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EXPERIMENTAL METHODS FOR ASSESSING ENVIRONMENTAL BENEFITS

Volume II

Laboratory Experimental Economics as a Tool for Measuring Public Policy Values

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CHAPTER 1

EXECUTIVE SUMMARY

The contingent valuation method (CVM) has been used with increasing frequency to value a variety of public goods including, for example, atmospheric visibility, land-form alteration due to strip mining, air pollution induced health effects, wildlife, water pollution, preservation of river headwaters, urban infrastructure allocations, airline safety, visual effects of power plant cooling towers, boomtown infrastructure, public parks, odors, geothermal steam development and mosquito abatement. Needless to say, there has been an explosion in use of hypothetical survey values obtained through use of the CVM. The reasons for this explosion, in our view, are that the technique generates its own data, does not depend upon pre-existing market data and therefore can be utilized to value any public good within a benefit-cost or optimal level of provision analysis. Additionally, market data is often unavailable to allow use of competing techniques such as the hedonic wage or property value methods or the travel cost method.

Contingent valuation studies may be distinguished from other forms of public good evaluation methods by their use of hypothetical questions in a survey format to acquire information on values. However, little is understood about the conditions under which the technique provides accurate values. Criticisms both of a direct or implicit nature have been raised by a variety of groups including psychologists, sociologists, decision theorists, public choice theorists, and environmental and experimental economists. These criticisms and concerns have been summarized in Volume I of this report and led the authors of that volume to develop a list of what they term “reference operating conditions”: a list of circumstances or conditions under which the CVM might yield accurate value measures for public goods. The term “reference operating conditions” was adopted from the scientific literature on measurement accuracy.

These reference operating conditions are:

1) Subjects must understand, that is be familiar with, the commodity to be valued.

2) Subjects must have had (or be allowed to obtain) prior valuation and choice experience with respect to consumption levels of the commodity.

3) There must be little uncertainty with respect to allocation of the commodity.

and 4) Willingness to pay, not willingness to accept measures are elicited.

It should be recognized that these and possibly other reference operating conditions are, in fact, conjectures based on anecdotal empirical evidence and theory from a variety of disciplines where the contingent valuation technique itself has not been the object of analysis. Much of this anecdotal evidence is drawn from laboratory studies from experimental psychologists and economists.

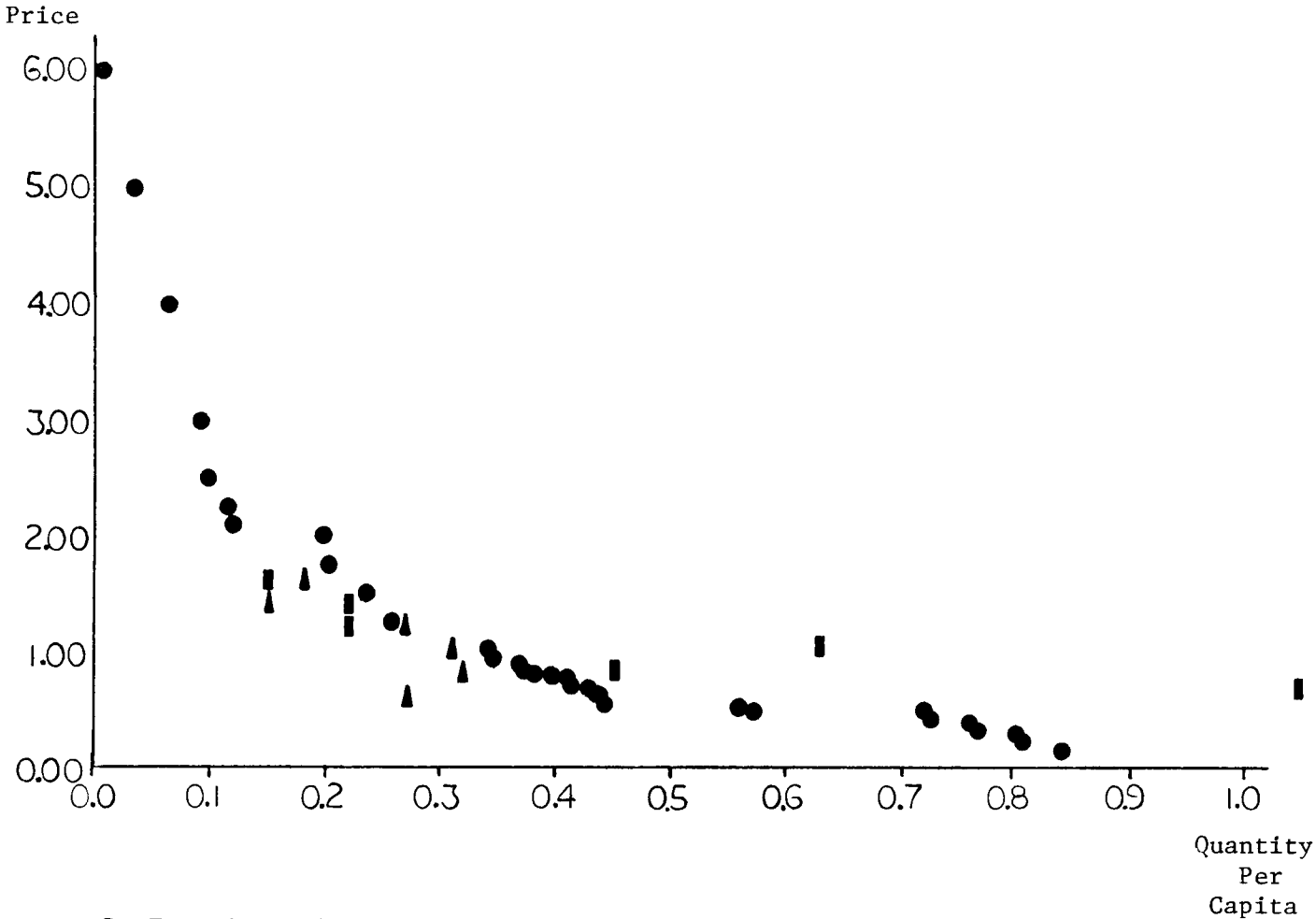
We show in this report that one approach likely to improve accuracy of the contingent valuation method, and perhaps the only inexpensive one, is a laboratory experimental economics procedure. In a controlled laboratory environment, when actual physical goods with unknown individual value are used in experiments, respondents can be provided with incentives to disclose actual valuations. These responses can then be compared to valuation responses obtained from alternative hypothetical survey questionnaires and for commodities which satisfy or fail to satisfy alternative combinations of reference operating conditions. The research reported herein represents a first step in this process.

Of central importance to the research conducted in this study are the techniques developed by public choice theorists and experimental economists which have been shown to place individuals in a market or market-like situation where they honestly and fully reveal demand for both private and public goods. Other procedures which do not utilize these techniques are unlikely to be demand revealing and to consequently provide accurate measures of value. This is not to say that hypothetical values obtained using the contingent valuation method are necessarily inaccurate. Rather, laboratory values obtained using demand revealing mechanisms can provide an accurate basis for comparison as outlined in Chapter 2.

The only necessary condition for using laboratory results as a basis for improving the contingent valuation method is the establishment of correspondence between behavior in the laboratory and behavior in the field.

Thus, the first step in our research plan is to attempt to demonstrate this correspondence. The first experiment, reported in Chapter 3, compares (i) an actual demand schedule obtained from data collected on door to door sales of pints of fresh strawberries from a random demographic sample of individuals to (ii) a demand schedule generated in the laboratory for pints of fresh strawberries using a demand revealing auction mechanism (where subjects were also chosen from the same random demographic population). Also, a hypothetical demand curve was generated using a survey instrument. The composite data which comprise these three demand schedules are shown in Figure 1.1. As is obvious from casual observation of Figure 1.1 the three demand schedules obtained from actual and hypothetical field sales, as well as the laboratory appear to be equivalent.

Figure 1.1: Composite Array of Hypothetical, Actual, and Experimental Auction Schedules



Two conclusions may be drawn from the first experiment.

- Behavior in the laboratory for the familiar private good setting parallels actual sales in the field.

- Hypothetical and actual demand relationships obtained in the field are equivalent for a familiar private good--strawberries.

The first conclusion suggests that the laboratory may be a relevant environment for conducting research with the goal of improving the contingent valuation method. The second conclusion may well be the result of the fact that the reference operating conditions, (l)-(4) above, (actually developed for public goods) are satisfied for a familiar private good like strawberries.

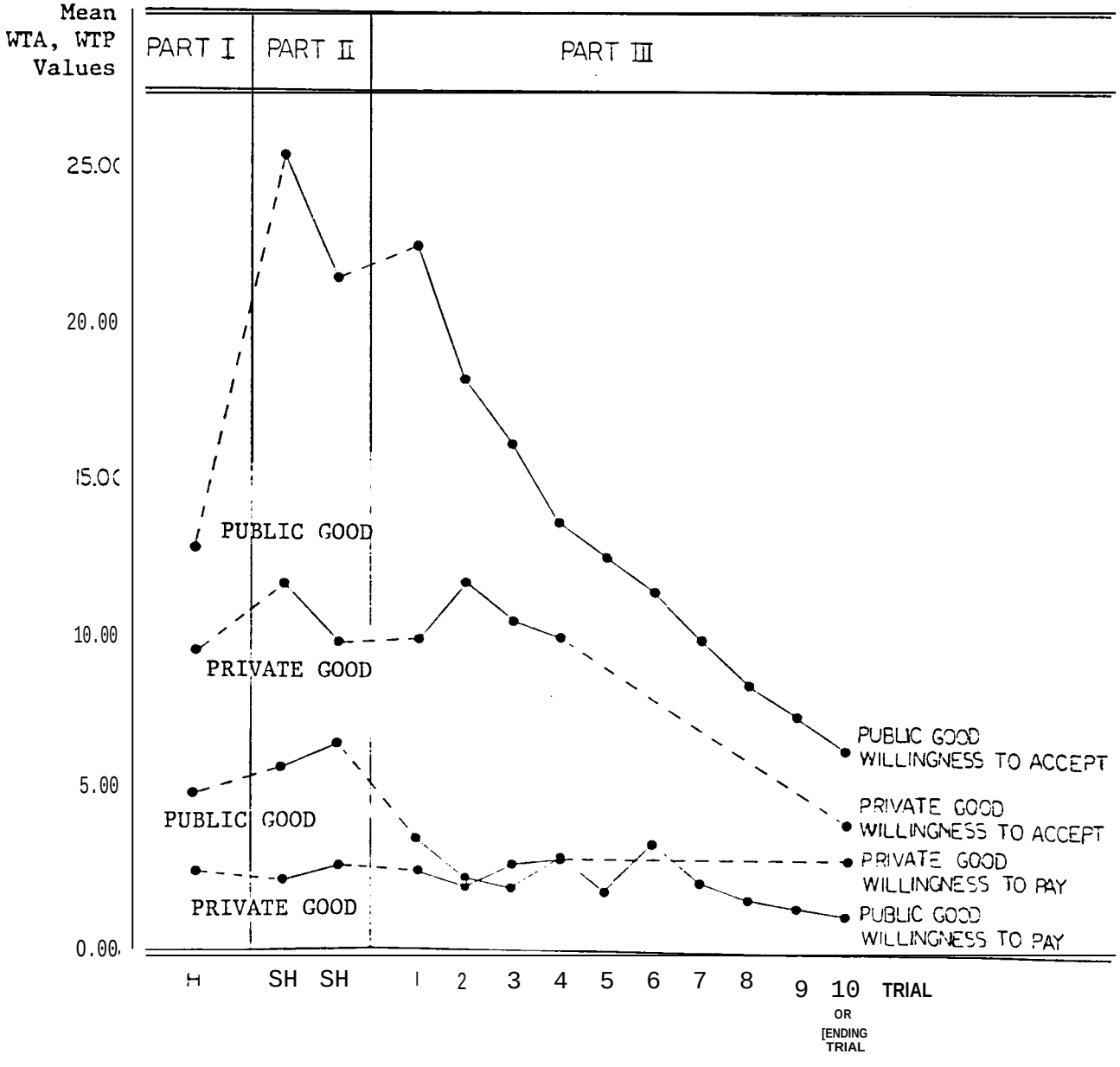
With this basis, the second experiment, reported on in Chapter 4, deliberately weakens the reference operating conditions by placing individuals in a situation more similar to that for an environmental commodity. In the experiment, reference operating conditions (l), (2) and (3) are relaxed at least to a degree. However, the structure of the experiment is still that of a private commodity.

