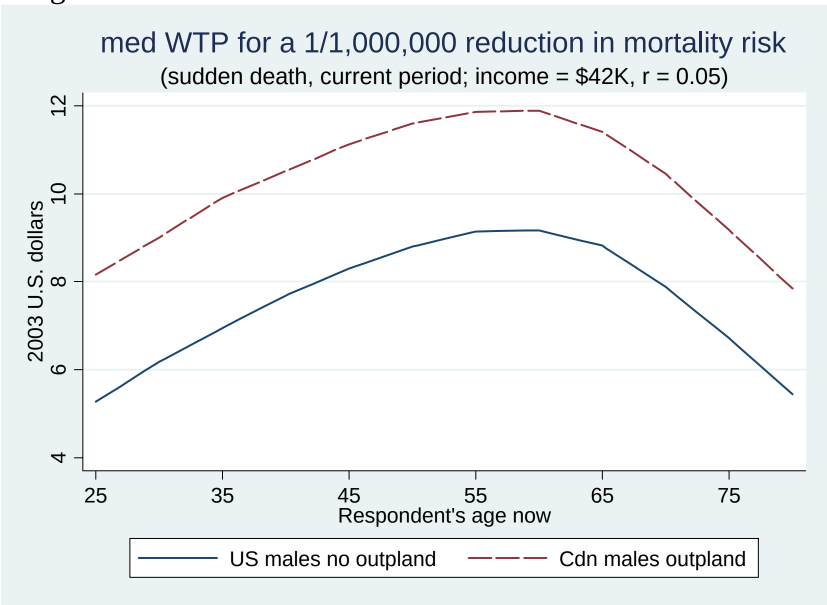


Figure V.4



Appendix VI:

Table 3(expanded): Empirical Results (extensive format with t-test statistics)

	Model 1		Model 2		Model 3	
	US	CDN Δ	US	CDN Δ	US	CDN Δ
Net income term (complex formula)	.01285 (10.48)***	.01258 (3.85)***	.01287 (9.46)***	.01031 (2.81)***	.01429 (6.16)***	
$\ldots\times$1(female)	-	-	-	-	.01047 (4.23)***	
$\ldots\times$1(mod low risk of this illness)	-	-	-	-		.01572 (2.18)**
$\ldots\times$1(high risk of this illness)	-	-	-	-	-.00761 (2.56)**	
$\ldots\times$1(not confident in health care)	-	-	-	-		.0185 (2.54)**
$\ldots\times$1(confident in health care)	-	-	-	-	.004833 (1.99)**	
Illness Years: $\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)$	-27.13 (4.71)***	-2.493 (0.24)	-47.37 (5.44)***	-23.68 (1.51)	-57.53 (3.83)***	-57.8 (2.89)***
$\ldots\times$1(female)	-	-	-	-	32.87 (3.11)***	-
$\ldots\times$1(low risk of this illness)	-	-	-	-	35.98 (2.50)**	-
$\ldots\times$1(mod low risk of this illness)	-	-	-	-	24.63 (1.84)*	-
$\ldots\times$1(mod high risk of this illness)	-	-	-	-	-14.48 (1.12)	-
$\ldots\times$1(high risk of this illness)	-	-	-	-	-33.71 (2.08)**	-
$\ldots\times$1(mod. high opp. impr exercise)	-	-	-	-	-30.87 (2.87)***	-
$\ldots\times$1(high opp. impr exercise)	-	-	-	-	-41.16 (3.84)***	-
$\ldots\times$1(very low opp. impr smoking)	-	-	-	-	-	43.83 (2.68)***
$\ldots\times$1(mod low opp. impr smoking)	-	-	-	-	-	187.3 (2.40)**
Recovered Years: $\Delta\Pi_i^{AS}\log\left(pdvr_i^A+1\right)$	-22.81 (2.45)**	-7.764 (0.45)	-17.54 (1.87)*	-7.952 (0.45)	-	-
$\ldots\times$1(female)	-	-	-	-	-67.88 (4.82)***	44.76 (1.87)*
Lost Life Years: $\Delta\Pi_i^{AS}\log\left(pdvl_i^A+1\right)$	-29.23 (5.88)***	20.01 (2.20)**	-428.1 (2.65)***	-27.75 (0.08)	-443.5 (2.87)***	-
$\ldots\times$age	-	-	12.04 (1.86)*	-5.734 (0.40)	27.48 (4.45)***	-24.77 (9.10)***

