Assessing the Determinants of Willingness to Pay for Urban Flood Control: The Role of Locational, Demographic and Attitudinal Factors

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Abtract: The urbanization of urban watersheds can influence flooding risks. Traditional Federal Emergency Management Agency (FEMA) flood risk maps identify 100 year floodplains. These maps are updated infrequently. However, as a community urbanizes, flood risks can change, especially for downstream residents. Thus, one would expect that the willingness to pay (WTP) to prevent the worsening of flooding risk would depend in part on the location of the household in the community and their associated flooding risk. Economists and regional scientists have evaluated the role played by traditional demographic factors. However, attitudinal factors measuring community norms, political philosophy, and other psychological factors that may be unique to the individual have not received the same level of scrutiny.

Milwaukee, WI has experienced major flooding events, classified as floods with an expected frequency of once every 100 years or less, in 1986 and most recently in 1997 and 1998. In this study, 1000 residents of the Menomonee watershed in Milwaukee were interviewed in a two-wave panel survey (i.e., telephone interviews took place in 2000 and 2001) to determine their willingness to pay for a referendum which would prevent flood risks from worsening. The interviews queried respondents about their attitudes concerning flooding and ecological risks, political beliefs, information seeking behavior, and other psychological factors unique to the respondent. Information was also gathered on demographic characteristics of the respondent, and also that individuals address. The address was geocoded and hydrologic modeling was used to determine the unique flood risk associated with the residence. A willingness to pay function was estimated using Tobit analysis. Preliminary findings indicated that all three categories of factors influence willingness to pay, with psychological factors and flood risk factors having a relatively strong impact on willingness to pay.

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1. Introduction

Economists have long understood the difficulty associated with the valuation of nonmarket goods and various techniques have been developed in an attempt to value such goods[1]. Nonmarket goods may have both public good and private good attributes. Whereas consumers reveal their preferences for private goods by interacting with sellers in markets, such markets do not necessarily exist for public goods. This is due to a market failure that results from non-identifiable individual property rights. That is, consumers cannot be excluded from enjoying the good once it is provided (i.e., the good is nonexcludible), and the good is also nonrivalrous in that one person's consumption does not inhibit another individual from also consuming the good.. Freeman (1979) notes that benefits from a good can also be characterized along another dimension (i.e., they may be direct or indirect benefits). Direct benefits are those that accrue directly to a given individual or group. In contrast, indirect benefits are experienced by the entire community.

The good under consideration in this study is flood control in a watershed in the Milwaukee Metropolitan area. This is predominantly a public good with a degree of local excludability. In addition, the resulting benefits are both direct and indirect. Specifically, given the spatial nature of these benefits, some direct benefits can accrue to a subset of the population. For example, if a project reduces the probability of flooding, those residents living in the 100 year floodplain will be expected to experience less flooding and hence experience direct benefits. Publicly provided goods (e.g., roads, public buildings, etc.) are also less likely to be damaged. However, there are also indirect benefits to the wider community emanating from flood control projects. Indirect benefits may be commercial (e.g., businesses avoiding passing on increased costs due to flooding to their consumers) or they may be altruistic (sense of "doing the right thing" for the whole community, valuing the environment, etc.). Given that residents in the Milwaukee metropolitan area have experienced three so-called 100 year flood events in the last 15 years[2], the issue of flood control has had a high public profile. This study will employ the Contingent Valuation Method (CVM) to evaluate community support for watershed management practices.

2. Theory of Contingent Valuation Method

Basic utility theory is used in this study to guide the development of a theoretical model to describe a household's willingness to pay for two separate goods: flood control and ecological improvement within the watershed. It is assumed that an individual maximizes his or her utility subject to a budget constraint. In this study, the household's utility can be described by a vector of market goods, X, and a nonmarket good, Z. From Samuelson (1954), the value of the nonmarketed public good, which is not priced and can only be provided in a fixed amount, is given by the household's WTP for the nonmarket good. This will be shown to be related to the consumer surplus, or area under the consumers demand for the nonmarket good. The optimization problem is defined by equation [1][3].

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[1] A good is a product or service that generates positive levels of satisfaction to the consumer.

[2] Major flooding events took place in Milwaukee in 1986, 1997 and 1998.