The commodity used in the second experiment is a bitter-unpleasant taste experience, Psychologists have traditionally used sucrose octa-acetate (SOA) in taste experiments because it is the only known laboratory substance which is bitter and yet non-toxic. SOA is safe (breaking down into sugar and vinegar in the body) but very unpleasant. SOA is the only known bitter yet non-toxic substance and thus was chosen to proxy for an environmental discomfort. The experiment consisted of three parts. In Part I SOA was described and hypothetical values were solicited for avoiding tasting a one-ounce cup of the liquid for 20 seconds. In Part II subjects tasted a few drops and were then asked again how much they would pay to avoid tasting a one-ounce cup. Respondents were then further asked if they would not actually pay more and the revised response was recorded. In Part III individuals participated in a demand revealing auction. The description above refers to the willingness to pay (WTP) part of the experiment. The experiment was also conducted for different subjects using willing to accept (WTA), in violation of reference operating condition number 4, where subjects indicated how much compensation was required to taste the liquid. Results are illustrated in Figure 1.2 where WTP and WTA are tabled “Private Good.”

Thus, in contrast to the first experiment where the commodity consisted of strawberries, we utilized an unfamiliar commodity (SOA) and solicited WTA values (as well as WTP values). Note initially that WTA values in the hypothetical parts I and II are very high relative to hypothetical WTP values. However, during the learning trials of the auction (as discussed in Chapter 4) WTA measures collapse downward to become statistically identical to final auction values for WTP. Also, hypothetical WTP measures are statistically similar to final auction values.

Figure 1.2

Summary Results: Private and Public Good Experiments



These results suggest four conclusions:

- Given the demand revealing nature of and learning experiences in the auction, final average private WTA and WTP values do not differ significantly in this experiment. This result is consistent with economic theory and suggests that the divergence obtained from hypothetical measures of WTA and WTP may result mainly from lack of a market-like environment as was provided in the laboratory.

- Hypothetical measures of value obtained using WTA are likely to be biased upwards from what we would interpret as revealed values obtained from a market-like auction. Psychological factors may of course explain this bias.

- Hypothetical measures of value obtained using WTP may correspond more closely than hypothetical WTA measures to revealed values.

- The unfamiliarity with SOA apparently does not contribute to any large bias in hypothetical WTP measures in a private good environment.

The third experiment described in Chapter 5 is similar in structure to the second, with the exception that the SOA taste experience is made a pure public good. Thus, subjects must contribute as a group in the case of WTP a sufficient amount to avoid tasting SOA as a group. Consequently, everyone in the group either tastes or does not taste SOA together. In the case of WTA the group must determine individual shares (which are related to their bids) of a predetermined fund they would accept to jointly taste SOA. Everyone either consumes or does not consume SOA together. Part I again solicits hypothetical values after a brief description of SOA and the public good situation. Part 11 allows subjects to taste a few drops of SOA and then solicits a revised hypothetical value followed by an attempt to adjust the value by the monitor. Part III consists of a demand revealing public good auction which allows for learning over a series of trials.

Figure 1.2 reports the results for this experiment where WTA and WTP values are labeled “Public Good.” Again, note that hypothetical WTA values greatly exceed hypothetical WTP values. Also, WTA values over the successive trials of the public good auction decline but do not become statistically identical to WTP in the ending auction trial in contrast to the private good experiment. Further, hypothetical measures of WTP from parts I and II exceed final auction WTP values, suggesting that hypothetical WTP values obtained for an unfamiliar pure public good may be exaggerated upwards. This conclusion extends to a comparison between hypothetical public WTP and final auction private WTP values. Economic theory suggests that revealed public and private measures of value should be identical. And, in fact, final auction WTP values in the private and public good experiments are statistically identical.

These results suggest the following conclusions:

- For a pure public good, hypothetical values obtained using WTP may be exaggerated.

- WTA measures of value appear to be biased upwards both for hypothetical and auction values in a pure public goods setting. This suggests-at lack of familiarity with pure public goods may create serious problems when to accurately measure value using any technique.

- These results may well not apply to a mixed public-private commodity. Thus, for example, where a hedonic market exists such as a property value market which includes the effect of air pollution, individuals may well have sufficient experience to value environmental commodities.

In summary, our research suggests that it will be difficult to measure value for pure public goods using any available technique. Reasonable values might only be obtained by creating public good market-like institutions wherein individuals can gain experience and familiarity with valuing such commodities. In the absence of such experience, individuals may simply be unable to provide or generate reasonable values appropriate for public policy analysis. A major task which should direct future research is to determine the degree of privateness, familiarity, or experience necessary to obtain plausible value estimates.

CHAPTER 2

HYPOTHETICAL, ACTUAL, AND EXPERIMENTAL AUCTION PURCHASING BEHAVIOR FOR A PRIVATE COMMODITY

2.1 INTRODUCTION

As noted by Smith (1982, p. 936), "Which kinds of behavior [observed in the laboratory] exhibit parallelism [in the field] and which do not can only be determined empirically by comparison studies." In this chapter we report on a comparison of individual values obtained using hypothetical sales and actual sales data for a private good actually solicited in the field. Additionally, we compare these values to values obtained in a controlled laboratory setting using a Vickrey auction mechanism with strong demand revealing properties.

The commodity utilized in this comparison study was fresh pints of strawberries identical to those obtainable from local suppliers. Strawberries were used because of three main properties. First, strawberries are a nondurable (excluding possible preservation techniques) and therefore could be analyzed in a static time framework. Second, strawberries are a relatively inexpensive commodity when measured in pints which made analysis of demand variability of different prices tractable. Third, since fresh strawberries are seasonal in nature and usually have prices which vary greatly over the range of the season, demand could be estimated over a wide spectrum of possible prices.

In the next section we describe the sample plan, survey formats, and laboratory procedures utilized in the comparison. The data obtained from the three studies is then analyzed and compared in terms of a demand schedule for strawberries.

2.2 SAMPLE PLAN, SURVEY FORMATS AND LABORATORY PROCEDURES

2.2.1 Geographical Region

Laramie is a city of nearly 25,000 residents located in the southeast corner of Wyoming. Its elevation is 7,200 feet with a dry cool climate. The surrounding area is primarily grazing land with literally no other agricultural activity. Laramie is the location of the University of Wyoming with approximately 10,000 students in the academic year and 2,000 in the summer. The University is the largest single employer with retail trade and construction following in importance. The racial distribution is 94 percent white with the largest minority being Hispanic, 3 percent. The local climate is such that there are essentially no local fruits grown

either commercially or privately. Further, fruit stands are not present. In particular, there are almost no strawberry gardens in the city. Four grocery stores comprise the grocery retail trade market.

2.2.2 Sample Size and Structure

The determination of sample size for implementing the actual sales and the hypothetical sales (contingent valuation) parts of the study were based upon simulations of assumed price/quantity relationships. In the absence of actual data of this exact or similar type, assumptions were made concerning the plausible range of price elasticities and the plausible range of variance of the data. Since the response variable of interest was number of pints purchased at a given price, one of the first approximations considered was of a poisson random variable whose variance is equal to its mean. Data were simulated under this range of assumptions. A coefficient of variation of 10 percent (ratio of standard error of the estimate to the estimated elasticity) was targeted. These considerations led to sample size of at least 50, and the value of 50 assumed that the price would be essentially orthogonal to other demographic characteristics of the respondents. The final sample size chosen was 72 for each of the actual sales and the hypothetical sales survey formats. This allowed a margin above the minimum value, and provides ample opportunity to reasonably approximate the desired orthogonality.

The basic structure of the sampling plan consisted of

- the identification of primary sampling units (PSU),
- the stratification of primary sampling units by income,
- the stratified random sampling of primary sampling units with probability proportional to PSU size,
- the identification of clusters within each PSU and the random selection thereof, and
- systematic sampling within selected clusters.

Six equally spaced levels of price were selected which spanned the plausible ranges of prices experienced over time in the Laramie stores, and each of these six price levels were randomly assigned to the same number of households in each cluster. The sample plan guaranteed a full range of the income variability and near orthogonality of income with price.

Four laboratory experiments were conducted using a Vickrey auction method. Each experiment required at least five and at most eight subjects. For comparability of results, it was essential that the subjects be drawn from the same population as for the actual sales and hypothetical sales surveys. Therefore, the laboratory subjects were randomly selected from the same primary sampling units as the field surveys. Laboratory subjects from each income strata were selected for each of the four experiments to maintain balance.

The separate steps of the sampling plan, adapted from Sudman (1976), are discussed in more detail in the following paragraphs.

The planning office of the city of Laramie has partitioned the city into 19 relatively homogeneous units. This partition is useful for their planning purposes, and detailed demographic information is available for each unit. These units were chosen as the primary sampling units for this study. The most important demographic variable for the study was income. Table 2.1 contains a listing of the 19 units with their corresponding number of households and mean income. The primary sampling units are listed in increasing order by mean income.

Since income was the most important demographic variable, the 19 PSU'S were stratified by income as lower, middle, and upper thirds. Two PSU'S were selected at random from each of the three strata with sampling proportional to size (number of households) of the PSU. Each of the selected PSU were further partitioned into clusters of approximately 40 households each. From each selected PSU, one cluster was selected at random to be included for the actual strawberry sales experiment, a second was selected for hypothetical sales experiment, and the remainder were available for selection of individuals for the laboratory experiments.

A target of 12 completed interviews from each cluster was specified for household sampling. After a starting household was selected at random for each cluster (street or set of streets), every third house was chosen until 12 sample points had been obtained from all six clusters. If a regular grocery shopper was unavailable at one of the chosen households, the survey team returned to the house at a later time. If this second attempt to contact a regular grocery shopper failed, or in the rare case where this person refused to participate in the study, one of the two houses next door was chosen at random (coin toss). In the case that the target of 12 households was not attained by this procedure, a completed household was selected at random, and a house on either side was chosen at random as above.

2.2.3 Survey Procedures

Three survey teams of two persons each were utilized for the data collection. The survey teams spent approximately two days in preparation for the field work. The shortness of the training period was possible in that the survey team members were present throughout the design phases. The data were collected on four consecutive days, with the actual sales completed the first two days and the hypothetical sales interviews the last two days. Each team completed one PSU each day. The surveys were conducted in the late afternoon and early evening. With one exception, each team completed interviews with two clusters drawn from different income strata in both the actual and hypothetical portions of the study. The exception arose in the hypothetical portion when one member of the third survey team became ill and was unable to conduct the 12 assigned interviews in the low income stratum. Rather than delaying the survey for an unknown length of time or substituting an untrained interviewer, six of these interviews were conducted by the first team and six by the second.

TABLE 2.1

MEAN INCOMES FOR PRIMARY SAMPLING UNITS--LARAMIE, WYOMING

Primary Sampling Unit (PSU)	Number of Households	Mean Income ($)
2*	400	9,156
12	138	11,522
14	321	15,016
15*	428	17,199
11	230	17,446
10	167	17,710
18	106	18,361
7	397	19,909
13	92	21,359
8*	316	21,689
16	151	22,343
9	223	24,165
4	323	24,222
6*	560	24,998
3*	265	25,061
17	101	27,203
19	113	27,766
1	511	28,853
5*	499	32,277

* PSU selected at random.

Six price levels were used in the surveys with two households in each PSU at each level. Thus there was complete balance of income levels and initial price.

2.2.4 Private Good Field Surveys

The field private good survey instruments were designed to obtain actual and hypothetical sales data for strawberries in Parts A-B of the formats. All other additional questions in Parts C-E (e.g., other fresh fruit purchases, income, etc.) were identical for the actual and hypothetical sales formats. Appendix A contains the complete surveys as well as the answer sheets. Hence, we will briefly detail the overall structure of the survey formats.

The procedure for the actual sales format was as follows. Initial contact with the household identified an individual who regularly shopped for groceries. After a brief introduction the household was informed that "each pint (of strawberries) is selling today for a price of $0.60." The range of prices utilized were $.60, $.80, $1.00, $1.20, $1.40 and $1.60. If at least one pint was purchased the actual exchange of pints and money was completed at this point.

If strawberries were not purchased, the respondent was queried as to the reason. The sales question was then restated at $.30 below the initial price to determine whether the individual would hypothetically have bought 1 or more pints at a lower price.

