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ABSTRACT. *This paper contrasts the results of the contingent valuation, hedonic price, and property damages avoided valuation techniques. Each technique was used to estimate the value of flood risk reduction from the construction of a flood control project. Voting behavior in a referendum called specifically for the provision of the project was used to further interpret the results from the three valuation studies. Substantial differences were found between the estimates. In explaining these differences an alternative perspective on the current debate over the validity and accuracy of nonmarket value estimates is offered.* (JEL Q20)

I. INTRODUCTION

Roanoke, Virginia, has experienced ten floods of varying magnitude since the turn of the century, with major floods occurring in 1959, 1972, 1978, and 1985. The November 1985 flood that caused an estimated $200 million in flood damages motivated city support for a U.S. Army Corps of Engineers project to widen the river channel, build protective walls and dikes at several locations, and install a flood warning system (*Roanoke Times and World News* 1989; U.S. Army Corps of Engineers 1984). In a city of about 100,000 people, the project would reduce the probability of flooding for 2,265 single- and multiple-family residential structures. Also, the project would provide flood protection to about $250 million invested in businesses and industry employing about 5,000 people.

Under federal law, the city was required to provide $14.3 million dollars of the $34.4 million needed to build the project. The city raised $6.8 million through private land donations and other funding sources. A special single-issue referendum was called April 11, 1989, asking voters to approve a $7.5 million bond issue to finance the city's remaining cash share of the project's cost. The citywide utility tax would be raised from 10 to 12 percent to repay the bond. The city estimated that the average household's utility bill would rise by approximately $24 per year for fifteen years. Because alternative flood reduction proposals were considered politically infeasible, rejection of the bond issue implied that the city would be without any flood protection measures for years to come. The bond issue passed with over 56 percent support (4,271 to 3,273), with 19.6 percent of the registered city voters casting ballots.

A series of previously published papers and reports estimated the flood risk reduction benefits from the construction of the Roanoke flood control project (U.S. Army Corps of Engineers 1984; Thunberg and Shabman 1991; Driscoll, Dietz, and Alwang 1994). The objective of this paper is to compare residential flood risk reduction benefit estimates from the property damages avoided (PDA), hedonic price, and contingent valuation (CVM) techniques. In addition, voting behavior in the referendum called exclusively for the flood control project provides evidence about actual citizen choices for this particular nonmarket commodity.

This paper is divided into four sections. The first describes three previously published studies designed to estimate the benefits to flood risk reduction for a group of residential landowners. The second section presents the benefit estimates from each study and includes a comparison of CVM survey responses with actual voting choices made in the flood control referendum. Based on these empirical findings, we argue in the final two sections that the results lend support for an alternative perspective on the

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current debate over the validity of different nonmarket valuation techniques.

II. NONMARKET VALUATION TECHNIQUES APPLIED TO FLOOD RISK REDUCTION

Two criteria are used in Figure 1 for categorizing the nonmarket techniques used in this study: (1) whether choices are *revealed* through some market exchange or are *hypothetical* in an imagined market setting, and (2) whether choices are made to secure the flood risk reduction service (a *direct* choice) or to secure a good or service related to flood risk (an *indirect* choice). Techniques in cells (1)–(3) are ways to approximate the value that would arise in cell (4) if market trading for the flood risk reducing project was possible.

The specific nonmarket valuation techniques listed in cells (1)–(3) were used to estimate the individual property owners' value for flood risk reduction. Of the residential neighborhoods exposed to a flood risk, an area in southeast Roanoke that consisted of relatively homogeneous, residential properties was selected as the study site. This particular neighborhood consisted of 134 landowners.

The U.S. Army Corps of Engineers (1984) used the property damages avoided (PDA) technique (Cell 1) to calculate the residential flood control benefits for individual properties in the case study area. Procedurally, the analyst using PDA computes the repair costs to a specific property with and without a flood risk reduction project for a given flood event. The difference between repair costs is the annual flood risk reduction benefit estimate for that flood. The analyst then weights each benefit estimate by the likelihood of the flood event in a year and sums over all possible floods to calculate the annual expected benefits for the property. The present value of the expected annual benefits, computed at the project discount rate, is the total benefit to the property. The PDA technique is hypothetical since no post-flood repair choices are observed. Instead it is assumed that the property owner would make such repairs. Also, PDA is an indirect benefit measure since repair costs are a proxy for the commodity of interest—flood risk reduction.

The hedonic price technique (Cell 2) estimates the implicit price land market traders are willing to pay for a marginal reduction in the level of flood risk (Cropper and Oates 1992). To arrive at a total benefit estimate, this implicit price is multiplied by the amount a flood control project is expected to reduce flood risk. Individuals are not directly observed purchasing flood risk reduction, but value estimates are statistically

CHOICE BEHAVIOR	COMMODITY BEING VALUED: Indirect	Direct
Hypothetical	(1) Avoided Damages	(3) Contingent Valuation Method
Revealed	(2) Hedonic Price *	(4) Market Valuation (Benchmark)

FIGURE 1

APPROACHES TO NONMARKET VALUATION

*The travel cost, averting behavior, and weak complementarity approaches also derive benefit estimates based on revealed choices about related goods. See Cropper and Oates (1992) for a summary of these three indirect revealed approaches to benefit estimation.

inferred from revealed differences in property prices.[1]

A hedonic price equation for the Roanoke case study area was estimated using 99 property transactions sold at fair market prices between 1980 and 1990 (Driscoll, Dietz, and Alwang 1994). The database excluded properties not repaired after the 1985 flood. The different degrees of flood risk at each property were represented in the hedonic price equation by a flood zone variable defined as the percent chance of not being flooded in a given year.

