

## CHAPTER 9

### CONCLUSIONS

#### 9.1 Implications and Relevance of the Study

The results of this study have implications for two issues surrounding the valuation of environmental health risks - - the question of the appropriate social rate of discount in the benefit-cost analysis of environmental and public health regulations, and the debate surrounding stated preference methodology. The viability of proposed health and safety regulations hinges on the rate at which the future benefits of such programs are discounted. This is especially true for long-term public investments that require a substantial initial investment, but yield benefits over a number of years into future. Examples of such investments are public programs to address groundwater contamination, hazardous waste disposal, and the preservation of biodiversity. The question of the appropriate social discount rate is especially critical for the global warming threat, because it is likely that the benefits of programs to address global warming will be spread out over time horizons of one hundred years or more. The present value of a dollar's worth of benefits one hundred years from now, if we assume constant exponential discounting and the Office of Management and Budget's standard discount rate of 7%, is negligible.

This study lends support to previous research that finds that the rate of discount declines with the time horizon. The estimated mean implicit discount rates for the ten and twenty-five year time horizons in the context of general life-saving programs are significantly different. In addition, the estimated linear discount rate function indicates that the discount rate for general-life saving programs is negatively related to the length

of the time horizon. These results have favorable implications for programs that address long-term risks to health and safety, suggesting that when it comes to threats to human health, individuals may not be nearly as myopic as they are in their private decisions, such their purchases of consumer durables or the rates at which they borrow money through a credit card.

This research also finds that the individual's rate of time preference may be context-specific. In the context of general life-saving programs, the estimated mean implicit discount rates for the ten, twenty-five, and fifty year time horizons are 10.35%, 2.9%, and 3.82% respectively, while the estimated median implicit discount rates for the ten, twenty-five, and fifty year time horizons are 0%, 0%, and 3.22%, respectively. In the context of reducing the risk of chemical forms of groundwater protection, the estimated implicit discount rate for the ten-year time horizon is zero; individuals appear to place equal value on reducing their risk this year and reducing their risk in ten years. This study's conclusion that the individual's rate of discount may be context-specific means that, once again, we are faced with the question of which rate to use for social discounting! While this study certainly cannot resolve that debate, it appears that in the case of specific, long-term risks to human health, such as groundwater protection, the standard rate of 7% currently used by the Office of Management and Budget may be too high. Of course, this begs the question: in what contexts, other than groundwater protection, does the individual value place equal weight on present and future benefits? And if this study had valued groundwater protection benefits that occur one hundred years from now, would the study have found a zero rate of discount? These questions can only be answered by additional research. As we watch the world grapple with

determining how to address the threat global warming poses to the health of future generations, it is increasingly evident just how relevant this research is; it is critical to determine if we are as myopic as a rate of 7% would suggest when faced with preserving the health of future generations.

The results of this study also have interesting implications for the stated preference methodology debate. The author finds that willingness-to-pay estimates for groundwater protection are sensitive to both the size of the present and future risk reductions, and to the extent of protection. Thus, she argues that the willingness-to-pay estimates in this study appear to pass the “scope” test. However, the author also finds that estimates of willingness-to-pay are highly sensitive to choice of the stated preference model.

This study’s results are consistent with prior studies that find that WTP estimates obtained from conjoint models tend to be larger than WTP estimates from contingent valuation models. Some have argued that the conjoint format may be preferable to the contingent valuation format because it is more familiar to the individual and allows him to express ambivalence; therefore, use of the conjoint format may minimize the problems of protest behavior and non-response. While this author agrees that the individual is likely to be more comfortable with the conjoint format and that the conjoint format does indeed offer him the opportunity to express indifference, she believes that this is not necessarily an entirely good thing if we seek meaningful estimates of WTP - - i.e. estimates that reflect what the individual would actually be willing to pay. It is quite likely that the individual views the conjoint ratings and contingent valuation formats very differently. Individuals may view the conjoint ratings task as opportunity to express what

he “likes” without even considering if he is actually in the market for the proposed environmental amenity. The author suspects that the individual is likely to downplay the cost attribute in the CJ format more so than in the CVM format. Ultimately, the individual is being asked to make a purchasing decision with regard to an environmental amenity; it appears that this is made more explicit to the individual in the CVM format. In addition, one could argue that if the individual was ambivalent or uncertain in the *hypothetical* context, he would be highly unlikely to pay for the proposed amenity at that moment in time in an *actual* market.

The argument that conjoint analysis, particularly the conjoint binary ratings difference model, may over-estimate willingness-to-pay for public goods is supported by the results of this study. A significant number of respondents did not view the assignment of a rating to the proposed groundwater protection program that exceeded the rating they assigned to the status quo as a ‘yes’ vote for that program. In addition, when asked in the modified dichotomous choice CVM format to indicate the ONE program they would be willing to undertake and pay for, a number of respondents did not choose the program to which they had assigned the highest rating in the CJ ratings format.