If pints of strawberries were initially purchased, the $.30 lower hypothetical price question was also administered. For both purchase questions, the individual was asked how many pints would be canned or preserved thus indicating consumption patterns. This information then allows an elasticity determination.

The procedure and price ranges for the hypothetical sales were identical to the actual sales format. Two differences, however, were present. Before the hypothetical sales question was posited, the respondent was told that the following questions were for market research purposes. The posited question was "suppose each pint is selling today for the price of $0.60."

With these procedures completed (Parts A-B), the remainder of each survey format (Parts C-E) was identical except for the introduction. The introductory differences were as follows. In the case of the actual sales survey where a purchase and exchange of pints and money was completed, the money was returned and the individual kept the strawberries. If no pints were purchased in the actual sales situation, a few pints were offered as they were in all of the hypothetical sales cases. It was explained at this point in the survey procedure that "our main objective is not to sell strawberries but to collect important information about the buying and eating habits of households in Laramie."

Information on grocery purchasing and consumption habits of the household was gathered in Part C. A budget share analysis was obtained for the household (or only the individual being interviewed if food expenses were not pooled). Total monthly income after taxes was determined and then disaggregated into savings and investments, housing, transportation, personal care and food. The greatest detail was obtained for the food category.

In addition to obtaining the food category expense, a fresh fruit monthly budget expense was determined. This involved ascertaining the frequency of major fruit purchases and focusing upon either a representative last major fruit purchase or the last monthly overall purchase. Purchased quantities from 26 different fruits were determined. In conjunction with the weekly price data for all fruits from all of the major stores the total fresh fruit expenses can be determined.

Finally, Part E was comprised of a series of socio-economic questions about sex, race, education and occupation of the wage earners in the household, and the amount of time spent working. The following summary statistics table (Table 2.2) contains aggregate information concerning the individual samples used in the three studies.

2.2.5 Experimental Design

The experimental design used to obtain a laboratory demand curve for a familiar commodity, strawberries, to compare both to hypothetical and actual field sales of the commodity, necessarily, has to satisfy two requirements.

First, the circumstances of the experiment should be reasonably similar to the field sales. Thus, for example, the laboratory experiments were run during the early evening hours, the preliminary questions asked of the experimental subjects were similar to those asked in the field (see Appendix A, “Purchasing and Consumption Habits in Laramie, Wyoming”), and the subjects were shown the fifteen pints of strawberries for sale in the experiment in a manner similar to that of the field sales.

The second requirement is use of a standardized laboratory procedure which has been shown to reveal demand in laboratory situations using induced values. Thus, a multiple unit Vickrey auction was utilized which has both the desired theoretical and experimental properties, i.e., the procedure successfully reveals demand.

If both of these requirements are satisfied, as we believe they are, then, if the demand curve obtained in the laboratory corresponds closely to the actual demand curve obtained in the field, it can be argued that behavioral results obtained in the laboratory may well be generalizable to real world situations. If this is true, then the laboratory can be a powerful and fairly inexpensive tool for making predictions about and understanding real world behavior. Of course, the behavior of concern for benefit cost studies is how people value commodities not normally traded in markets. If, for example, the laboratory experiment were to fail to

TABLE 2.2: SUMMARY STATISTICS: ACTUAL, HYPOTHETICAL, AND LABORATORY STATISTICS

Part C[a]	Actual	Hypothetical	Laboratory
Q8 How long has it been since you last ate any foods? (in hours)	$\bar{x}$ = 2.9 σ = 4.1 n = 72	$\bar{x}$ = 2.8 σ = 3.3 n = 72	$\bar{x}$ = 1.5 σ = 1.8 n = 28
Q9 How long has it been since you last ate a full course meal (main dish, salad, bread, dessert)?	$\bar{x}$ = 44 σ = 114[b] n = 72	$\bar{x}$ = 17 σ = 19 n = 72	$\bar{x}$ = 16 σ = 29 n = 28
Q10 In how many hours will you eat again?	$\bar{x}$ = 5.9 σ = 5.3 n = 72	$\bar{x}$ = 4.6 σ 4.1 n = 72	$\bar{x}$ = 10 σ = 5.0 n = 28
Q10A What type of meal will you eat?	Percent 29 Breakfast 1 Lunch 10 Light Dinner 50 Dinner 10 Snack 100 Total n = 72	Percent 17 Breakfast 1 Lunch 22 Light Dinner 53 Dinner 7 Snack 100 Total n = 72	Percent 68 Breakfast 4 Lunch 0 Light Dinner 7 Dinner 21 Snack 100 Total n = 28
Q11 How many permanent members in your household?	$\bar{x}$ = 3.2 σ = 3.4 n = 72	$\bar{x}$ = 3.5 σ = 4.6 n = 72	$\bar{x}$ = 2.8 σ = 1.4 n = 28
Q12 How many of the permanent members of your household do you regularly buy groceries for?	97 percent of Q11 n = 72	98 percent of Q11 n = 72	96 percent of Q11 n = 28
Q13 Of these, how many eat strawberries?	94 percent of Q12 n = 72	93 percent of Q12 n = 72	95 percent of Q12 n = 29

(continued)

Table 2.2, continued

Part C[a]	Actual	Hypothetical	Laboratory
Q14 Please give us your age . . . (Rest of question to be completed later.)	Average Age = 41 σ = 16 n = 72	Average Age = 40 σ = 16 n = 72	Average Age = 43 σ = 18 n = 28
Q15 Do you currently have out-of-town visitors staying with you? If yes, Q15a.[c]	% Yes = 14 % No = 86 n = 72	% Yes = 14 % No = 86 n = 72	% Yes = 4 % No = 96 n = 28
Q15a How many?	Average number of guests = .375 σ = 1.18 n = 72	Average number of guests = .208 σ = .627 n = 72	Average number of guests = .036 σ = .189 n = 28
Q16 Does your household share food expenses?	% Yes = 96 % No = 4 n = 72	% Yes = 96 % No = 4 n = 72	% Yes = 82 % No = 18 n = 28
Q16a Does your household share housing expenses, including rent or house payment and utilities?	% Yes = 96 % No = 4 n = 72	% Yes = 96 % No = 4 n = 72	% Yes = 82 % No = 18 n = 28
Q16b Does you household share transportation expenses, such as vehicle payments, fuel, maintenance, insurance?	% Yes = 94 % No = 6 n = 72	% Yes = 97 % No = 3 n = 72	% Yes = 86 % No = 4 n = 28
Q17 Do you buy most of your groceries at one store? (If no go to 17b)	% Yes = 56 % No = 44 n = 72	% Yes = 57 % No = 43 n = 72	% Yes = 43 % No = 57 n = 28

(continued)

Table 2.2, continued

Part C[a]	Actual	Hypothetical	Laboratory
Q17a Is most of your shopping done at some of the largest grocery stores in Laramie?	% Yes = 56 % No = 44 n = 72	% Yes = 100 % No = 0 n = 30	% Yes = 100 % No = 0 n = 15
Q17b Do you buy most your groceries in Laramie?	% Yes = 0 % No = 100 n = 2	% Yes = N/A % No = N/A n = 0	% Yes = N/A % No = N/A n = 0
Q18 At what store do you buy most of your groceries?	Percent 10 Albertsons 20 Buttrey 4 Ideal 11 Safeway 45 Not one Store 100 Total n = 72	Percent 6 Albertsons 15 Buttrey 21 Ideal 14 Safeway 44 Not one Store 100 Total n = 72	Percent 18 Albertsons 4 Buttrey 7 Ideal 14 Safeway 57 Not one Store 100 Total n = 28
Q19 How many times a month do you make a major grocery purchase?	$\bar{x}$ = 3.7 σ = 2.6 n = 72	$\bar{x}$ = 3.6 σ = 2.2 n = 72	$\bar{x}$ = 4.0 σ = 2.5 n = 28
Q20 When was the last time you made a major purchase? (Days ago)	$\bar{x}$ = 6.8 σ = 9.4 n = 72	$\bar{x}$ = 5.9 σ = 6.7 n = 72	$\bar{x}$ = 8.1 σ = 17.0 n = 28
Q21 Do you normally make your major fruit purchases at the same time as you make you make your food purchases?	Percent 89 Yes 11 No n = 72	Percent 92 Yes 8 No n = 72	Percent 89 Yes 11 No n = 28

(continued)

Table 2.2, continued

Part C[a]	Actual	Hypothetical	Laboratory
Q22 How many times a month do you make major fruit purchases?	$x = 2.50$ $n = 72$	$\bar{x} = 3.33$ $n = 72$	$\bar{\kappa} = 2.43$ $n = 28$
Q23 When was the last time you made a major fruit purchase? (Days ago)	$\bar{x} = 2.1$ $\sigma = 11$ $n = 72$	$\kappa = .88$ $\sigma = 3.3$ $n = 72$	$\bar{\kappa} = .500$ $\sigma = 1.8$ $n = 28$
Q24 Try to recall your last major fruit purchase. Was this last major fruit purchase representative of other purchases over the month?	Percent 80 Yes 20 No $n = 72$	Percent 79 Yes 21 No $n = 72$	Percent 82 Yes 14 No 4 Unanswered $n = 28$
Socio-economic Questions:			
Q27 How many wage earners are in your household?	Per household $\bar{x} = 1.5$ $\sigma = .69$ $n = 72$	Per household $\bar{x} = 1.5$ $\sigma = .56$ $n = 72$	Per household $\bar{x} = 1.4$ $\sigma = .63$ $n = 28$
If there is more than one wage earner in your family complete for both[d]			
Q28 Sex	Percent 61 male 39 female 100 Total $n = 109$	Percent 58 male 42 female 100 Total $n = 109$	Percent 62 male 38 female 100 Total $n = 39$

(continued)

Table 2.2, continued

Part C[a]	Actual	Hypothetical	Laboratory
Q29 Race	Percent 90 White 0 Black 8 Hispanic 1 Amer. Indian 0 Asian 1 Other 100 Total n = 107	Percent 94 White 2 Black 2 Hispanic 0 Amer. Indian 2 Asian 0 Other 100 Total n = 108	Percent 95 White 0 Black 0 Hispanic 2.5 Amer. Indian 0 Asian 2.5 Other 100 Total n = 39
Q30 Education	Percent 0 0-5 years 4 0-6 years 2 9-11 years 17 12 years 0 Vocational 27 Some college 16 BA or BS 14 Some grad. 20 Advanced or Prof. 100 Total n = 108	Percent 1 0-5 years 1 6-8 years 1 9-11 years 8 12 years 2 Vocational 29 Some college 16 BA or BS 10 Some grad. 32 Advanced or Prof. 100 Total n = 107	Percent 0 0-5 years 0 6-8 years 0 9-11 years 7 12 years 0 Vocational 31 Some college 26 BA or BS 18 Some grad. 18 Advanced or Prof. 100 Total n = 39
Q31 Employment Status	Percent 88 Employed 12 Unemployed 100 Total n = 108	Percent 84 Employed 16 Unemployed 100 Total n = 109	Percent 84 Employed 16 Unemployed 100 Total n = 38

(continued)

Table 2.2, continued

Part C[a]	Actual	Hypothetical	Laboratory
Q32 Occupation[e] What is this person's occupation?	Percent 16 Service Worker 5 Laborer 5 Trans. Operator 0 Equip. Operator 1 Craft Worker 12 Clerical Worker 3 Sales Worker 5 Manager or Admin. 52 Professional or Tech. 0 Farm Worker 1 Retired 0 Student 0 Military 100 Total n = 96	Percent 8 Service Worker 5 Laborer 6 Trans. Operator 0 Equip. Operator 4 Craft Worker 11 Clerical Worker 5 Sales Worker 6 Manager or Admin. 50 Professional or Tech. 0 Farm Worker 2 Retired 2 Student 1 Military 100 Total n = 99	Percent 12 Service Worker 9 Laborer 3 Trans. Operator 0 Equip. Operator 0 Craft Worker 21 Clerical Worker 0 Sales Worker 9 Manager or Admin. 44 Professional or Tech. 0 Farm Worker 2 Retired 0 Student 0 Military 100 Total n = 34
Q33 Is this person paid an hourly wage?[e]	Percent 33 Yes 67 No 100 n = 98	Percent 40 Yes 60 No 100 n = 95	Percent 24 Yes 76 No 100 n = 34
Q33A What is the hourly wage?	$\bar{x}$ = 5.67 n = 33	$\bar{x}$ = 5.08 n = 38	$\bar{x}$ = 5.70 n = 8
Q34 How many weeks per year does this person work?	$\bar{x}$ = 45 n = 98	$\bar{x}$ = 44 n = 95	$\bar{x}$ = 48 n = 34
Q35 On average, how many hours per week does this person work?	$\bar{x}$ = 41.64 n = 92	$\bar{x}$ = 38.53 n = 92	$\bar{x}$ = 40.27 n = 37