The final estimated equation predicted that land traders after the 1985 flood were willing to pay higher prices for property that was less likely to be flooded. Prior to 1985, however, the flood zone location of property did not have a significant effect on land prices. The 1985 flood appears to have focused traders' attention on a previously unacknowledged flood hazard, despite the fact that floods of smaller magnitudes had occurred as recently as 1978. For this paper the benefits in the case study area were calculated by determining the change in flood zone for each property with versus without the project and multiplying the change by the hedonic price.

The contingent valuation method (CVM) is a direct hypothetical approach to benefit estimation (Cell 3) because it asks individuals for their willingness to pay for a prospective change in a nonmarket resource (Cummings, Brookshire, and Schulze 1986; Mitchell and Carson 1989). A contingent valuation study for the residential study area in Roanoke was administered in the fall of 1987, about two and a half years after the 1985 flood (Thunberg and Shabman 1991). Efforts were made to contact all 134 landowners in the study area. From this population, 86 individuals were eventually contacted and agreed to participate in the study. The CVM questionnaire was designed using state-of-the-art procedures existing at that time.[2] The CVM questionnaire was administered through a personal interview at the respondent's home, and the respondent's statements of willingness to pay were used as the benefit estimates for the flood risk reduction project. Although the personal interview is the most expensive survey instrument, it is generally thought to produce the best overall CVM results (Mitchell and Carson 1989; NOAA 1993).

In setting up the contingent market, the general characteristics of the proposed flood control project were described to the respondents. The interviewer highlighted some of the damages associated with the 1985 flood, described in general how these damages would be reduced by the construction of the project, and presented respondents with illustrations of the physical appearance of the project. The commodity to be valued —flood risk reduction—was then presented to the respondent as the probability of flood water entering the landowner's first floor at least once in ten years (see the Appendix for the description of the commodity and WTP questions). Visual aids (pie charts) and follow-up questions were used to ensure that respondents understood what "commodity" was being described (Thunberg 1988).

The landowner was informed that the project cost would be shared between the city and the federal government. At the time of the CVM interviews, there had been no decision to hold the bond referendum. The respondents were presented with two hypothetical payment methods: (1) respondents were asked how much they would pay for the project in a onetime assessment (lump-sum bid), and (2) how much they would pay each year for fifteen years (annual payment bid). A payment card was used to elicit WTP responses. A payment card was chosen over the dichotomous choice and open-ended formats for several reasons. The open-ended question has been

[1] Another indirect measure of flood risk reduction would be flood insurance purchases. This approach was not used to measure benefits to flood risk reduction, because property owners were *required* to obtain flood insurance as a condition to receive disaster relief assistance following the 1985 flood. Thus, the flood insurance purchase was not a voluntary choice.

[2] With the exception of the payment card, many of the design features used to construct this CVM questionnaire reflect the NOAA panel's CVM design guidelines (NOAA 1993).

criticized as being too difficult for respondents to answer since most people have no experience with valuing a nonmarket good (NOAA 1993). Unlike an open-ended question, the payment card approach allows the respondent to consider a range of possible WTP bids. A single follow-up question was designed to focus the respondent's attention on the "purchase" decision, and to ensure that the bid given indeed represented the respondent's maximum willingness to pay (Thunberg 1988). Although increasingly popular among CVM practitioners, the use of the dichotomous choice format raises a number of statistical concerns including the need for large sample sizes to generate robust statistical models (Cameron and Huppert 1991).[3]

III. COMPARING RESULTS FROM THE NONMARKET VALUATION TECHNIQUES

To date there has been no research which compares estimates from the three different approaches to nonmarket valuation shown in Figure 1 (Cells 1, 2, and 3). Some comparative studies of nonmarket benefit estimation techniques have compared the travel cost (Cell 2) and CVM (Thayer 1981; Seller, Stoll, and Chavas 1985; Smith, Desvousges, and Fisher 1986; Loomis, Creel, and Park 1991). Others have compared CVM with the hedonic price technique (Brookshire, Thayer, Schulze, and d'Arge 1982; Blomquist 1988). Some researchers have found that different nonmarket techniques generated similar results (Thayer 1981; Seller, Stoll, and Chavas 1985). In comparing hedonic and CVM estimates for the value of a scenic view, Blomquist (1988) found CVM estimates were not significantly greater than hedonic estimates. Other researchers have reported opposite results. Brookshire et al. (1982) found hedonic price benefit estimates for changes in air quality were double or triple CVM estimates, but concluded these differences could be explained by the limitations of the hedonic price technique.

Another type of research has compared the hypothetical responses to a CVM survey with observed behavior (Cells 3 and 4) (Smith 1993; Hanemann 1994; Cummings and Harrison 1994). Specific comparisons have been made between hypothetical CVM choices and actual choices for tradable or private goods and between hypothetical CVM choices and actual choices made in experimental settings. Dickie, Fisher, and Gerking (1987) compared hypothetical and actual strawberry sales while Neill et al. (1994) compared hypothetical willingness to pay for a painting and a map with actual payment commitments revealed in an auction setting. Bishop and Heberlein (1979, 1990) conducted a number of experiments which examined actual and hypothetical choices regarding the sale and purchase of hunting permits. These and similar studies report cases of both consistent and inconsistent choices (see Smith 1993 and Hanemann 1994 for a comprehensive summary). Studies which compared hypothetical to actual giving to environmental groups/causes have generated less favorable results. Kealy, Montgomery, and Dovidio (1990) recorded respondents' hypothetical WTP for deacidification of New York lakes. Two weeks later the same group was asked for an actual payment. This study concluded that individuals were likely to overstate their WTP in the hypothetical situation. Seip and Strand (1992) asked a group of Norwegian respondents what they would be willing to pay to join a prominent Norwegian environmental group. Those that indicated they would pay to join were contacted a month later and asked to join. Less than 10 percent of these respondents actually agreed to join, again suggesting CVM overstatements of willingness to pay.