This survey instrument was unique in the inclusion of the modified dichotomous choice CVM question, which immediately followed the traditional DC CVM or the CJ ratings format. While the traditional DC CVM format and the CJ ratings format asks the individual to compare each of four programs to the status quo of no protection (essentially four pair-wise comparisons), the modified DC CVM format asks her to indicate the ONE program she would be willing to undertake and pay for. The modified DC CVM question is then followed by a question that asks the individual to indicate her

degree of certainty. Although the WTP estimates from the traditional DC CVM and the CJ binary response ratings difference models are not directly comparable with the WTP estimate from the modified DC CVM format, we can interpret the WTP estimate from the modified DC CVM format as a conservative, lower bound estimate of willingness-to-pay for the proposed public good.

Finally, the study contributes significantly to the existing body of groundwater quality valuation studies. The valuation format used takes into account the intertemporal nature of groundwater protection benefits. The willingness-to-pay estimates obtained are willingness-to-pay estimates for reducing the risk of exposure to unsafe levels of chemical contaminants in well water. Prior studies have either failed to specify the type of contaminants the groundwater protection program addresses, or have focused on contamination from nitrates. In addition, in this study, the exposure risks, this year and ten years from now, under the status quo and under each groundwater protection program, are clearly specified. This allows us to estimate willingness-to-pay for risk reductions of various sizes. The bulk of prior groundwater quality valuation studies have estimated willingness-to-pay for an unspecified change in groundwater quality only. Finally, this study finds evidence of non-use value for groundwater quality; individuals are significantly more likely to undertake groundwater protection if the proposed program protects all Massachusetts residents, rather than their household only.

## 9.2 Directions for Future Research

The question of the appropriate rate of social discount is clearly an area that demands further research. The importance of the discounting issue cannot be overestimated - - particularly for benefits that address long-term environmental and

public health threats. The state of the world that our sons and daughters, and their sons and daughters, will inherit depends upon the environmental and public health programs that we do and do not undertake today. The consequences of these choices are much more significant than those of private intertemporal choices, such as deciding which air conditioner to buy, or whether to receive one's salary in nine or twelve month installments. This results of this study suggest that, in certain contexts, the individual's social rate of discount is zero; further research is necessary to determine if individuals have zero, or very low, rates of discounts in contexts other than groundwater protection.

Some might argue that the results of this study undermine the validity of stated preference methodology, thereby providing ammunition for the critics of the methodology who argue that it should not be used in either benefit-cost analysis or compensatory damage assessments. However, this author argues that the study demonstrates that more research is necessary to refine stated preference methodology. This study has shown that estimates of willingness-to-pay are highly dependent upon the model specification. However, the fact that the WTP estimates vary considerable does not necessarily indicate that stated preferences techniques are not capable of accurately measuring the individual's value for the public good, but rather that the individual may view the various valuation formats differently - - he may not necessarily think that he is being asked to consider the "purchase" of the proposed public good, particularly in the conjoint ratings format. Therefore, if the individual does not view the different formats as asking the same question, it is not surprising that his responses to these formats vary. In addition, non-use values for public goods may represent a significant portion of the value that the individual has for a public good; if we wish to capture non-use values, we

must turn to stated preference methodology. This study suggests that non-use value may be a significant component of the individual's total value for groundwater protection.

How can stated preference methodology be refined to improve the estimation of health and safety benefits? Studies such as this one, which explore the sensitivity of willingness-to-pay estimates to model specification, can shed light on how the individual responds to different valuation formats. This enables stated preference researchers to further refine the methodology. Secondly, studies must specify exactly what the health or safety benefit is by clearly indicating the risk reduction the proposed program offers. To do this, we need to be able to communicate risk effectively. This brings us to a third point. Current research indicates that individuals have a great deal of difficulty comprehending small probabilities that are characteristic of many environmental health risks. A stated preference mail survey may be a poor vehicle for estimating willingness-to-pay for risk reductions, as there is limited opportunity to communicate with the respondent. It is difficult to assess how well the individual understands the risk information presented to him. If the individual does not understand the risk reduction being offered by the proposed program, his willingness-to-pay value for that program is not meaningful. Thus, it is clear that, to make real strides in improving the methods used to value health and safety risks, the stated preference methodology research agenda must be devoted in part to risk communication issues. For example, what types of risk communication devices are most effective? Should risk information be presented in frequency or probability form? To what extent do individuals tend to ignore the status quo risk levels in favor of their own subjective risk perceptions? These are questions that can only be answered through careful research.

In conclusion, stated preference methodology will likely remain controversial for some time; it is this controversy that makes valuation methodology an intriguing area of research. There is simply a lot that we don't know, and the answers to our current questions, as well as the questions we have yet to think to ask, have important implications for public policy. Many members of society are understandably uncomfortable with the notion of attempting to place a dollar value on human health and safety. We cling to the idea that health is, or rather should be, a "priceless" commodity. Fuchs and Zeckhauser (1987) observe, "that life is priceless need not imply that we will spare no expense to save a life or cure a disease. Yet that myth persists and gives us comfort" (Fuchs and Zeckhauser, 1987, pp.267). However, avoiding the issue of valuing health does not serve us well in implementing policy that most accurately reflects what we, as a society, desire. The development of new valuation methods, and refinement of existing ones, allows us to better direct our scarce resources. Effective environmental and public health policy necessitates attaining an optimal balance between the opportunity costs associated with ensuring a greater level of health and safety, and the benefits derived from increased levels of physical and emotional well being. Improving the methods that we use to value health and safety is critical to achieving and maintaining that balance.