[3] The distinction between the areas under the Hicksian-compensated and Marshallian-uncompensated demand curves will be discussed in more detail later in this section.

$$\text{Maximize } U(X; Z) \qquad \text{Subject to: } \sum_i P_i \, X_i < Y \qquad [1]$$

where Y is income and P is a vector of prices for the marketed good in vector X. Solving this optimization problem generates a demand function for the market good, defined by equation [2].

$$X_i = X_i\,(P,Z,Y) \qquad [2]$$

From equation [2] it is seen that the level of a nonmarketed good enters as an argument in the demand for a marketed good. However, because the nonmarketed good is not priced it is not possible to similarly derive a demand function for the nonmarketed good from the utility maximization system. However, the dual of the utility maximization problem is the expenditure minimization problem. Specifically, minimizing the expenditure function, conditional on a given level of utility, as shown by [3], can be used to derive the willingness to pay function.

$$\text{Minimize } \sum_i P_i \, X_i = M \quad \text{Subject to: } U(X,Z) = U^* \qquad [3]$$

U^* is a reference level of utility and M is the minimum money expenditure required to attain U^*. By solving [3], the household's expenditure function results:

$$E = E\,(P, Z, U^*) \qquad [4]$$

A Hicksian-compensated demand curve is a demand curve where the level of utility is constant at every point on the function. In contrast, the Marshallian demand curve allows utility to vary along the demand function. To generate the Hicksian-compensated demand function for the market goods, equation [4] can be partially differentiated with respect to a given price for the good, holding utility constant.

$$c^* = E_P\,(P,Z, U^*) \qquad [5]$$

Since utility does not change, the change in expenditure that is necessary to compensate for the change in the good, while holding utility constant, is the monetized value of utility derived from the good.

Both equivalence and compensating surplus measures can be evaluated through equation [5] depending on the reference level of utility (Thunberg, 1988)[4]. To generate the Hicks-compensated *inverse* demand function for the nonmarket good, equation [4] is differentiated with respect to Z. According to Mishan (1976), this is the theoretically appropriate surplus measure for welfare comparisons. It will further be argued that WTP, rather than WTA is the correct measure in this application (Mitchell and Carson, 1989).

$$m^* = E_Z\,(P, Z, U^*) \qquad [6]$$

[4]Assuming the respondent has rights to the original level of utility, the compensating surplus represents the payment that the individual would be willing to make (WTP) that would just compensate for any change in utility from consuming a higher level of the good. On the other hand, if the consumer has the right to the new level of utility, then the compensation that would be required to maintain utility at the original level of consumption is the equivalent surplus (i.e., willingness to accept compensation, or WTA). Note that for a quantity decrease, the equivalence and compensating surplus' would be reversed. If the consumer has the right to the original level of the good, then the consumer must pay for the new higher level, and hence the appropriate utility concept is compensating surplus, and hence willingness to pay (WTP). In contrast, if the consumer has the right to the new level of utility, then the appropriate surplus measure is equivalence surplus, and hence the consumer must be paid to accept the old level of utility (i.e., there is a willingness to accept (WTA) compensation along with the old level of the good). In either case, the individual is equally well off at either level of consumption.

In terms of money income transfer required to maintain the household's utility at U^*, equation [6] gives the marginal WTP for a change in the level of Z. The benefit to the individual for a change in Z is therefore given by

$$WTP = \int_{Zold}^{Znew} E_Z (P, Z, U^*) \, dZ \qquad [7]$$

The good being considered in this project is the maintenance of flood control at current levels in light of ongoing development throughout the watershed. Although the proposed project in this study would maintain the current level of flood risk, it is difficult to know what the exact resultant level of flood protection services provided by such a project for each household. The valuation of the flood control project proposed in this study depends upon each household's subjective assessment of the flooding risk, which in turn depends on proximity to the river, location in the flood plain, and other factors. It also depends on the extent to which the proposed project will impact that risk as well as local resident's perception of that risk. An important question then becomes: What is the appropriate theoretical model of decision making under uncertainty?