What is missing from the literature is a direct comparison of benefit estimation techniques with actual choices people make about a *nonmarket* good in a *nonexperimental setting*. Revealed voting behavior has been

[3] Some studies have shown that the WTP question format creates statistically significant differences in individual WTP responses (Kealy and Turner 1993; Johnson, Brengenzer, and Shelby 1990), while others report that different WTP formats generate similar results (Reaves 1993).

suggested as the closest nonexperimental direct test of the hypothetical nature of the CVM instrument (Hanemann 1994). Voting behavior in the Roanoke referendum could be classified under Cell 4 in Figure 1. In the Roanoke referendum individual voters made direct choices about paying for the flood control project. The bond referendum was called specifically for voter approval of this particular bond issue and was not held in conjunction with any local, state, or national election. The revenue from the bond issue was earmarked exclusively for the flood control project. The additional tax costs for the individual citizen were clear and well publicized.

In this study, we were able to compare individuals' voting behavior in the referendum to the bids they made in the CVM survey, by using voting records on whether the property owner was registered to vote and whether he/she voted in the Roanoke flood control referendum. CVM respondents had the opportunity to vote for the exact same flood control project that was described to them a year and a half earlier during the CVM interview. While the CVM bid elicitation procedure was not presented in referendum format, the annual payment WTP question was similar to the way citizens were actually asked to pay for the project.

Thus, comparisons could be made between each benefit estimation technique and between CVM bids and actual voting behavior. For an *identical* set of residential properties and property owners, there was a PDA (Cell 1) and hedonic price (Cell 2) estimate for the parcel, and lump-sum and annual payment CVM bids (Cell 3) and evidence of voting behavior for the owner of that parcel (Cell 4). A total of 73 observations were included in the comparative analysis.[4]

Comparing PDA, Hedonic, and CVM Benefit Estimates

Mean benefit estimates by flood zone (the probability of being flooded in any given year) for the three techniques are presented in Figure 2. By using the lump-sum CVM bids in Figure 2, all three estimates can be interpreted as the present value of expected net benefits from the reduction in flood risk. The hedonic price technique generated the largest estimates, with the gap between the estimates greatest for the most flood prone areas. For those with a greater than 2 percent chance of being flooded, the hedonic price estimates are two to three times greater than the PDA estimates and dwarf the CVM lump-sum bids. For those with a less than 2 percent chance of being flooded, the hedonic estimates are more similar to mean CVM bids, but still greater than PDA estimates. Property owners faced with a 5 percent and 2 percent chance of being flooded, stated they would only be willing to pay a total of $115 and $203, respectively, for the project. The Corps estimated that the present value of avoided property damages for the same property owners was $2,412 and $908, respectively. In addition, the hedonic price estimates indicated that people were willing to pay a substantial premium for reductions in flood risk.

Of the 73 CVM survey respondents included in this analysis, 18 would not respond (protesters) and 11 could not respond (uncertain) to the CVM willingness-to-pay question. Their bids were entered as zero bids in developing Figure 2. Most protesters objected to being asked to pay for the project, feeling that they had suffered from the 1985 flood and that someone else —like the federal government—should pay for the project. Those who could not respond (15 percent of respondents) were simply unable to provide a willingness-to-pay bid, even when prodded by the interviewer. Presented the task of "purchasing" something so unfamiliar as a reduction in flood risk, these respondents either could not comprehend the willingness-to-pay question or were unable to attach a monetary figure to the reduction in flood risk. Table 1 summarizes

[4] From these voting records, 13 of the 86 property owners either did not reside in the city at the time of the referendum or could not be clearly identified, leaving an effective sample of 73. The relatively small sample is one potential limitation of this comparison. Similar comparisons for identical groups of respondents, however, have been conducted with fewer observations (Smith, Desvousges, and Fisher 1986).