(continued)

Table 2.2, continued

Part C[a]	Actual	Hypothetical	Laborat
Q36 Approximately what percentage of the income does this person earn?	$\bar{x}$ = 62 n = 98	$\bar{x}$ = 66 n = 95	$\bar{x}$ = 82 n = 34

Part D: Budget Breakdown All answers to nearest cent	Actual Sales	Hypothetical Sales	Laboratory Sales
Income: What is the total monthly income, after taxes, of your whole household?	$\bar{x}$ = \$1884.00 σ = \$1165.77 n = 72	$\bar{x}$ = \$1721.57 σ = \$1351.57 n = 72	$\bar{x}$ = \$2200.79 σ = \$1201.68 n = 28
Savings and Investments: Of this amount, how much is saved or invested in stocks, bonds, annuities, IRA's, etc.?	$\bar{x}$ = \$341.69 σ = \$494.74 n = 71	$\bar{x}$ = \$244.014 σ = \$370.51 n = 72	$\bar{x}$ = \$404.46 σ = \$464.35 n = 28
Housing: The housing category includes not only your rent or house payment, but utilities, maintenance, and any home-owners, mortgage or renters insurance that you may have. How much do you spend monthly on these items?	$\bar{x}$ = \$331.13 σ = \$260.78 n = 71	$\bar{x}$ = \$375.611 σ = \$340.58 n = 72	$\bar{x}$ = \$458.68 σ = \$225.29 n = 28
Transportation: By transportation expense, we mean total vehicle payments, fuel, maintenance, and vehicle insurance. How much do you spend in this category on a monthly basis?	$\bar{x}$ = \$142.85 σ = \$151.73 n = 71	$\bar{x}$ = \$121.94 σ = \$120.00 n = 72	$\bar{x}$ = \$191.21 σ = \$141.24 n = 28

(continue

Table 2.2. continued

Part D: Budget Breakdown All answers to nearest cent	Actual Sales	Hypothetical Sales	Laboratory Sales
Personal Care: Before we get to the food category, we need to know how much is spent monthly on such personal care items as shampoo, toothpaste, cosmetics, and so on. Many people buy these things at the grocery store, so you may have to estimate how much they contribute to the total bill.	$\bar{x}$ = \$46.72 σ = \$50.36 n = 71	$\bar{x}$ = \$34.38 σ = \$31.05 n = 72	$\bar{x}$ = \$57.32 σ \$45.87 n = 28
Food: Finally the food category. Since this is the main point of our study, we need to get a little more detail here. First we need to know the amount spent on "in-home-use." This is basically your total monthly grocery bill, after subtracting out all non-food items such as personal care, magazines, pet foods, tobacco, etc. that you may buy at the grocery store. Next, how much do you spend on eating out? Finally, how much do you spend monthly on alcoholic beverages and tobacco?	In Home $\bar{x}$ = \$223.31 σ = \$130.13 n = 71 Eat Out $\bar{x}$ = \$53.28 σ = \$48.00 n = 71 Alc. & Tob. $\bar{x}$ = \$18.49 σ = \$24.57 n = 71	In Home $\bar{x}$ = \$213.12 σ = \$151.66 n = 72 Eat Out $\bar{x}$ = \$50.681 σ = \$76.32 n = 72 Alc. & Tob. $\bar{x}$ = \$21.58 σ = \$27.51 n = 72	In Home $\bar{x}$ = \$232.50 σ = \$114.63 n = 28 Eat Out $\bar{x}$ = \$78.36 σ = \$75. 6 n = 28 Alc. & Tob. $\bar{x}$ = \$21.64 σ = \$34.447 n = 28

(continued)

Table 2.2, continued

AVERAGE MONTHLY PER CAPITA FRUIT PURCHASES IN LARAMIE[f]

Fruit	Actual n = 206 people	Hypothetical n = 212 people	Laboratory n = 77 people
Apples	1.0 lbs.	1.0 lbs.	1.0 lbs.
Apricots	.0 lbs.	.1 lbs.	.2 lbs.
Avocados	.1 lbs.	.2 lbs.	.3 lbs.
Bananas	1.1 lbs.	.9 lbs.	1.0 lbs.
Blueberries	0 pts.	.1 pts.	.3 pts.
Blackberries	0 pts.	0 pts.	0 pts.
Cherries	.5 lbs.	.4 lbs.	.4 lbs.
Coconuts	0	0	0
Cantelope	2.4 lbs.	2.9 lbs.	4.3 lbs.
Grapes	1.0 lbs.	.9 lbs.	1.9 lbs.
Grapefruit	.7 lbs.	1.0 lbs.	.2 lbs.
Honeydew Melon	.2 lbs.	.6 lbs.	.1 lbs.
Kiwi Fruit	0	0	.1 each
Lemons	.4 each	.4 each	l.1 each
Limes	.3 each	.5 each	1.3 each
Mangos	.1 each	.1 each	0 each
Nectarines	.7 lbs.	.2 lbs.	.4 lbs.
Oranges	1.6 lbs.	1.2 lbs.	.8 lbs.
Papayas	0	.1 lbs.	0 each
Peaches	1.3 lbs.	1.2 lbs.	2.2 lbs.
Pears	.1 lbs.	.3 lbs.	.9 lbs.
Pineapples	0	0	.1 lbs.
Plums	.3 lbs.	.5 lbs.	.7 lbs.
Raspberries	0	.1 lbs.	0
Strawberries	.4 lbs.	.6 lbs.	.6 lbs.
Watermelons	4.7 lbs.	5.3 lbs.	6.4 lbs.

[a] All numbers rounded to two digits unless otherwise specified.
[b] Three digits.
[c] Nearest full percentage point.
[d] Of all wage earners.
[e] Rounded to nearest whole percentage point.
[f] Household fruit purchases were converted to monthly purchases and divided by the number of household members to get the average unit consumed per capita rounded co the nearest one/tenth of a unit.

generate a reasonably accurate demand curve for strawberries, as compared to actual field sales, then one might seriously question the applicability of laboratory results to the real world (or alternatively the design of our experiment) . Thus, an experiment testing the "real world" validity of economic values obtained in the laboratory for a straightforward and familiar private good is a necessary first step for using the laboratory to examine the more complex issues surrounding the valuation of public goods for benefit-cost analysis.

Each of the four experiments employed seven subjects who were chosen according to the same sample plan used for the field sales and who were solicited using the telephone. Thus, the 28 subjects who took part in the experiments represented a random sample of consumers in Laramie, Wyoming. Each subject was given $15.00 for participating in the experiment. This compensation was deemed necessary since the subjects were primarily adults, drawn from a community, who were required to come to the University of Wyoming campus to participate, spending as much as two hours of their time.

It was made clear in the instructions to the experiment (see Appendix B, "Auction Instructions and Bidding Form") that they were in no way required to buy strawberries and that the $15.00 was theirs to keep. Subjects were allowed to read the auction instructions as many times as they wished and were then able to ask questions of the experiment monitor. The monitor then orally reviewed the multiple unit Vickrey auction procedure. Since 15 pints of strawberries were auctioned off, each subject could place as many as 15 different bids, a separate bid for each pint. All bids from all subjects in the experiment were then rank ordered from highest to lowest and the highest 15 bids obtained pints of strawberries. However, all winning bidders had to pay the same market price, equal to the sixteenth highest, or first rejected, bid. It is, of course, this feature of Vickrey auctions, that bidders typically pay less than the amount that they bid, which yields incentives for "true" demand revealing behavior,

2.3 COMPARISON OF RESULTS: HYPOTHETICAL VERSUS ACTUAL PURCHASING BEHAVIOR

The basic demand relation estimated using both the actual market transactions and hypothetical response data is shown in equation (l).

$$Q_i = f_j(P_i, \text{INCOME}_i, \text{NUMBER}_i, \text{ATE}_i, \text{AGE}_i, \text{SHOP}_i, \text{WHITE}_i, \text{SCHOOL}_i) \quad (1)$$

where Q_i denotes the number of pints of strawberries that would have been purchased by the i^{th} respondent at price P_i, i = 1, ..., 144. The observations on the variables in equation (1) are ordered such that i = 1, ..., 72 corresponds to the actual market transactions data and i = 73, ..., 144 corresponds to the hypothetical response data. The function subscript j can take on two values depending on whether the actual market transactions data or the hypothetical response data are considered. Thus, j = 1, if i = 1, ..., 72 and j = 2 if i = 73, ..., 144.

Regression estimates of four versions of equation (1) are presented in Table 2.3. These estimates are used to examine the differences between the

actual market transactions and the hypothetical response demand functions. In the first and second columns of Table 2.3, separate regressions are presented for each type of data collected in the survey. A regression based on pooling the two types of observations is shown in the third column. The fourth column shows another pooled regression in which a dummy variable (MARKET) together with interaction variables between MARKET and all other explanatory variables are added to the covariates included in the column three regression. MARKET equals unity if i = 1, ..., 72 and zero otherwise. Additionally, all four equations include dummy variables for two of the three survey teams (TEAM1 and TEAM2) in order to measure enumerator effects. Equations with dummy variables for PSU also were estimated but are not presented since the coefficients of PSU never were significantly different from zero at the 5 percent level. Thus, similar to the findings in larger scale surveys by Kish and Frankel (1970), the regression coefficients in Table 2.3 appear to have quite small design effects.

All four equations shown in Table 2.3 were estimated in a tobit framework (see Tobin, 1958 and Judge et al., 1980) since the dependent variable Q. was zero for 58 percent of the observations in the actual market transactions portion of the study and for 47 percent of the observations in the hypothetical response portion. Table 2.3 reports estimates of the unnormalized coefficients. These values, which are estimates of the original coefficients in the regression model, simply are the normalized coefficients multiplied by the standard error of the estimate. In the equation estimated using only the actual market transactions data (see Column 1), the coefficients of the key variables P. and $INCOME_i$ have the expected signs (negative and positive, respectively)[1] and are significantly different from zero at less than the 1 percent level. The performance of the remaining explanatory variables listed in equation (l), however, is not as strong. Younger and less formally educated respondents tended to purchase larger amounts of strawberries; however, the coefficients of NUMBER, ATE, ATE2, MALE, SHOP, and WHITE are not different from zero at conventional significance levels. Finally, the significant negative coefficient of TEAM2 indicates the presence of enumerator effects. In other words, the characteristics of TEAM2 apparently lowered the quantity of strawberries demanded even though all teams were trained to conduct the interviews in a standardized manner. This problem contributed to the comparatively larger number of observations where $Q_i = O$ found in the actual market transactions portion.