One possibility is to employ the expected utility model, developed by Von Neumann and Morgenstern (1947). The authors argue that the rational decision maker, when faced with choices with uncertain outcomes, will maximize the expected utility of consumption. Many risk reduction WTP studies use this expected utility model (Brookshire et al., 1985; Smith and Desvouges, 1987). However, Mitchell and Carson (1989) as well as other researchers[5] indicate that the EU model's hypothesis are not appropriate for the analysis of decision making involving potential losses (i.e., without the expenditure, the severity of flooding within the watershed will increase, as a result of continued development in the watershed). An alternative proposed by Thunberg (1988:12), and applied to the issue of flood control assumes that flood plain landowners maximize the utility of the expected value of an investment in flood protection. The context of decision making under uncertainty is maintained as individuals [households] are assumed to form subjective judgments over future flood event and flood consequences. The same argument can be made regarding the future ecological health of the watershed. In the absence of the proposed project, the household's utility, U^o is conditional upon expected events related to flooding and ecological impacts, as well as price levels, income, and general economic conditions. If flooding levels increase over time, the household must pay in order to maintain the current welfare position, the landowner's WTP for a river flood control project can be derived by forming a lifetime expenditure function

$$E = E (P, FP, EP, U^o) \qquad [8]$$

Where E is the minimum level of lifetime expenditures required to attain U^o, the current level of welfare, P is a vector of prices over the time horizon for consumption goods, FP is the flow of flood protection. Differentiating with respect to one of the goods (e.g., FP):

$$ME/MFP = E_{FP} (P, FP, U^o) \qquad [9]$$

then integrating from zero to a specific level of flood protection (FP^n)

$$WTP = \int_{FPo}^{FPn} E_{FP} (P, FP, U^o) \, dFP \qquad [10]$$

gives WTP which is equivalent to the compensating variation measure. That is, equation [10] describes the maximum WTP that would maintain the household's current welfare position, U^o. As all the variables

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See also Schoemaker (1982), Smith and Desvouges (1985), and Kahneman and Tversky (1979).

are considered over time, equation [10] measures the household's WTP as if the payment were lump sum. Consequently, the WTP decision represents an investment in a flood control project with the expectation of receiving a future flow of flood protection services in order to maintain the current level of flood risk. In other words, investment in a flood control project will be a function of the level of flood protection services provided. Flood risk generates property (P(f)) and nonproperty effects (NP(f)) effects, although the potential property effects are potentially larger for flooding. Nonproperty effects would include the expected impacts of enhanced flood risk on the community for example. The household's subjective probability distribution for varying risk levels can be defined as m(f). The expected net present value of the property and nonproperty effects that are avoided with the proposed project is the WTP, or value of the investment in the project. Therefore, the WTP can be stated as a general function of subjective probabilities, m(f), property P(f), and nonproperty, NP(f), effects, and the household's budget, B.

$$WTP = f(m(f), P(f), NP(f), B) \qquad [11]$$

The issue of WTP vs. WTA

Survey data will be employed to estimate equation [11] for a hypothetical flood control project. Before discussing these empirical applications, an important theoretical issue must be addressed. Specifically, should the survey ask the respondent about their willingness to pay (WTP) for the project, or their willingness to accept compensation (WTA) for the project in question. As noted above, the salient issue is one of the entitled property rights of the respondent. If the respondent has a right to the original level of utility, and the goal is to evaluate the value associated with a new higher level of the good, then WTP has traditionally been advocated. On the other hand, if a reduction from the current entitled level of the good is being considered, then WTA would be the asked of the respondent. It was determined by the engineering team working on this study that reasonable flood control objectives would not lead to appreciable reductions in flood risk. Rather, they would result in the maintenance of current flooding risk (i.e., prevent the expansion of the floodplain or increase in the frequency of flooding) in light of current urbanization trends. Thus, it at first appears that the flood control question should be asked in terms of willingness to accept compensation. However, Mitchell and Carson (1989, pp. 40-41) argue that "(a) different set of dimensions is needed to define the property right to a public good which requires annual payments to maintain a given level" (see Mitchell and Carson, 1989, p. 38). Specifically, Mitchell and Carson focus on two dimensions; the extent to which the consumption of the good conveys individually held and/or collectively held rights, and the extent to which it is accessible[6]. Assuming the good is collectively held, the accessibility of the good represents whether there exists the ability to access a higher level of the good than currently exists. For collectively held goods in which there is there is a right to the existing level of the good, and for which improvements in quality current level of the good are possible (as is the case with the ecological quality of the watershed), the appropriate survey question is one of WTP. In that case, the response to the question give the compensating surplus for the good. When the good is collectively held, but higher levels of the good are not accessible (as was indicated by the engineering team), WTP is still the appropriate survey question for two reasons. There is an ongoing cost to provide flood control, and in light of continued development in the watershed, especially development upstream. Thus, in the absence of enhanced spending, the frequency of flooding will increase, as will the spatial dimensions of the 100 year floodplain. Again, WTP reveals the compensating surplus.