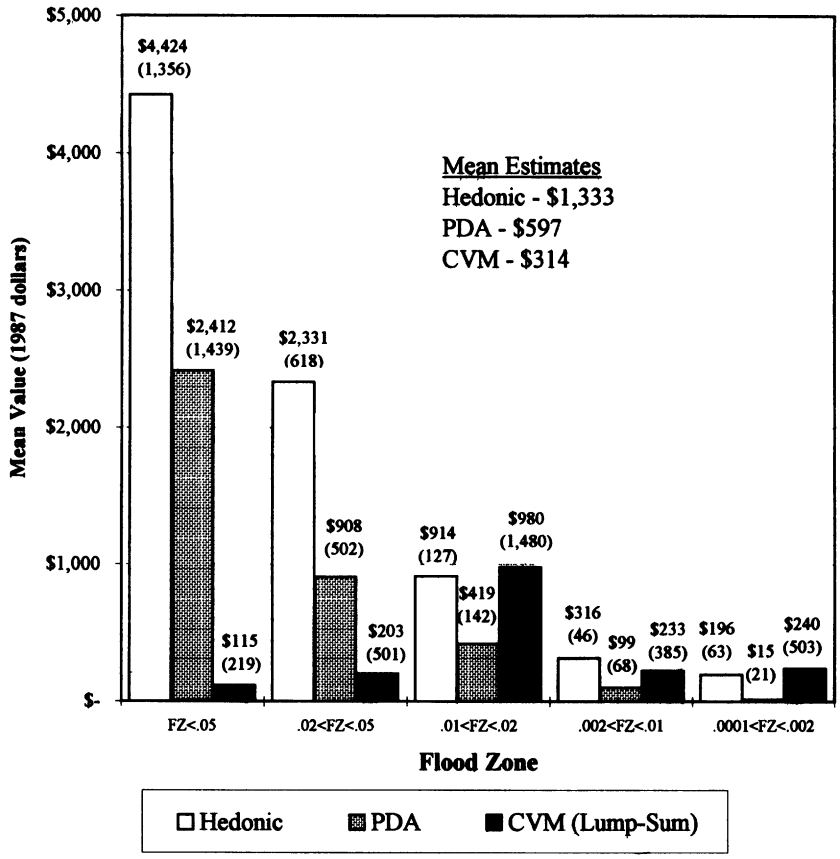

FIGURE 2
MEAN VALUES OF ESTIMATES BY FLOOD ZONE
(Standard deviations are in parentheses.)

TABLE 1
CVM LUMP-SUM WTP BIDS BY FLOOD ZONE

	CVM Bid Range		Mean CVM Bids		
Flood Zone	Min.	Max.	All Bids	Excluding Uncertain Bids	Excluding Uncertain & Protest Bids
FZ < .05	0	600	115.00	143.75	230.00
.02 < FZ ≤ .05	0	2,000	203.33	305.00	381.25
.01 < FZ ≤ .02	0	5,000	980.00	980.00	1,225.00
.002 < FZ ≤ .01	0	1,500	223.08	241.67	322.22
.0001 < FZ ≤ .002	0	2,000	240.00	272.72	428.57
All FZ	0	5,000	313.70	369.35	520.45

the mean CVM bids by flood zone including all bids; excluding just uncertain bids; and excluding protest bids and uncertain bids. The same general pattern shown in Figure 2 holds regardless of whether protest or uncertain bids are included: average willingness-to-pay bids were still substantially lower than PDA and hedonic estimates.[5]

Comparing CVM Responses to Referendum Voting Behavior

CVM respondents had an opportunity to vote for the project and impose only a small annual utility tax on themselves. Therefore, the *annual* payment CVM question was similar to the way citizens were asked to pay for the flood control project in the flood control referendum (see Appendix). Table 2 reports the distribution of voting behavior for those who provided positive, zero, and uncertain/protest bids in the CVM study. First, note that only 28 of the 73 CVM respondents voted in the referendum. Second, consider the CVM responses of those who did vote. A little more than a third (10 out of 28 voters) had positive CVM bids, but half of the 28 voters had stated either a protest or uncertain WTP bid. Third, it appears that people not registered to vote were most likely to state a positive WTP bid, and least likely to protest the WTP question. Overall, those who had been most likely to state a positive willingness-to-pay bid were the least likely to carry through with that choice in the voting booth.

Table 3 shows the mean annual WTP bids for those who voted, those who were registered to vote but did not, and those not registered to vote. Sixteen positive bidders who were not registered to vote had stated they would be willing to pay—on average—about $124 each year for 15 years. Conversely, those who actually voted stated a willingness to pay of about $93 each year. Considering all CVM participants, the average WTP bids of those not registered to vote were more than double those who did vote. Thus, the nonregistered voters were not only more likely to offer a positive bid, but they also stated higher bids, on average, than the other voter groups. In summary, expressions of willingness to pay in the hypothetical CVM bids did not translate into actual choice behavior.

IV. ON THE DIFFERENCES IN ESTIMATES

The standard nonmarket valuation techniques that were used to measure individual landowner benefits for reduced flood risk along the Roanoke River originate from the utility maximization framework of neoclassical economics. This framework justifies interpreting people's choices to infer, and then monetize, their preferences. If individuals have consistent preferences for alternative states of the world and choose according to

[5] While those with a 1 to 2 percent chance of flooding provided the largest mean WTP, the largest WTP bid ($5,000) was also given by a respondent in this flood zone. Excluding this bid, the average falls from $980 to $533.

TABLE 2
CVM ANNUAL PAYMENT BIDS AND VOTING BEHAVIOR: NUMBER OF RESPONDENTS

Class	CVMBID > 0	CVMBID = 0	Protest & Uncertain	Total
Registered and Voted	10	4	14	28
Registered and Did Not Vote	4	1	12	17
Not Registered	16	6	6	28
Total	30	11	32	73

TABLE 3
CVM ANNUAL PAYMENT BIDS AND VOTING BEHAVIOR: AVERAGE BIDS

Class	Positive Bidders	Positive & Zero Bidders	All Respondents
Registered and Voted	$92.90	$66.35	$33.18
Registered and Did Not Vote	$91.25	$73.00	$21.47
Not Registered	$124.38	$90.45	$71.07

those preferences, subject to income and price constraints, then buyers and sellers will equate their marginal utility for the traded goods and services to market prices. As a result, prices reflect marginal valuations and thus provide the empirical data for preference measurement. Absent market prices, interpretation of prices paid or received for related goods and services (PDA and hedonic price) or stated choice intentions on a CVM survey that has been carefully designed to mimic a "real" market choice provide the basis for value inference.