The fitted tobit demand equation for the hypothetical response data (see Column 2) is in several respects similar to the equation for actual market transactions just discussed. P and $INCOME_i$ enter with negative and positive coefficients, respectively, which are significantly different from zero at the 5 percent level using a one-tail test. The negative coefficient of AGE also is significant using the same test procedure, while the coefficients of the remaining variables are not significant at conventional levels. A key difference between the actual market transactions and hypothetical response equations is that in the latter, t-statistics of TEAM1 and TEAM2 are small. This outcome is not surprising since the actual market transactions data were collected during the first

TABLE 2.3: COMPARISON OF ACTUAL MARKET TRANSACTIONS AND HYPOTHETICAL RESPONSE DEMAND EQUATIONS

Independent Variable	Unnormalized Tobit Regression Coefficients[a]			
	Actual	Hypothetical	Pooled	Pooled
CONSTANT	5.547	7.591	7.000	7.100
	(3.559)	(3.318)	(4.841)	(3.715)
P	-2.393	-3.119	-2.473	-2.922
	(-3.966)	(-3.380)	(-4.395)	(-3.798)
INCOME	0.000401	0.000499	0.000365	0.000472
	(2.637)	(1.711)	(2.369)	(1.934)
NUMBER	0.0113	-0.473	-0.0373	-0.444
	(0.295)	(-1.414)	(-0.559)	-1.589)
ATE	0.0546	-0.236	-0.158	-0.227
	(0.372)	(-1.418)	(-1.333)	-1.628)
ATE2	0.00184	0.0106	0.00956	0.0102
	(0.326)	(1.391)	(1.902)	(1.592)
AGE	-0.0238	-0.0321	-0.0245	-0.0284
	(-1.784)	(-1.740)	(-2.028)	-1.839)
MALE	-0.239	0.862	0.0236	0.792
	(-0.604)	(1.222)	(0.0599)	(1.339)
SHOP	-0.0107	-0.0688	-0.0446	-0.0627
	(-0.311)	(-1.312)	(-1.412)	(-1.418)
WHITE	-0.0566	-1.023	-0.819	-1.026
	(-0.0907)	(-1.315)	(-1.521)	(-1.581)
SCHOOL	-0.176	-0.0933	-0.195	-0.0761
	(-2.355)	(-0.821)	(-2.687)	(-0.800)
TEAM1	0.703	1.111	0.868	1.011
	(1.592)	(1.281)	(1.810)	(1.390)
TEAM2	-1.318	0.500	-0.184	0.479
	(-2.549)	(0.602)	(-0.382)	(0.687)
MKT				-0.614
				(-0.216)
MKTPRICE				-0.0101
				(-0.00894)
MKTINCOME				0.00000249
				(0.00765)
MKTNUMBER				0.456
				(1.597)
MKTATE				0.282
				(1.102)
MKTATE2				-0.00721
				(-0.691)
MKTAGE				-0.000560
				(-0.0226)
MKTMALE				-1.104
				(-1.336)
MKTSHOP				0.0502
				(0.752)
MKTWHITE				1.019
				(0.906)
MKTSCHOOL				-0.140
				(-0.977)
MKTTEAM1				-0.184
				(-0.191)
MKTTEAM2				-2.167
				(-2.114)
Standard Error	1.146	1.967	1.817	1.656
Predicted Probability of $Q_i > 0$	0.408	0.518	0.465	0.448
Observed Frequency of $Q_i > 0$	0.417	0.528	0.472	0.472
Log of Likelihood	-64.592	-99.214	-177.469	-167.555

at-statistics in parentheses,

two days of the four day interview period, while the hypothetical response data were collected during the last two days. Increased familiarity with interview procedures may have led to the smaller enumerator effects found in the hypothetical response data.

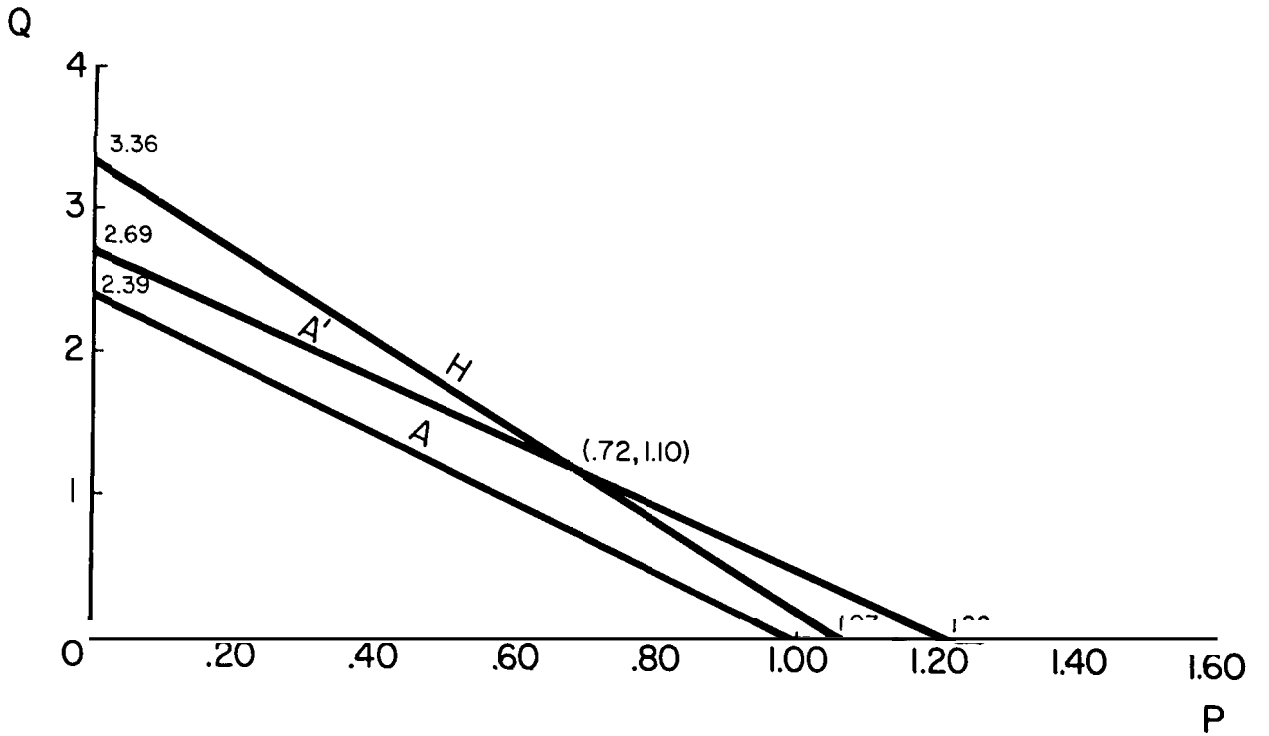
The third and fourth columns of Table 2.3 provide a basis for testing the null hypothesis of equality between the coefficients of the actual market transactions and hypothetical response demand equations. Since both equations are estimated using the tobit procedure after pooling the two types of data, the test examines the performance of the MARKET dummy variable (a constant term shifter) and the interactions of MARKET with all other covariates (the slope shifters). Except for the interaction between MARKET and TEAM2, none of the coefficients of these variables are significantly different from zero at the 10 percent level using a two-tail test. In general, however, tests of individual coefficients are not as powerful as joint tests of significance. Consequently, a likelihood ratio test was made for the joint significance of the MARKET dummy variable and all interaction variables. This test fails to reject the null hypothesis of structurally identical actual and hypothetical demand equations at the 5 percent level.

The information obtained from this statistical test is augmented by comparing the values of the dependent variable predicted by the actual market transactions and the hypothetical response demand equations. These direct comparisons warrant attention because sample size influences the level at which the difference between two sets of regression coefficients is statistically significant. For example, if a larger sample had been used in this study, the null hypothesis in the above test probably could not have been rejected at a higher significance level. Additionally, this approach makes the results presented here easier to compare with those reported in the Kish and Lansing (1954) and Kain and Quigley (1972) papers.

Figure 2.1 graphically depicts actual market transactions and hypothetical response demand equations in P, Q space. To obtain the curves labelled A and H, the estimated equations in the first two columns of Table 2.3 were evaluated at the overall sample means of all covariates except for P. The same procedure was used to obtain the A' curve except enumerator effects were controlled by re-estimating the actual market transactions demand equation after eliminating the 24 observations collected by TEAM2. Three aspects of this figure warrant further discussion. First, it illustrates the functional form imposed by the tobit model. In the A curve, for example, the predicted value of Q is a negatively sloped linear function of P on the interval $0 \leq P \leq \$1.00$, and at higher prices, predicted Q = 0. Second, the value of $\bar{P}$ at which predicted Q = 0 is higher for the H curve than for the A curve. This situation reflects the greater percentage of households in the actual market transactions portion to which no strawberries would have been sold. Third, the figure shows that eliminating he actual market transactions observations collected by TEAM2, which reflected a significantly lower sales volume, brings the two demand curves closer together. In fact, A' intersects H at the point P = .72, Q = 1.10, whereas H lies above A at all points on the interval $0 \leq P \leq \$1.07$.

Figure 2.1

Actual and Hypothetical Demand Curves*



*The curves labelled A and H were derived by evaluating the estimated equations in the first and second columns, respectively, of Table 2.4 at the overall sample means of all covariates except P. Curve A' was derived in a like manner except enumerator effects were controlled by re-estimating actual market transactions demand after excluding TEAM2's observations. Excluding TEAM2 enhances considerably the similarity of the actual and hypothetical demand curves. Also, the tobit method of handling the truncation of Q is illustrated. When P exceeds $1.00, $1.07, and $1.22, respectively, for the A, H, and A' curves, predicted Q = 0.

Table 2.4 presents calculations of payment bias (PB) using the demand equations presented in Figure 2.1. The values of PB presented compare the H curve with both the A and A′ curves at $.10 intervals between $.60 and $1.40. For example, to compare A and H, PB_i is calculated using equation (2).

$$PB_i = ((P_iQ_{Ai} - P_iQ_{Hi})/P_iQ_{Ai}) = ((Q_{Ai} - Q_{Hi})/Q_{Ai}) \quad (2)$$

where Q_{Ai} (Q_{Hi}) denotes the predicted quantity from the A (H) demand curve and P_i denotes a price shown in the left margin of Table 2.4. Therefore, multiplying PB_i by 100 measures the difference in total strawberry expenditures predicted by the A and H curves.

As shown in Table 2.4, there is considerable variation in values of PB_i. Of course, where the two demand curves compared both lie on the P axis, the absolute payment bias is zero, even though PB_i cannot be calculated. Additionally, PB_i is small for values of P near the point of intersection of the A′ and H curves. Table 2.4 also shows cases in which the difference in predicted total expenditures is 100 percent or more. As a consequence, the table illustrates the potential for PB_i to be large even though: (1) the null hypothesis of structurally identical A and H curves was not rejected at the 5 percent level and (2) the significant enumerator effects associated with TEAM2 were controlled in obtaining the A′ curve.

TABLE 2.4 : PERCENTAGE DIFFERENCES IN PREDICTED TOTAL EXPENDITURES

Price	Percentage Differences	
	A and H	A′ and H
$1.40	a	a
1.30	a	
1.20	a	100
1.10	a	100
1.00	b	50. 2
.90	-126.1	21.6
.80	-78.7	6.6
.70	-62.7	-3.3
.60	-34.7	-8.9

[a]both demand equations lie on P axis
[b]actual market transaction demand equation lies on P axis

A final comparison can be drawn by examining the average expenditure for strawberries by respondents in the actual market transactions and hypothetical response portions of the study. Average expenditure is computed by adding the products of price and quantity (rather than predicted quantity) for each respondent and then dividing by the number of respondents. Thus, the average expenditure made by actual market transactions respondents ($\bar{E}_A$) can be compared to its counterpart for hypothetical survey respondents ($\bar{E}_H$) using the relation $D = ((\bar{E}_A - \bar{E}_H)/\bar{E}_A)$

= -.583. After eliminating the actual market transactions data collected by TEAM2, however, this value declines substantially to D = -.134. This latter value of D still is somewhat larger than those found by Kain and Quigley (1972) and Kish and Lansing (1954). In their study of housing in St. Louis, Kain and Quigley found: (1) an average absolute percentage difference of 21.2 percent between owner and professional appraiser estimates of value in 113 owner occupied structures and (2) a percentage difference between the mean owner and appraiser values of 1.8 percent. Additionally, Kish and Lansing found roughly a 4 percent difference between mean owner and mean appraiser house values using a national probability sample of 568 homeowners. This comparison with the housing studies, however, should not be overdrawn for two reasons. On the one hand, appraiser estimates value may differ from the price received if the house were actually sold. On the other hand, the actual market transactions demand data (with or without the TEAM2 observations) may only approximate behavior at the grocery store.

This section has compared demand relations for fresh strawberries based on actual market transactions and hypothetical response data. The empirical analysis reveals that the null hypothesis of structurally identical demand equations obtained with these two data collection methods is not rejected at the 5 percent level of significance. However, at given prices inserted in the two demand equations, percentage differences in the predicted quantity of strawberries purchased can exceed 100 percent. A problem with the data collected is that one of the three interview teams sold relatively fewer pints of strawberries during the actual market transactions portion of the study. If the data collected by this team are set aside, then the percentage differences between average strawberry expenditures by respondents in the two portions of the study are about 13 percent.