6Collectively held rights are non-transferrable. Put another way, the good is nonexcludible, since once the good is provided, it is provided to all residents. In contrast, individually held rights imply some level of excludability. Thus the individual vs. collective property right addresses the public vs. private nature of the good. Typically, the less excludible the good, the greater likelihood that it is publicly held, and financed via taxes and fees. Goods that are collectively held (as is the case with both of the goods defined in this study) do not convey an individual right to transfer the quantity of the good to a different level.

Open Ended vs. Discrete Choice Approaches

There are different ways to elicit WTP responses. Two alternatives are possible in this study; a modified open-ended (OE) approach and the discrete choice (DC) approach. The simple OE approach asks respondents to place their highest value on the project being described. This method is appropriate if the respondent has some experience valuing the good in question. Given the recent experience with local flooding, and the high-profile flood control efforts of the Metropolitan Milwaukee Sewerage District (MMSD)[7], it is likely that residents of the Menominee River watershed have substantial experience with the flood control good.

The DC approach derives WTP estimates from a logistic model in which respondents indicate whether they would vote in favor of a project if it were presented in a referendum at a randomly chosen bid-price. This approach was advocated by an expert panel evaluating assembled by the National Oceanic and Atmospheric Administration to determine the value of CVM for cost-benefit analyses (Arrow et.al., 1993). Mitchell and Carson (1989) suggest that a combination of OE and DC formats may be appropriate in some applications. Specifically, an iterative DC approach, with a follow-up OE question is desirable when a sizeable number of zero bids are expected. There are several reasons to anticipate zero bids in this study. First and foremost, Wisconsin in general, and Milwaukee in particular has a relatively high tax burden. While attempts have been made to avoid direct references to specific types of taxes, some respondents will undoubtedly oppose any project because of its anticipated impact on the tax burden. Second, there has been growing public criticism of the MMSD in light of the substantial expenditure on the deep tunnel project. In addition, strong public disagreement exists over the appropriate manner in which to fund MMSD. The City of Milwaukee preferred a funding formula based on property value assessments, where as the suburban communities preferred a fee based on usage. The resulting legal debate was resolved in favor of the city, but this has led to ongoing criticism of any action undertaken by MMSD by some residents. Again, while we took steps to distinguish these proposed plans from any existing or proposed plans of MMSD, it is possible that respondents to the flood control question will oppose it because it could support an institution that they oppose. In light of the high Milwaukee tax burden and the significant expenditure that has already been undertaken locally to control flooding, it is not unreasonable to expect numerous respondents to make zero-bids. Hence, the modified iterative DC-OE approach is used in this study.

3. Empirical Methodology

In this study, WTP was measured as part of a two-wave, panel design sample survey of residents of two impacted watersheds in the Milwaukee area: the Menominee River watershed on the west and northwest side of the area, and Oak Creek watershed on the south side. While the initial survey design was to measure willingness to pay for flood control in both watersheds, focus groups were conducted in both watersheds, and it was determined that the flood risks in the Oak Creek watershed were deemed to be very low, and nonthreatening to property, even if in light of ongoing development in the areas. Thus, the issue of flooding was only studied in the Menominee watershed.

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[7] MMSD has taxing authority for the communities that are in the Menominee River watershed. Currently, municipal sewerage bills reflect payments for the deep tunnel project, which cost in excess of $1 billion and are being financed over a 20-year period.