Using the neoclassical model of choice as a logical foundation, the PDA estimate implicitly assumes that a utility maximizing individual would compute flood risk reduction benefits in the same fashion as the analyst.[6] The PDA analysis implies that avoided damages to real property is the only argument in the flood plain occupant's utility function. The PDA technique also assumes that the flood plain occupant possesses the project planner's knowledge and understanding about the probability and consequences of flood events and has a time horizon, risk attitude, and discount rate equivalent to that used by the analyst.

The hedonic price and CVM techniques do not require this strict parallelism between the analyst and the flood plain occupants' assessment of the flood risk situation. Since PDA generates estimates that are not based on any observed behavior, different value estimates for flood protection among PDA and the other techniques should be expected. The utility maximization framework, however, does not predict how actual or assumed conditions embedded in the different nonmarket valuation techniques will yield different results.

Thus this study's different and contradictory results among the valuation measures and voting behavior may prompt the question, "Which technique provides the correct estimate?" Indeed, the debate in the nonmarket benefit estimation literature tends to revolve around questions about whether a particular technique generates an "unbiased," "reliable," or "accurate" estimate. It is often pointed out that the hedonic price technique generates upwardly *biased* estimates for nonmarginal changes in flood risk (Freeman 1979).[7] Much of the CVM literature is filled with studies concerned with the many potential *biases* associated with the measurement instrument (i.e., nonresponse *bias*, payment method *bias*, strategic *bias*, information *bias*, anchoring *bias*). In a recent summary of this CVM literature, Smith notes:

> Because mainstream economists remain skeptical of the insights derived from people's responses to hypothetical questions, initial objections to CVM crystallized around two general questions: is CVM reliable, and is it accurate? The next stage in CVM research sought to address these questions in a variety of ways. The

[6] The PDA technique is one of the many approaches to value estimation that uses an analyst's estimate of the potential increase in net income as a measure of benefits. Examples of this approach are the valuation of increased irrigation water to a farm or the valuation of improved fish harvest opportunities in a commercial fishery.

[7] In the more flood prone areas, the project is expected to substantially reduce the threat of flooding. Thus, the benefit estimates based on hedonic prices will "overstate" total WTP for these nonmarginal changes in flood risk. Adjustments made to compensate for this problem in the Driscoll, Dietz, and Alwang (1994) study, however, do not bring consistency among hedonic, PDA, and CVM estimates.

current stage in CVM research is derivative of both these efforts. (Smith 1993, 8)

The current debate surrounding nonmarket benefit estimation techniques (particularly CVM) rests on the premise that there exists a single "true" value for which an accurate and unbiased estimate is being made. The search for a "true" value is premised on (i) the neoclassical utility maximization model's behavioral postulate that individual's have stable, precise, and well-defined preferences, and (ii) that only the limitations of economists' nonmarket valuation techniques stand as a barrier to calculating the true value. One economist in reflecting on the differences between choices made in laboratory setting and choice intentions stated in a CVM survey expressed the following desire:

> What I want to know is whether a neoclassical framework is inferior to existing, perhaps more realistic, more detailed, or more accurate models of "true" behavior when my analytical purpose is to assess the willingness of people to sacrifice some goods (some market goods or disposable income) in order to maintain or restore environmental attributes. (Swallow 1994, 1009)

However, there may be no single "true" behavior if preferences vary across time and between choice-making circumstances. Choices are made by "human beings [who] have unstable, inconsistent, incompletely evoked, and imprecise goals at least in part because of human inabilities to limit preference orderliness" (March 1978, 598). Psychologists have noted that when choices are made under unfamiliar, complex, uncertain, and limited information conditions, people do not recall preferences as much as *construct* preferences in the context of specific choice circumstances (Fischoff 1991). Rather than arguing that the observed differences in the Roanoke studies arise from limitations of the techniques, we believe that a more compelling argument for the differences rests in the notion of constructed preferences. In support of this view, we draw upon the work of psychologists and the critiques of neoclassical preference theory by neo-Austrian and institutional economists.

Many psychologists stress that the typical choices observed in a CVM scenario are not *retrieved* from previously formed preferences, but are instead more likely *constructed* (Tversky, Sattath, and Slovic 1988; Slovic, Griffin, and Tversky 1990; Gregory, Lichtenstein, and Slovic 1993; Schkade and Payne 1994; Schkade 1995). Fischoff, Slovic, and Lichtenstein (1980, 118) state that "subtle aspects of how problems are posed, questions are phrased, and responses are elicited can have substantial impact on judgments that supposedly express people's true values." In the process of how a researcher asks questions, preferences are created. Common "biases" found in the CVM literature—such as information bias, payment vehicle bias, payment method bias, anchoring bias—take on an entirely different meaning in the context of constructed preferences. After finding that subtle changes in WTP elicitation format result in significant differences in WTP responses, McFadden (1994, 706) concludes:

> The experiments display patterns that are more easily explained by "constructed" preferences rather than by rational individualistic stationary preferences. While the magnitude of the effects in this experiment may depend on its particular design, including the survey method and the clarity and cogency of the resource issue, they are nevertheless typical of psychometric distortions that pervade market research and psychological experiments. (McFadden 1994, 706)

CVM scenarios usually involve descriptions of complex problems and ask respondents to undertake complex mental tasks. The more complex the decision problem, the more likely responses will be constructed based only on a fraction of the available information (Gregory, Lichtenstein, and Slovic 1993). In a study of the actual mental processes people undertake in CVM studies, Schkade and Payne (1994) found few instances of people trading off income for a change in the provision of an environmental good. Instead, respondents sought to simplify and redefine the problem into a more manageable form or into a form

that they typically think about similar issues. During the CVM interview process in Roanoke, the cognitive demands of placing a monetary value on the reduced probability of flooding was enough for 15 percent of the respondents to give up even trying to come up with a WTP bid (Thunberg 1988). Many respondents had a difficult time attempting to come up with a willingness-to-pay bid despite the fact that the consequences of flooding and the flood control project were familiar and had had a direct effect on their lives.