The results of this section suggest that while demand equations based on actual market transactions and hypothetical response data may be similar from a statistical perspective, the latter type of data may be best utilized in aggregate form. In this situation, which characterizes measures of the average value of homes in a census tract using owner estimates or the average willingness to pay for a hypothetical environmental improvement elicited from a group of survey respondents, the payment bias from individual observations may have a tendency to cancel out. Further research would be useful in establishing whether the findings presented here can be extended to other circumstances, particularly those involving public goods. For example, are individuals better able to accurately answer hypothetical questions about what quantity to buy at given prices (the situation considered in this study) in comparison with questions asking for hypothetical valuations (the situation encountered in the housing and environmental studies)? Additionally, what is the effect on payment bias in instances where less control can be exercised over other potential sources of hypothetical response bias? One generalization in this context would be to analyze a good of a more public character and thereby allow for the possibility of strategic bias. Other possible cases include consideration of goods with which subjects are less familiar, both

in terms of the nature of the commodity and the prior valuation experience they have had with it.

2.4 COMPARISON OF RESULTS: LABORATORY VERSUS ACTUAL PURCHASING BEHAVIOR

Table 2.2 reports the household socioeconomic variables collected in both the actual field sales survey and the laboratory situations. As is evident from the summary statistics reported in this table, the sample populations utilized in each of our two situations were indistinguishable.

Observations of quantities demanded from the actual field sales were arrayed by price. Quantities were transformed into mean pints of strawberries per capita for the six prices. Data obtained from the four auctions was collected and arrayed in a similar manner. The aggregate price/quantity schedules for each of the two data sources are illustrated in Figure 2.2. Note that the range of prices utilized in the field is $1.60 to $0.60 while the range of prices observed in the auction is $6.00 to $0.10.

Because 58 percent of the observations on the quantity of strawberries demanded were zero, a Tobit estimator was utilized to estimate the actual field sales demand schedule. The dependent variable in this equation is quantity of strawberries per capita where “capita” indicates the number of household members. The independent variables used in this regression are typical of the set of variables traditionally used in demand analysis. A variety of independent variables were tested along with alternative functional forms. However, our results were not sensitive to these alternative specifications. Table 2.5 reports the results of the Tobit estimates for the actual sales.

The nature of the data generated in the auction experiments is different than the data collected from actual sales. This difference arises from the fact that a vector of (possibly) different bids is collected for each individual in the auction whereas a single quantity is obtained from the announced price in the field sales. This difference makes direct econometric comparison of laboratory results with field results intractable.

The laboratory demand equation was estimated using ordinary least squares with the same set of included independent variables used in the field regression. The independent variables associated with each individual’s distinct single bid were obtained by averaging the value of all independent variables associated with each unique bid value. For instance, if two individuals submitted the same bid price, the value of all other independent variables at that price was obtained by averaging over the two individuals.

Again, various functional forms were estimated, but our results were not sensitive to their selection. Estimated coefficients for the semi-logarithmic transformation are reported in Table 2.6.

Fi 2.2

Composite Array of Actual Field and Experimental Auction Schedules

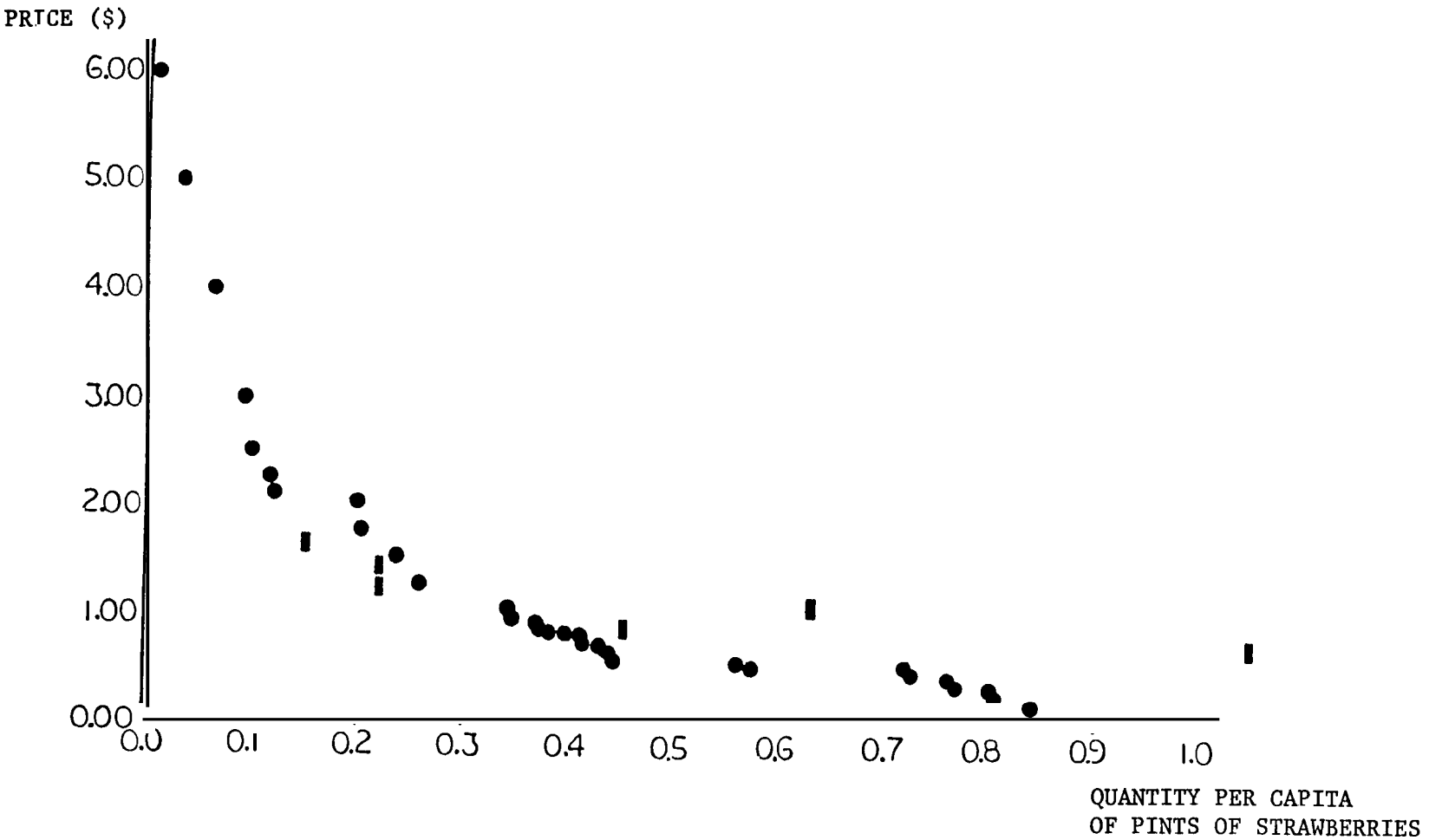


TABLE 2.5. FIELD DEMAND EQUATION (t-statistics in parentheses)
(Tobit Estimates)

Independent Variable	Normalized Coefficient	Regression Coefficient
Constant	4.20 (3.50)	2.33
P = price per pint quoted at door	-1.42 (-3.10)	-.788
INCOME = quantity per capita	.000432 (1.59)	.000240
ATE = hours since last full meal	-.0634 (-.556)	-.0352
ATE2 = ATE squared	.00644 (1.45)	.00358
AGE = age in years of respondent	-.0133 (-1.29)	-.00740
SHOP = days since last grocery shopped	-.00444 (-.172)	-.00246
WHITE = 1 if white, 0 otherwise	-.373 (-.686)	-.207
SCHOOL = average education of household wage-earners	-.139 (-2.57)	-.0772
Standard Error	.555	
$\hat{}$ Predicted Probability of QPC > 0	.432	
Observed Frequency of QPC > 0	.417	
Log of Likelihood	-47.4	
Number of Observations	72	

TABLE 2.6. LABORATORY DEMAND EQUATIONS (t-statistics in parentheses)
(ordinary least squares)

	SEMI-LOG
Independent Variable	Estimated Coefficient
Constant	2.08
P = price per pint quoted at door	-.692
INCOME = monthly income per household member	-.208 (-2.47)
ATE = hours since last ate full meal	.117 (1.72)
ATE2 = ATE squared	-.0218 (-1.74)
AGE = age in years of respondent	.0233 (-.230)
SHOP = days since last grocery shopped	-.00281 (-1.78)
WHITE = 1 if white, 0 otherwise	.184 (1.58)
SCHOOL = average education of household wage-earners	.0786
Standard Error	.166
Log of likelihood	17.4
Adjusted R^2	.943
Number of Observations	420

Given that direct econometric comparison is intractable, the appropriate comparison of the two estimated demand schedules is reported in terms of willingness to pay. This method is appropriate for two reasons. First, use of willingness to pay estimates allows a comparison over a price range found in both data sets. Recall that the laboratory auction yielded a range of offered prices from $0.60 to $6.00, while the field sales prices were restricted to a range of $0.60 to $1.60. Second, willingness to pay measures (total and incremental) are the appropriate measures for public policy issues involving alternative allocations of resources. That is, if laboratory methods are externally validated in a series of comparison efforts such as this study, then application to public policy problems involving private and public goods will be forthcoming. Such applications can generate demand schedules that are premised, in part, on laboratory situations where the public policy issue involves alternative allocations of the commodity. Resulting estimates of incremental willingness to pay values can then be utilized in benefit-cost analyses.

Estimated incremental willingness to pay areas within the price range utilized in the field surveys were calculated as follows. Sample medians of each variable (except P) were multiplied by their estimated coefficient, these products were summed, and then added to the estimated intercept term. In this fashion, an average per-capita demand schedule was obtained in the price/quantity plane. Then, incremental willingness to pay values were calculated as areas under the average per-capita demand schedule for the actual and laboratory demand curves. These results are reported in Table 2.7 for a set of price ranges.

Differences as measured by incremental willingness to pay do exist between field and laboratory buyers as presented in Table 2.7. However, these differences are “small” over the range of price/quantity behavior observed in both settings. The differences in incremental willingness to pay values reported vary from 6 percent to 13 percent over the range of prices of $1.35 to $0.60. Above $1.35, the Tobit estimator intersects the price axis and no additional comparisons can be made.

As always in economic analysis, a word such as “small” can only have a relative meaning. We have various meanings in mind which relate to relative scientific accuracy and traditional measures of demand variability. There are at least two ways to view scientific accuracy: 1) significant digits and 2) order of magnitude. We have reported our calculations to the nearest cent, which implies an accuracy of ±$.005 (Kreyszig, 1979). Most likely economic estimates of demand from any source are not that accurate. We consider ±$.05 as an appropriate measure of implied accuracy based upon the implied accuracy of field sales prices utilized (e.g., $0.60, etc.). Certainly the incremental willingness to pay values from “the two sources are indistinguishable following this interpretation. A second view of accuracy relates to the notion of order of magnitude estimates, of which little needs to be said, in that the reported values in Table 2.7 are consistent following this interpretation.

Another distinct set of interpretations of the meaning of “small differences” relates to comparability of the two sets of willingness to pay

TABLE 2.7. INCREMENTAL ESTIMATED WILLINGNESS TO PAY OBTAINED FROM THE FIELD AND LABORATORY DEMAND SCHEDULES

PRICE RANGE[a] (dollars)	FIELD SALES (cents per capita)	LABORATORY AUCTION (cents per capita)
1.60 to 1.35	00.0[b]	0.35
1.35 to 1.10	0.37	0.34
1.10 to 0.85	0.19	0.18
0.85 to 0.60	0.18	0.16

[a] l.60 to 0.60 is the overall range of the prices used in the field sales.

[b] This value is 0.00 because the Tobit estimator intersects the price axis below 1.35.

values with respect to other identified sources of demand variance. Sources of such variance have been discussed by Learner (1983) and have been explored empirically by Coursey and Nyquist (1984). In the Coursey and Nyquist study, estimates of demand parameters were found to change by 50 percent or more simply by changing functional form or the nature of the error distribution. In this context, the robustness of the estimated incremental willingness to pay values for the field and laboratory data generating techniques is on par with the robustness expected from other typical sources of demand variation.

The final empirical conclusion of the section should not come as a surprise. In the context of a privately consumed commodity, we fail to reject the hypothesis that valuation measures obtained from traditional actual field sales data are the same as those that are obtained in a laboratory auction which has strong demand revelation properties. Or, in other words, valuation measures used in the laboratory appear to be externally valid for (at least) a class of private goods. But, if one examines what experimental economists actually do in their laboratories it is obvious that they control rather than measure values. Why then is our finding of parallelism important?