A two-wave, panel design random sampled survey was conducted by telephone in the winter of 1999-2000 (first wave) and 2000-2001 (second wave) by the subcontractor University of Wisconsin Survey Center (UWSC), a professional research organization. In the first wave, 294 households were interviewed. In the second wave, 185 of the first wave respondents were re-interviewed, and 91 new residents were interviewed for the first time. The sampled population was the non-institutionalized adult resident heads of households of the Menominee watershed. Heads of households were designated as respondents because of their decision-making roles in the households, roles which should make them aware of household finances and what the household could afford to pay for the projects. The cases consist of randomly selected households that were located within census blocks corresponding to the two watersheds. A stratified random sampling strategy was used to obtain a probability sample of adult heads of households in each of the two watersheds separately. The sampling plan did not oversample floodplain residents because one of the goals was to ascertain the relative importance of watershed management strategies for all watershed residents, not just a select group[8]. The interviews, which lasted an average of 21 minutes, were conducted by trained interviewers using the CATI (Computer Assisted Telephone Interviewing) system. Up to 20 attempts were made to interview a given respondent. Partial interviews were not included in the final data set.

In this study, we investigate WTP using a referendum approach. Respondents are asked the most they would be WTP and still vote in favor of a plan if it were on the next referendum. This approach is appropriate given that spending on public projects is frequently determined in this fashion. Respondents were given a description of a project whose primary objective was the maintenance of flood risk at its current level. They are told that scientists indicate that as the region urbanizes, the problem of river flooding increases. The potential consequences are identified, and the magnitude of additional damage, and likely location of that damage is also identified. All respondents were provided with reference points of other types of local public expenditures[9], and then asked the WTP question in an iterative fashion.

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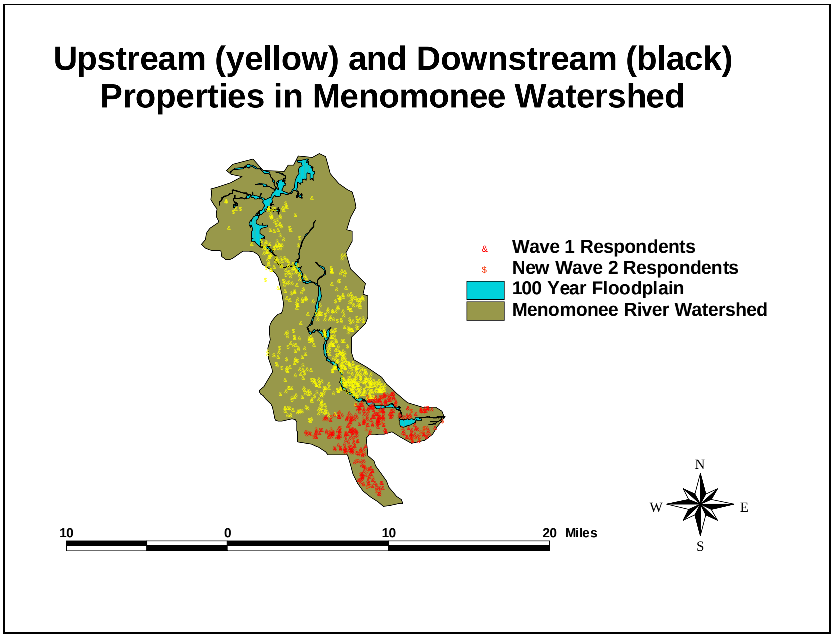
[8] A random sampling strategy should guarantee that no single group of respondents is over-represented. The University of Wisconsin Survey Center obtained the sample of telephone numbers from Survey Sampling Inc. The sample is representative of currently working and listed residential telephone numbers in the census tracts located within the two watersheds. A census tract was included into the sample if the majority (97% or higher) of the census tract was located within one of the two watersheds. Survey Sampling, Inc. updates their sample approximately three times a year. It is estimated that approximately 5-7 percent of United States households do not have telephones, and would not be represented in the sample, and that this percentage is approximately the same for the state of Wisconsin. In addition, in order to insure that all sample points were located within the identified census tracts, UWSC was unable to include unlisted phone numbers. Approximately, 13% of Wisconsin households are unlisted.