The hedonic model also reflected the cognitive difficulties people have making choices in a complex and uncertain decision environment. When housing purchases are considered, the buyer is simultaneously considering dozens of attributes of the particular property: number of bedrooms, condition of the plumbing, location of the neighborhood, the barking dog next door, the condition of homes nearby, the quality of the local schools, street congestion, and the size of the lot. Somewhere in these considerations, the location of the house in relation to the river is noted. In the Roanoke study land market traders appear unable to understand flood potential without some major flood to anchor their perceptions. There was no statistical evidence in the housing transactions prior to 1985 to indicate land market traders considered the flooding a significant risk. The results of the Roanoke hedonic price study are consistent with results from controlled laboratory experiments designed to solicit measures of subjective probability of natural hazards. This research suggests that for natural hazards, low probabilities are, at some point, assigned a zero value. Thus the objective probability of loss is ignored (Slovic et al. 1977; Schoemaker and Kunreuther 1979). Kunreuther (1985) argues that unlike technological risks, people generally "focus on the low probability aspect of a natural disaster, claiming 'it won't happen to me.'" It was the severity of the 1985 flood that appeared to focus land traders' attention on the flood hazard. Tobin and Montz (1994) also found that hedonic estimates are sensitive to the market traders' recent experience with a natural hazard. Hedonic price estimates were either very large or zero depending on the timing of the study vis-à-vis the latest flood. It would be reasonable to hypothesize that the magnitude of CVM bids would also be dependent on the timing of the study regardless of the quantity or quality of objective information provided to the respondent. The important point here is that the magnitude of a hedonic price estimate can be attributed to the process of preference construction in a real, as opposed to artificial, market.

The neo-Austrian economist would not be surprised at the shifting preferences revealed in the Roanoke housing market. For the neo-Austrian economist, market prices are a historical record of choices made by traders under time-specific circumstances of information, income, and available alternatives. People's preferences are expected to change over time with new knowledge about, and experiences with, certain goods and services, and, as a result, people may be willing (or unwilling) to pay more of their money income for those services. In the Austrian world, equilibrium never exists at the level of the market and is only a temporary state for individual market traders. Indeed, neo-Austrian economists reject the equilibrium models of neoclassical economics that allow prices to be interpreted as marginal values. Market prices encourage people to continuously adjust preferences which are discovered and revised during market exchange (Dolan 1976; Baird 1989). Klamer and McCloskey describe the Austrian view this way:

> The problem in economic life is not calculating what to do after knowing all that you need to know. The problem is to know. The Austrians see the economy with the metaphor of fog, the fog in which we maximize what the neo-classicals so confidently describe as "objective functions" . . . the main problem is acquiring knowledge not exploiting it. (Klamer and McCloskey 1988, 10)

Thus for the Austrian economist, the search for a stable and precise value is misplaced since choices are both conditional and made

in a "fog." From the Austrian viewpoint, all hedonic estimates are "correct," and they should be expected to be different because they were constructed under different circumstances, experiences, and information.

In addition to the influence of cognitive obstacles, moral considerations affect preference construction. Gregory, Lichtenstein, and Slovic (1993, 181) add that "an important corollary of the constructive view is that strong values that people hold for environmental goods are not represented in their minds in monetary form." People may express strong positive feelings for a particular nonmarket commodity, but they are not accustomed to thinking about nonmarket goods in dollar terms. While acknowledging that the averaging citizen places some positive value on nonmarket commodities, Schkade (1995, 113) states "because these preferences are usually quite vague and are given form only in response to a question, little more can be said with confidence about the precise magnitude of the monetary values that attach to them." Stevens et al. (1991) concluded that protests to a WTP question can be traced to either an unwillingness or inability of respondents to trade income for a moral principle.

Equity concerns also appeared to substantially influence CVM bids. Some Roanoke respondents objected to a "victim pays" principle implied by the CVM questions.[8] Evidence from the Roanoke CVM study suggests that *how* the flood protection was going to be paid for was at least as important as *how much* flood protection was provided. To many of the respondents, the relevant question was not "What am I willing to pay for reduced flood risk provided by the flood control project?" but rather "Who should pay for the project?" The general feeling among many CVM respondents, who gave both protest and positive bids, was that it seemed unfair to ask those who suffered the most financial and personal flood-related loss to have to pay for the project (Thunberg 1988). This fairness issue is one of the most plausible explanations for the low CVM bids relative to hedonic and PDA estimates in the most flood prone areas.