The answer to this question lies in the answer to another question. Specifically, what would be necessary if our study (and other replications like our study) had found a lack of parallelism in observed behavior?

Would this mean a nail in the coffin for experimental economics? Not in our opinion. Rather, lack of parallelism would suggest that questions about applicability to actual "real world" settings and about correspondences between "actual" traders and student-subjects raised in the introduction to this paper are the most relevant research questions for the experimental economist. Lack of parallelism would suggest that what experimentalists ought to do before anything else is to explain the nature of the differences that exist in the "real world."

Our conclusion implies that the experimental economists' resources are better invested elsewhere. Additionally, the profession as a whole is now provided with a limited piece of information which suggests that a larger degree of confidence ought to be forthcoming in the work that most experimentalists actually do. However, before such confidence can be complete, more links between the field and the laboratory need to be empirically explored. This study has only examined one very specific macroeconomic environment. Other environments, especially those associated with collective choice, remain important areas for future research.

CHAPTER 3

THE APPLICATION OF LABORATORY EXPERIMENTAL ECONOMICS TO THE CONTINGENT VALUATION OF PUBLIC GOODS: A RATIONALE FOR THE EXPERIMENTAL ECONOMICS APPROACH

3.1 INTRODUCTION

The traditional proposition in public finance theory is that market or voting institutions are inherently flawed in their ability to bring about efficient allocation of resources when public goods exist. However, in the past twenty years the theory of public goods has challenged this proposition through a variety of different channels.

One such channel involves simply constructing a mechanism which solicits the consumer for his or her willingness to pay function for the public good. This approach is now commonly referred to as contingent valuation. Contingent valuation studies may be distinguished from other forms of public good evaluation methods by their use of a survey questionnaire to acquire information. Central to this approach is the construction of a hypothetical allocation procedure for the public good. This procedure usually follows the following pattern: First, the commodity in question is described in terms of its quantity, quality, location, and time dimensions. Then, the hypothetical market institutions, including the allowable messages which each individual can send, the allocation rules, cost imputation rules, and, when appropriate, the adjustment process rules, are described to each respondent. Finally, each respondent chooses a message he or she wants to send to the interviewer, the interviewer transforms this message into a final allocation outcome, and this outcome may or may not be reported to the respondent.[2]

Brookshire and Crocker (1981) have argued that the survey approach for valuing public goods has a number of demonstrable advantages. Foremost among these is the fact that the technique generates its own data, does not depend upon pre-existing market data, and therefore can be used to value any public good within a benefit-cost or optimal level of provision analysis. The motivation for this approach also is the result of the outright failure or impossibility of more traditional hedonic valuation approaches in a number of important instances.[3,4]

The flexibility of this technique has fostered an explosion in its use to determine the benefits of government regulations designed to alter or manipulate natural systems. The analytical foundations for currently used contingent valuation techniques have their origin in the work of Davis (l963), Bradford (1970), Randall et al. (1974), Hori (1975), and Freeman (1979). Schulze et al. (1981) and Brookshire and Crocker have summarized

the wide variety of non-marketed goods for which the contingent valuation method has been used.[5]

While we detail some of these applications in the next section, it should be immediately apparent that the application of a new technique, such as contingent valuation, to a variety of novel circumstances and situations is likely to generate new problems and questions. Resolution of these problems and questions is required before the technique can be considered accurate and reliable. Thus, since the time that Brookshire and Crocker argued for more wide ranging application of the survey method, it has been shown that the technique provides values which approximately coincide with the traditional property value (Brookshire et al., 1982), wage hedonic (Cummings et al., 1986), and travel cost (Desvousges et al., 1983) methods of valuing public goods. Unfortunately, these traditional methods each have their own operational and empirical difficulties.[6] Therefore, we must conclude that the comparison studies themselves are all inexact and provide little guidance as to the design of improved survey instruments. Ideally, we would like to know a priori the exact individual willingness to pay functions for a particular public good and then apply alternative questionnaire designs to these individuals until a design is found which provides accurate responses. Unfortunately, this is difficult, if not impossible, in most field situations.

However, all hope in improving survey instruments is not lost. We argue in this chapter that an approach likely to improve accuracy of the contingent valuation method, and the only inexpensive one, is a laboratory experimental economics procedure. In a controlled laboratory environment, individual values can be induced over public goods or, when actual physical goods with unknown individual value are used in experiments, respondents can be provided with incentives to disclose actual valuations. These responses can then be compared to valuation responses obtained from alternative survey questionnaires. Ultimately, the researcher will then be able to walk away from the laboratory with a "best set" of questionnaires which can be used in the treatment of public good production problems in the field.

In the next section we review in detail the present state of contingent valuation theory and practice. A number of problems are identified from the survey literature which suggest the need for alternative approaches: How, or in what fashion, can survey instruments be designed so as to eliminate the systematic strategic and nonstrategic biases inherent in soliciting individual valuations? What role do iterative "bidding game" (Davis, 1963; Bradford, 1970; and Randall et al., 1974) modifications have upon the validity and accuracy of survey instruments? What role do psychological factors have in the divergent measurements associated with different public good valuation techniques? Section 3.3 reviews past theoretical treatments of the public good allocation problem and how proposed allocation methods have performed in the laboratory. Included are theoretical discussions of private good demand revelation processes (Vickrey, 1961; Loeb, 1977; Cox, Roberson and Smith, 1982; Forsythe and Isaac, 1982; and Milgrom and Weber, 1982), competitive public good demand revelation processes developed by Clarke

(1971), Groves (1973), Groves and Ledyard (1977), and Tideman and Tullock (1976), and the role of unanimity voting in public choice discussed by Wicksell (1896), Buchanan and Tullock (1962), and Smith (1977). Attention is then turned to summarizing the results of applying these mechanisms in the laboratory and in the field. Section 4 discusses the practical integration problems involved with moving from a laboratory research environment to a field contingent valuation study. This section addresses the operational issues involved with taking a mechanism with theoretically strong demand revelation properties and a strong laboratory performance record and constructing its field survey Counterpart. An example concerning the construction of an auction-like survey instrument designed to extract information about the amount of income required for a group of individuals to consume a pollutant is considered. The paper closes with a suggested agenda for future experimental research.

3.2 ISSUES AND EVIDENCE FROM THE CONTINGENT VALUATION LITERATURE

As noted in the introduction, the contingent valuation approach has been used to generate willingness to pay functions for a large and diverse set of consumer goods. A recent study has extended the technique from consumers to business firms who were solicited for their willingness to pay for a proposed national coal resources data system (Brookshire et al., 1983). In most of these studies, survey techniques were used because other techniques based upon market behavior could not be employed or had prohibitive costs. None of the published results suggests that strategic behavior, in the classic free-rider sense, has affected results. Rather, the principal concern remains that answers to hypothetical survey questions concerning value may be biased and not conform with actual behavior. As originally expressed by Bohm (1972), respondents who do not have to actually pay for the provision of the public good in question and who doubt that any real decision will be made on the basis of their answer will pose problems to the surveyor and to later analysis. While not necessarily having an incentive to exhibit free-rider behavior, these subjects also have no incentive to "tell the truth" and may easily be influenced by spurious, irrelevant factors such as a desire to please the surveyor or the desire to avoid socially unacceptable responses.

The contingent valuation method does try to reduce the role of these irrelevant factors by making survey questions as realistic as possible. This has lead Davis (1963) and Randall et al. (1974) to construct so called bidding game surveys, These surveys attempt to iterate towards an individual's maximum willingness to pay value for a hypothetical public good. These surveys initially propose a hypothetical change in the level of a public good and then ask the respondent what he or she would be willing to pay for this level in terms of increases in utility rates, taxes, entrance fees, etc. The respondent answers with an initial starting bid. The surveyor then begins a process of increasing the bid of the respondent until the respondent indicates that he or she would not pay for the public good at the current price quoted by the interviewer.[7]

Another approach, which has been utilized by Mitchell (1981) and Schulze and Brookshire et al. (1983) to collect bids involves the use of a so-called payment card. In this type of survey the respondent circles an amount of money from a set of alternatives printed on the payment card which most closely represents his or her maximum willingness to pay. Schulze and Cummings et al. (1983) used the results of three public goods studies to show that willingness to pay obtained from the iterative bidding approach significantly exceeds willingness to pay obtained from the payment card approach. Examination of Table 3.1 indicates that the iterative bidding approach yields measures about 50 percent higher than the payment card approach. Why would or should we expect this diversity? Which is the appropriate technique to employ?

At this time, both questions remain unanswered. The problem is that there exists no true set of values with which to compare the solicited values found in Table 3.1. The best that economists can do is to find market situations which might reflect values of associated public goods. Comparison studies with a goal of validating the contingent valuation approach have been limited to three studies: Brookshire et al. (1982), Desvousges et al. (1983), and Cummings et al. (1986).[8] Each of these studies compares the results of a survey study to an hedonic or travel cost measurement of a public good's value. In these studies market based results were within 50 percent of the survey results. These results are encouraging in suggesting that survey approaches yield value estimates of the correct order of magnitude. However, since the market based comparison measures themselves contain considerable amounts of noise, they provide no guidance for improving survey designs.

To illustrate the difficulty of precisely estimating the value of public goods using market data, consider the problem of using a property value study to determine the willingness to pay for clean air. Figure 3.1 illustrates how individuals' varied preferences will cause them to locate across a region with continuously varying air quality. Given the positively sloped rent gradient shown in Figure 3.1, an individual with tastes represented by indifference curve I chooses to locate at air quality level Q. Individual B with indifference curve I^B locates at air quality level Q^0. A's indifference curve is tangent to the rent gradient at point A and B's indifference curve at point B. Now consider Mr. C. **He** also locates at air quality level Q_I and has an indifference curve I tangent at point B, although his indifference curve has a radically different shape compared to Mr. B. In fact the demand curves for clean air (Q) for Mr. B and Mr. C will look like those in Figure 3.2. Mr. B **is** willing to pay more for an improvement in air quality than Mr. C (and vice versa for prevention of a decrease in air quality) but the information given by the hedonic rent gradient does not allow us to discern between B and C. Looking at Figure 3.2, we know from the rent gradient that marginal willingness to pay and quality of clean air demanded are at point Z . However, one point on an individual demand curve is not sufficient to make a slope estimate which would allow calculation of willingness to pay (area under the demand curve). Thus, individual demand curves for clean air cannot be estimated from a hedonic rent gradient for clean air.

TABLE 3.1: ITERATIVE BIDDING AND THE PAYMENT CARD APPROACH

		Average Bid (Standard Errors) Using:		Sample Size
		Iterative Bidding	Payment Card	
Commodity	Visibility at the Grand Canyon	$9.20 (11.54)	$5.69 (7.21)	64
	National Water Quality	$8.71 (11.11)	$6.50 (8.48)	56
	Containment of Hazardous Wastes	$25.85 (36.43)	$16.02 (20.78)	163