[9] These benchmarks described other public goods and services that the respondents were currently funding and the level of annual household contributions to these goods for the typical resident within the four county metropolitan area for 1997. As a result of feedback from the focus groups, comparisons to controversial local programs (i.e., a highly controversial local tax being used to fund a new professional baseball stadium) or to national programs (i.e., the NASA space program) were avoided. Annual household payments for the following goods were included as benchmarks in the final survey (rounded to the nearest dollar): ambulance service $8; parks and recreation $54; highway construction, maintenance, and administration $95; law enforcement and fire protection $203; public education $1500.

They were first asked if they would be WTP any positive amount of money for the project that was described to them. Payments would be made annually, and would continue for 20 years[10]. If they indicated the answer to that question was no, they were asked if they would be willing to provide an explanation as to why they would not support the proposal. These responses were used to classify protest bids which are discussed below. If they answered yes, then a randomly generated value between $5 and $500 was presented to them, and they were asked to indicate whether they would support that value. Based on that response, another dollar value was provided. The second value was either a number larger if they answered yes to the first question (approximately 50% of the way between the first bid amount and $500) or a number smaller (approximately 50% of the way between $0 and the first bid amount) if they answered no to the first question. Finally, the respondent was asked to provide the largest annual dollar payment that they would be willing to make and still vote in favor of the referendum.

Prior to the WTP question for the respondents, various Likert-type questions were asked of the respondent so as to provide a proxy for beliefs and attitudes towards a wide range of issues related to the environment, flooding problems, the government, etc. This was done to facilitate the testing of theories of information processing in the risk communication literature. In addition, respondents were asked demographic questions, including their income level.



ArcView was programmed to determine the unique flood risk, as defined by the recurrence interval (i.e., the expected years between flooding events from the Menomonee River for the property) for individual properties within the watershed. Since much of the flooding within the Menomomee River watershed was in the region from the Village of Wauwatosa to the southeast, ArcView was also used to identify upstream and downstream properties.

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[10] Representatives from both the MMSD and the Southeast Wisconsin Regional Planning Commission indicated that a typical watershed project would be financed over a period of 20-30 years.

4. Empirical Model

The generalized model specified in equation [11] guides the selection of variables used in the empirical analysis. The model estimated is given by equation [12]

WTP = *f*(*demographic, residence controls, survey controls, psychological controls, risk*, ,) [12]

where *demographic, residence controls, survey controls, psychological controls,* and *risk* are vectors of variables contained in the models. The individual variables will be discussed in more detail below. When there are substantial numbers of zero observations, OLS regression can generate biased and inconsistent parameter estimates. In addition, OLS models could predict WTP to be less than zero. In contrast, the Tobit model considers the censored nature of the error term, ,[11]. Thus, both OLS and Tobit models are estimated and presented for comparison. Residuals were found to be homoskedastic.

The description of the variables and the descriptive statistics for each variable, in each of the paths, are given in Table 1. The dependent variable is the real WTP, with the CPI-Urban deflator for the Midwest used to account for the influence of inflation. The base month is defined as January 2000. Since individual subjective measures of risk must be controlled in the sample, we include several demographic control variables. These include the age of the respondent, their years of education, marital and gender status, number of children and real income. Income is measured in natural log form, since WTP is expected to respond to proportional, rather than absolute changes in real income.

The variables in the *residence controls* category are dummy variables that account for whether the respondent is a homeowner and/or whether that individual resides in a single-family home. Two variables are included in the *survey controls* category to mitigate potential biases in the estimation. Another potential bias associated with the use of bidding procedures for CV is instrument bias, further breaking down into starting point and payment vehicle bias. The first of these is the starting point bias (Cummings et. al. 1986). Specifically, the WTP response may be influenced by the point at which the iterative bidding process begins. We include the starting point to control, in real terms to control for this potential bias. Second, some respondents provide zero bids because they truly place a zero value on the good. However, some zero bids reflect protest bids. For example, respondents may choose to offer a zero bid because they believe taxes are too high, or that it is the responsibility of government to take care of the problem. Others may be philosophically opposed to assigning a value to the good. When a zero response was given, the respondent was queried as to the reason for the response. Those responses were classified independently by two researchers. Intercoder reliability (Cohen's Kappa) for this measure is good (.75), which makes the code system used to derive this variable replicable across observers**.** Respondents who gave protest bids were eliminated from the sample.