$\ldots \times \text{age}^2$	-	-	-.08826 (1.44)	.1363 (0.96)	-.2769 (4.71)***	.3654 (8.05)***
$\ldots \times$ 1(female)	-	-	-	-	22.82 (2.06)**	36.44 (1.90)*
$\ldots \times$ 1(college degree or more)	-	-	-		-32.5 (2.93)***	37.11 (2.02)**
$\ldots \times$ 1(non-married)	-	-	-	-	35.94 (3.25)***	-34.01 (1.78)*
$\ldots \times$ 1(low risk of this illness)	-	-	-	-	66.8 (4.97)***	-
$\ldots \times$ 1(mod low risk of this illness)	-	-	-	-	31.08 (2.57)**	-
$\ldots \times$ 1(mod high risk of this illness)	-	-	-	-	-44.3 (3.67)***	-
$\ldots \times$ 1(high risk of this illness)	-	-	-	-	-70.09 (4.77)***	-
$\ldots \times$ 1(not confident in health care)	-	-	-	-	26.03 (2.19)**	-
$\ldots \times$ 1(confident in health care)	-	-	-	-	-17.74 (1.49)	46.32 (2.20)**
$\ldots \times$ 1(have gone outside CDN plan)	-	-	-	-	-	-34.57 (1.77)*
$\ldots \times$ 1(very low opp. impr. doct. visits)	-	-	-	-	-17.22 (1.81)*	-
Squared: $\left[\Delta\Pi_i^{AS} \log\left(pdvi_i^A + 1\right)\right]^2$	-	-	145.1 (1.80)*	60.41 (0.36)	149.1 (1.93)*	-
$\ldots \times \text{age}$	-	-	-4.919 (1.51)	.7678 (0.11)	-10.89 (3.50)***	9.454 (7.54)***
$\ldots \times \text{age}^2$	-	-	.04097 (1.31)	-.04427 (0.63)	.1123 (3.73)***	-.1426 (6.46)***
Interaction: $\Delta\Pi_i^{AS} \log\left(pdvi_i^A + 1\right) \times \log\left(pdvl_i^A + 1\right)$	-	-	31.14 (3.81)***	28.06 (1.87)*	-30.29 (2.96)***	93.07 (5.73)***
Scenario Adjustment Controls:						
(Net income term) $\times$ overest. of latency	-	-	-	-	.0008043 (6.54)***	-
$\Delta\Pi_i^{AS} \log\left(pdvi_i^A + 1\right) \times$ 1(benefit never)	-	-	-	-	206.8 (4.66)***	-
$\Delta\Pi_i^{AS} \log\left(pdvi_i^A + 1\right) \times$ overest. of latency	-	-	-	-	8.399 (8.95)***	-
$\Delta\Pi_i^{AS} \log\left(pdvl_i^A + 1\right) \times$ 1(benefit never)	-	-	-	-	639.3 (4.17)***	-
$\Delta\Pi_i^{AS} \log\left(pdvl_i^A + 1\right) \times$ overest. of latency	-	-	-	-	11.86 (14.31)***	-
$\Delta\Pi_i^{AS} \log\left(pdvl_i^A + 1\right) \times \text{age} \times$ 1(benefit never)	-	-	-	-	-7.035	-

					(2.77)***	
$\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\times\log\left(pdvl_i^A+1\right)$ $\times$ overest. of latency	-	-	-	-	-4.933 (4.43)***	-
$\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\times\log\left(pdvl_i^A+1\right)\times$ age $\times$ 1(benefit never)	-	-	-	-	-14.72 (4.18)***	-
$\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\times\log\left(pdvl_i^A+1\right)\times$ age^2 $\times$ 1(benefit never)	-	-	-	-	.2216 (3.97)***	-
$\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)$ $\times$ overest. of life expectancy	-	-	-	-	-1.918 (3.75)***	-
$\Delta\Pi_i^{AS}\log\left(pdvl_i^A+1\right)$ $\times$ overest. of life expectancy	-	-	-	-	-.7151 (1.52)	-
US Sample Selection Controls:						
$\Delta\Pi_i^{AS}\log\left(pdvi_i^A+1\right)\times\left[P(sel_i)-\overline{P}\right]$	-	-	-	-	3.936 (2.43)**	-
	32079		32079		31836	
	-16706.611		-16644.202		-15617.2	

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%