Beyond cognitive and moral issues, institutional economists would emphasize that each choice is made within a context that shapes people's preferences (Hodgson 1988; Vatn and Bromley 1994). The actual provision of nonmarket goods is usually undertaken in the political arena, and it is within this context that people form and express values about nonmarket commodities. In public decisions like the Roanoke referendum, people are expected to consider the broadly defined interests of the community. In fact a citywide telephone survey found that civic concerns were the most important factors in explaining the referendum results (Shabman and Stephenson 1992, 1994). The large majority of project supporters did not live or work in the flood plain yet tended to vote for the project to help others who suffered from flooding. Also, many city residents paid little attention to what the project was going to cost them in increased taxes. Although the details of the bond issue and flood control project were well publicized by the local media and the city, about 20 percent of all voters did not even know their taxes would increase. Another 33 percent of all voters knew about the tax increase but had no idea by how much their taxes would increase.[9] It seems that the actual decision process for the citizens of Roanoke revolved more around moral and civic issues. Attaching monetary consequences to the voting choice did not appear particularly important when preferences were being constructed for application in the voting booth.

Another contextual difference between the CVM study and voting behavior seems to have been particularly important. The

[8] It should be pointed out that this "victim pays" problem is not unique to this CVM study. CVM often imposes an entitlement structure that is different than what most people would assume. For instance, people may presume that they have a right to clean air or a healthy wildlife population. In these cases people may feel they should not have to pay for something that they consider "theirs" (Vatn and Bromley 1994, 141).

[9] This unawareness or unconcern for the tax costs involved eliminated the possibility of estimating Roanoke citizens' WTP for reduced flood hazards from the voting survey.

CVM questionnaire was administered by an interviewer sitting in the respondent's home probing for an answer to a hypothetical scenario. The respondent expressed an opinion about the flood control project and flood risk without an obligation to act on that opinion. There was no obligation to pay and there were no consequences associated with the opinion they held. The individual was a willing, but passive, subject. On the other hand, voting behavior required an expression of commitment. Voting required an action. The differences between voting behavior and opinions in the Roanoke studies indicate that the distinction between stating an opinion (preference) and making a choice is not a trivial one.

The proposition that preferences are constructed within choice-making circumstances is a useful framework for understanding the different results from the techniques used in the Roanoke study. In constructing preferences people tend to frame the choice problem within a familiar, manageable, and morally acceptable decision context. Each decision context differs from cell to cell in Figure 1. The hedonic price technique relies on the outcomes of bargained trades in the land market to generate benefit estimates. The CVM survey derives benefit estimates within the context of a person providing hypothetical answers to a university survey. When residents enter the polling booth, they face the similar WTP question not as a purchaser of reduced flood risk, but as a city citizen. This makes the search for a "true," "correct," or "unbiased" benefit estimate a futile one. Indeed, different benefit estimates from different techniques are not to be explained away, they are to be expected.

V. BENEFIT ESTIMATION IN PUBLIC DECISION MAKING

Based on the empirical evidence from the Roanoke studies and the critiques of the economic choice model, in a world of constructed preferences we believe economists should abandon the search for "unbiased" and "accurate" benefit estimates. For support of public decisions, however, there is a criterion to judge benefit estimation techniques. In our view that criterion warrants choosing the technique that best facilitates a collective choice process. In reflecting on how choices are made in public policy, Lindblom (1990) has emphasized how preferences (volitions) of partisan participants emerge and change in response to the process of social problem solving.[10] Sagoff states:

> Like actual markets, democracy does not take preferences as they come but alters them; for example, it subjects them to public scrutiny and debate . . . . The values emerging from democratic decision-making are supposed to differ from those entering it; the capacity of political debate to transform views even lends legitimacy to the political process. (Sagoff 1994, 136)

To facilitate this process, an acceptable benefit estimation technique does not have to measure or quantify all possible effects in direct accord with theoretical willingness-to-pay logic; instead the decision-participants must believe that the estimate reflects some salient feature of a choice. It also means that the estimate needs to be understandable to those who might use it. Participants in the public choice process then can focus on the merits of the issue under consideration, and not on the measurement technique.

The history of benefit estimation for flood control projects provides an excellent example of how benefit estimation techniques have met this criterion. The PDA endures as a useful benefit estimation technique for a variety of reasons—none of which is based on the argument that it is an accurate or comprehensive measure of the benefits of flood control. First, the PDA approach has a compelling, appealing, and understandable investment logic: if current expenditures for a flood control project were less than the present value of avoided future property repair costs, then the project may be justi-

[10] This view contrasts sharply with many economic models of the political process which assumes interest groups have well-articulated and stable preference orderings (Bullock 1994).

fied. Second, the limitations were well recognized and understood by participants in the decision process. The PDA has never been treated as an accurate measure of willingness to pay because the narrow PDA focus on property damages has long been recognized (Federal Inter-Agency River Basin Committee 1950; U.S. Water Resources Council 1969, 1973, 1983). Because it is clear to decision-participants what PDA is and is not measuring, when project investment priorities are set, the calculation of PDA benefits are part of a broader consideration of the "nonproperty" effects that may be mitigated by a project (Shabman 1989). For these reasons, PDA continues to be the primary technique to measure flood control benefits, even though CVM and the hedonic price techniques are conceptually able to quantify a wider range of flood control benefits.

Positive net benefits based on PDA estimates might get a project plan to the negotiating table, where the "value" of the project is discovered through inquiry, deliberation, and debate. Prior to the use of PDA, cooperative levee and flood districts estimated benefits from reduced flood risk as the expected differences in land prices with versus without a flood control project. The differences in land prices served as a starting point for negotiations between the districts and benefiting landowners on the property tax payments that would be made to pay for project construction. Like PDA, these hedonic estimates were not accepted as the benefits from the project, but they did help structure the negotiations over the benefits (Shabman 1989).