Several *psychological control* variables have also been included in the model. The variables are derived from Ajzen's (1988) Theory of Planned Behavior as applied to this WTP study and (a) Subjective Norms, or perceived social pressures from other persons (e.g., family, friends) important to them, and (b) Cognitive Structure (or "indirect attitude"), which is comprised of a set of beliefs individuals have about the outcomes associated with providing funds for the project (e.g, the extent to which they believe that providing the money would help people who live in the flood plain) times their personal evaluation of that outcome (the extent to which they evaluate helping people in the flood plain as a good or a bad outcome). Factor analysis was used to narrow down the potential measures of cognitive structure, and two factors

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[11] The Tobit model is sometimes defined as a latent variable model where $y^*=\exists_0+\exists_1X+$, where ,$*X$□Normal $(0,\Phi^2)$, and $y^*=\max(0,y^*)$. Thus, the model predicts $y^*=y$ when y is non-negative, and $y^*=0$ when $y<0$. For a more thorough presentation of the model, see Wooldridge (2000).

emerged from the factor analysis; one representing non-economic outcomes and the other related to economic costs (e.g., effects on taxes and personal affordability). Generally all these variables are expected to relate positively to WTP.

Finally, there are two different kinds of risk measures evaluated in this study. The flood risk is derived by evaluating the flood risk faced by each respondent, based on their geocoded address. A dummy variable for the 100-year floodplain is included, because those individuals who own homes in the 100-year floodplain currently must carry flood insurance as a condition for obtaining a mortgage. Thus, in the absence of the project described in the survey, it is argued that the frequency of flooding will increase, and the floodplain will expand. From an insurance perspective, the consequences are inconsequential since they already reside within the 100-year floodplain, and it was not indicated that flooding risk would in any way decrease. However, the frequency of flooding will certainly increase with additional upstream development, and as such, the economic consequences will also increase. A second floodplain dummy variable is the floodplain with a 101 to 1000 year expected recurrence. This is included separately to account for the fact that these respondents might reasonably expect to find themselves within a 100 year floodplain were the plan not adopted. Finally, the recurrence interval is included as a separate measure. However, it is reasoned that changes in the recurrence interval are unimportant for those outside the 1000 year floodplain. Thus, the variable is interacted with a zero one dummy for the 1000-year floodplain. The expected sign on the floodplain dummies is positive, whereas the higher the recurrence interval, the lower is the expected WTP.

5. Empirical Findings

The OLS and Tobit models are both presented in Table 2. The coefficients in the OLS model are interpreted as the marginal impact of the right hand side variable on the dependent variable. In contrast, the coefficients in the Tobit model incorporate two distinct effects: the marginal effect of the regressor on the dependent variable, given that the dependent variable is non-negative, and the likelihood that the dependent variable is observed. However, the signs on the coefficients and their significance levels can be interpreted as they are in the OLS model. In addition, the relative magnitudes of the coefficients across variables in the Tobit model are comparable to the relative magnitudes of the OLS model. Given that 22.5% of the nonprotest bids were truncated at zero, our primary focus is on the Tobit findings.

Among the demographic variables only three variables have z-scores exceeding unity. *Years of Education* has a positive impact on WTP, as does the *Log(Real Income)*. Female respondents have a negative impact on WTP although the z-score on that variable is only barely over one. Respondents who were homeowners had significantly higher willingness to pay than non-owners. This may be reflecting an attachment to the community, since it is positive even after controlling for the flooding risk faced by the respondent. The survey control was statistically significant and in the expected direction. Higher starting points did increase the real WTP.

Turning to the psychological proxy measures, once other attitudinal measures were controlled, the political philosophy of the respondent had no significant impact on the real WTP. However, the perceived beliefs that those who are important to the respondent would favor support of the referendum (*Subjective Norms)* increases WTP. Likewise, the cognitive structure (both economic and noneconomic) significantly increase real WTP.

Finally, the findings on the flood risk measures provide some interesting insights. The coefficient on *Floodplain -100 year* and *Floodplain-101to1000 year* are both positive and statistically significant. It is interesting to note that the coefficient on the 100 year flood dummy variable is approximately ½ of the magnitude of the 101-1000 year flood zone dummy in the Tobit model. There are several possible explanations for these findings. It may well be indicating that the respondents most concerned with

Table 2. Regression Results for Flood Control Regression Model

Regression Findings – First Wave Dependent variable-Real WTP				
	OLS Results		*Tobit Results*	
Variable	*Coefficient*	*t-statistic*	*Coefficient*	*z-statistic*
Intercept	-124.630	-0.974	-261.0818	-1.696
Demographic Variables				
Age	-0.012963	-0.029	-0.146979	-0.278
Years of Education	4.875472	1.579	6.092723	1.639
Married (yes=1)	-0.982631	-0.067	-10.01678	-0.573
Number of Children	-13.38783	-0.503	-6.737680	-0.209
Female (yes=1)	-9.029407	-0.714	-15.55960	-1.034
Log(real income)	8.746852	0.719	18.47717	1.245
Survey Control				
Real Starting Point	0.128751	2.875	0.158918	2.973
Residence Controls				
Homeowner (yes=1)	24.14248	1.138	51.58785	2.017
Single Family Home	4.470710	0.250	-3.999723	-0.208
Psychological/Attitudinal Controls				
Political Philosophy	-2.320351	-0.451	-5.243528	-0.847
Subjective Norms	11.06324	1.720	20.69858	2.719
Cognitive Structure Economic	13.20584	1.445	22.66455	2.046
Cognitive Structure Non-Economic	31.02703	4.451	50.06339	5.796
Flood Risk Measures				
Floodplain - 100 year	128.2008	2.520	135.1155	2.337
Floodplain - 101 to 1000 year	286.4310	3.292	272.8914	2.706
Recurrence * Floodplain1000 year	-0.425254	-3.031	-0.434799	-2.715
Regression statistics				
R-squared	0.241048		0.228626	
Adjusted R-squared	0.194876		0.178575	
F-statistic	5.221		---	
Log likelihood	-1674.969		-1372.451	
Left censored observations	63		63	
Uncensored observations	217		217	
Mean (:) and standard deviation (Φ) of dependent variable	:=82.61 Φ=110.25		:=82.61 Φ=110.25	

flooding risk are those that fear that they may be faced with higher risk of flooding, and perhaps higher insurance premiums in the event that the expenditure on flood protection is not made. Those in the 100 year floodplain are already in the higher insurance region. Thus, they still face an increased risk in the absence of the project, but their insurance premiums will not be expected to change. Finally, the variable *Recurrence* Floodplain 1000 year* has a negative and significant coefficient. Thus, the higher is the recurrence interval, the lower is the real WTP. Note that an upstream variable, measuring properties that are upstream of the Village of Wauwatosa (a very high risk area) was included but was not statistically important, and hence was ultimately dropped from the specification.

6. Conclusions and Policy Recommendations

Collectively, these findings suggest that there are a variety of factors that contribute to willingness to pay for flood control projects, not all of which are related to the expected property damage that increased flooding would generate. After controlling for flood risk, other factors, especially those related to homeowner status, and psychological and attitudinal measures of the respondent. Social pressure appears to be an important factor helping to determine the willingness to support flood control initiatives. This suggests that the failure to incorporate attitudinal measures in CVM specifications may distort the conclusions of those models. Furthermore, demographic controls that are frequently included in CVM studies may only partially control for these influences. Indeed, when the psychological measures were omitted, most demographic measures remained insignificant. The only variable to increase in statistical significance was the real income measure, although its z-score remained just below 1.9.

These findings must be considered preliminary and this paper is one of several studies currently in progress. An analysis of the second wave responses yields some surprising results. Specifially, whereas the attitudes towards the referendum were stable, the average real WTP was slightly higher (ie., the average increased approximately $6 to $88.98), and some of the determinants that were found to be important in the first wave, were no longer significant in the second wave. Most notably, the measures of flood risk were no longer statistically significant. Finally, it should be pointed out that the structure of the survey permits an alternative estimation methodology using discrete choice approaches advocated by Arrow et. al., (1993) Blue Ribbon Panel. We have only just begun to explore these alternative approaches.

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