This history should not be surprising to the economist. The private real estate market operates in an analogous fashion. The real estate appraiser can use a variety of methods to estimate the value of a particular property. Yet, the initial estimate of the appraiser is not considered the "value" of the property by the buyers and sellers. Value, in terms of a price, is the outcome of a negotiating process between the buyer and the seller with the appraiser acting as one provider of expert opinion.

This brief review of the current use of flood control benefit estimates provides lessons for those who advocate expanded use of CVM studies in decision making. Certainly, as CVM advocates claim, the CVM is theoretically capable of establishing the willingness to pay for the entire range of use and non-use services of the environment. Recently, CVM advocates have been buoyed by the opportunity to apply the technique in natural resource damage assessments (Randall 1993). Yet, many question whether court awards are anchored to these benefit estimates. Some have pointed out that CVM provides little useful policy information about the reasons why damages are awarded in the first place: compensating direct individual users harmed, paying for environmental restoration, and deterring future accidents (Castle, Berrens, and Adams 1994). In addressing these issues, CVM would not even be needed since other, more acceptable, analyses and techniques can be used (McManus 1994; Castle, Berrens, and Adams 1994).

At times, the proposed use of CVM results has generated more controversy than application in decision making (Diamond and Hausman 1994; Hanemann 1994; Portney 1994). In cases where CVM may be applied, the conflicting results in the CVM literature provide ample rebuttable evidence to challenge CVM estimates in court (McManus 1994; Anonymous 1992). The controversial nature of the CVM has been cited as the primary reason why the Clinton administration is formally distancing itself from supporting use of CVM in natural resource damage assessments (*Water Policy Report* 1995). Recently, Doug Hall, deputy administrator of NOAA stated, "While we firmly believe that CVM is a reliable economic tool, it has been seldom used and is of less significance to the natural resource damage assessment process than the debate regarding it would indicate." Hall goes on to say that the focus of the natural resource damage assessment process " . . . accorded too much attention to the methodologies used in the valuation process, namely contingent valuation, and too little attention to the goal of . . . restoration of natural

resources" (quoted in *Water Policy Report* 1995, 27). NOAA's final NRDA regulation, issued January 1996, deemphasizes CVM in favor of increased attention on restoration costs (*Water Policy Report* 1996). Clearly, only when a reasonable consensus and confidence develops among decision makers over the usefulness of any technique will the technique play a significant role in the collective choice process.

To be professionally effective in public policy, the economist has to become more attentive to what techniques, advice, and analyses are useful to those involved in making choices in the policy arena (Shabman 1984). There remains a vital role for economists in quantifying the impacts and consequences of different policy options. Quantification need not mean the common denominator of willingness to pay as measured in dollars. Impacts on incomes of individuals and financial costs of achieving increases in wildlife numbers, human life expectancy, and areas of habitat may be more important in facilitating Lindblom's (1990) and Sagoff's (1994) value discovery process than rigidly conceived benefit estimates. As Bromley (1990, 100) has noted, economists should "harness the impressive intellectual heritage of economic analysis to the task of designing an evaluative approach that reflects the concerns of public decision makers as opposed to one that reflects what we *think ought to concern them*" (italics in original). With this perspective, policy economists will be ineffective if they cling to the notion that there exists a "correct" benefit estimate and that their professional responsibility is to measure that value.

APPENDIX

The reduction in the probability of flood water entering the landowner's first floor at least once in a period of ten years was described as follows:

> Floods both larger and smaller than the 1985 flood can occur in the future. All these possible floods are considered in planning a project to protect all properties along the river. Therefore, the Corps has calculated the chance of flood waters entering the first floor or basement of your residence both before the project is built and after it is built. If no flood control project is built there would be a **(40)**% chance that flood waters would enter the first floor or basement of this residence at least one time in ten years. After the project is built the chance that flood waters would enter the first floor or basement of your house will be reduced to **(20)**%.

As each respondent was informed of these flood probabilities a pair of pie charts illustrating the with and without chance of flood water entering their home was displayed. Respondents also were offered an opportunity to ask questions about the project. Several follow-up questions were asked to insure that the respondent understood the project's effect. A probability based definition of the commodity was selected because it provides a description of the project output without providing cues that might bias responses to willingness-to-pay questions (Thunberg and Shabman 1991).

Respondents were presented with two possible ways the project could be paid for. First, the respondent was asked to consider the following scenario:

> Suppose the cost of the project will be paid by property owners (commercial and residential) as a one time only special assessment as soon as the project is built.

Each respondent was then presented with a card listing dollar amounts from 0 to $5,000 and asked to state how much he/she would be willing to pay for project construction. The respondent was then asked how much more than this initial bid he/she would be willing to pay. The initial and incremental bids were then summed and the respondent was asked to confirm whether or not the total bid was a maximum. The bids were interpreted as the present value of the benefits and are directly comparable with PDA and hedonic benefit estimates.

In addition to this "lump-sum" payment, the respondents were also asked how much they would be willing to pay for the project construction on a year-by-year basis. Following the lump-sum payment question, the respondents were told:

> Suppose that the cost of the project will be paid by property owners by a special assess-

ment to be paid once a year for fifteen years after the project is built. You would be liable for the yearly assessment only if you maintain ownership of the property.

Each respondent was then presented with a card listing dollar amounts from 0 to $550 and asked to state the most they would be willing to pay every year for next 15 years to help pay for the project. The follow-up bid question was repeated. The annual WTP bid format was similar to the way Roanoke citizens would be asked to pay for the flood control project in the referendum.

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