Figure 3.1
Individuals' Varied Preferences and Locational Choice

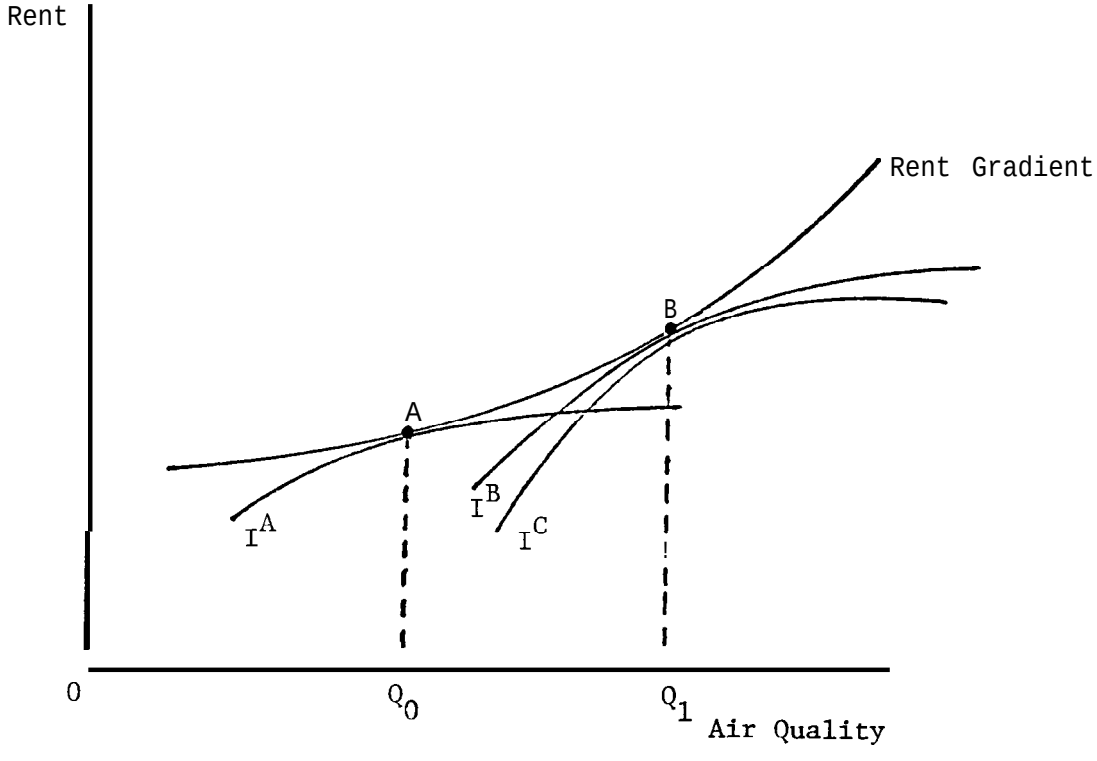
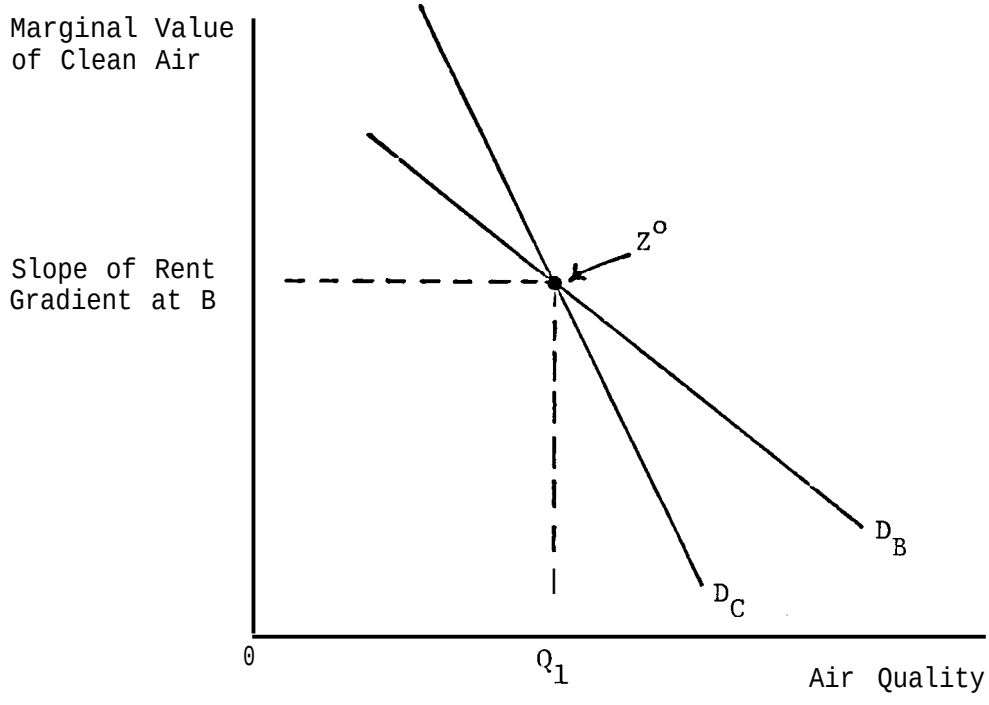


Figure 3.2

Mr. B and Mr. C's Demand Curve for Clean Air



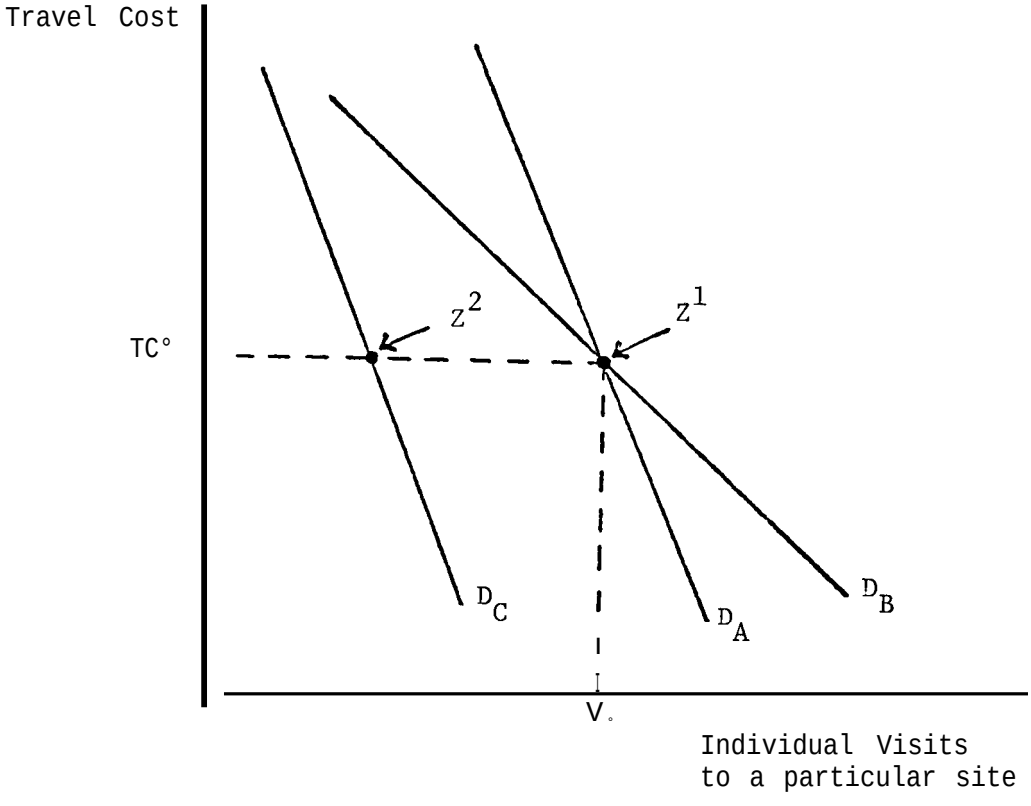
Next consider Figure 3.3, the classic Clawson-Hotelling travel cost case. Two individuals A and B live at the same distance from a site. Their individual demand curves are D_A and D_B. They have the same travel cost TC^o and number of visits V_o but different demand curves and consequently different willingness to pay for the site. Market data on Z^1 tells us nothing of the slopes and willingness to pay of the two individuals A and B. Thus, we are in an analogous situation to that of Figure 3.2. However, the situation is potentially even more complex. For example, individual C with demand curve D_C might choose a different number of visits but we still only obtain data on one point along his demand curve, Z^2. One can always solve these problems by adding enough arbitrary assumptions (form of utility function, identical number of visits etc.) or by adding additional data on individual behavior. The former solution does, however, make benefit estimates from the indirect market data approach dependent on which arbitrary assumptions have been introduced to get around the problem of nonidentical preferences. Consequently such benefit estimates must now be regarded as having considerable uncertainty introduced as to their accuracy. These concerns are now widely documented in work by Mäler (1974) (who perhaps first raised the issue), Mendelsohn (1980), Brown and Rosen (1982), and others.

We are consequently lead to the conclusion, at least temporarily, that hedonic and travel cost measures are not the answer to the problem of finding sufficiently accurate estimates of willingness to pay which could serve as anchors for improving survey instruments. It is our conjecture, developed upon sometimes serendipitous suggestions from the existing body of contingent value literature, that anchor values can be more accurately obtained in a laboratory setting using methods commonly employed in past and ongoing experimental economics. While this argument is carried to fruition in the next section, we turn now to an examination of the results which predicated our conclusion.

First, as shown in Table 3.1, values from the payment card approach, which might be interpreted as "opening bids" in an iterative bidding sense, are significantly smaller than the final bids obtained from the iterative approach. Randall et al. initially utilized an iterative bidding approach because they hypothesized that such a process might be more "market-like" to the respondents and could therefore simulate a competitive auction experience. In fact, laboratory auction results have shown that bidding in an auction process, even when it is theoretically in the immediate best interest of an individual participant, reflects full willingness to pay only after a series of iterative learning periods (Cox, Roberson, Smith, 1982). This would suggest a priori that an iterative bidding survey scheme might be expected to outperform the payment card approach.

A second unresolved problem in the contingent valuation approach is the unexpectedly large difference obtained for both private and public goods in willingness to pay versus willingness to accept compensation studies. Theoretically, questionnaires designed to ask an individual for payment to acquire a good should provide similar results as questionnaires designed to ask an individual how much compensation is required to give up

Figure 3.3
An Example of a Classic Clawson-Hotelling Travel Cost Case



the same good.[10] Results from three studies, compiled in Table 3.2, will serve to document these differences.

Table 3.2 compiles the results of a field survey concerning visibility improvements, a field study concerning hunting permits, and a laboratory study concerning lottery tickets. The results of both the hypothetical field and actual[11] laboratory studies all indicate that willingness to pay measures are significantly smaller than corresponding willingness to accept measures. All the differences are much larger than can be accounted for by possible income effects. Professional speculation about the nature of these large differences has usually centered upon ethical or psychological factors.[12] We offer a rather different working conjecture. If respondents treat the contingent valuation as an auction, then a logical strategy is to adopt an initial bargaining position with low initial bids and to strive to pay as little as possible for the good in question. Similarly, if the respondent is asked to consider giving up a commodity, then initial willingness to accept offers ought to be set as high as might seem credible. In either case the individual is just rationally beginning with a strong initial negotiation position. Without an addition to the iterative bidding survey mechanism which induces competitive incentives the gap between willingness to pay and willingness to accept should not be expected to disappear. None of the three studies mentioned above employed such a mechanism.

3.3 LABORATORY EXPERIMENTAL METHODS AND PUBLIC CHOICE

With the above background it is now possible to say something coherent about the relationship between laboratory experimentation[15] and contingent valuation methods of valuing public goods. Presently utilized contingent valuation surveys are designed to collect field data relevant for social policy analysis using alternative survey instruments. Each of the instruments has its own set of rules and therefore causes a specific set of individual messages about the public good to be furnished. The survey method exercises control over changes in the institutional rules for allocating a public good but little or no control over individuals' valuation of the good. A researcher may propose a new questionnaire design and test that design in the field. However, lacking control on information concerning preferences, the results of that survey cannot be unambiguously interpreted. Evaluation of each survey's results is complicated by the classic problem of underidentification. Field experiments must be interpreted in terms of assumptions about both individual preferences and assumptions about behavior implied by the rules of the survey. However, the fundamental objective behind a laboratory experiment in economics is to create a manageable "macroeconomic environment in the laboratory where adequate control can be mandated and accurate measurement of relevant variables guaranteed" (Wilde, 1980, p. 138). As pointed out by Smith, control and measurement can only be measured in relative terms, but undoubtedly are much more precise in the laboratory than in the field.

The technique of laboratory experimental methods is ideally suited for testing the relative performance of different contingent valuation surveys

TABLE 3.2: WILLINGNESS TO PAY VERSUS WILLINGNESS TO ACCEPT

Commodity	Average Willingness to Pay (Standard Error)	Average Willingness to Accept (Standard Error)
Visibility*	$3.53 (0.462)	$46.63 (14.14)
Goose Hunting Permits**	$21.00	$101.00
Lottery Tickets***	$1.28	$5.18

* Contingent Valuation of Visibility in Four Corners Area, Rowe et al. (1980). Average willingness to pay for improvement in visibility from 25 to 75 miles. Average willingness to accept compensation for visibility decrease from 75 to 25 miles.

** Willingness to pay or accept for goose hunting permits, Bishop and Heberlein (1979). No standard error reported in this study.

*** Willingness to pay or accept for lottery tickets. Knetsch and Sinden (1984).

and for designing and evaluating new survey instruments of interest to policy makers. Laboratory environs can give the economist complete control over individual preferences. Any desired configuration of preferences over an abstract collection of public or private goods can be induced for a group of individuals (Smith, 1976, 1982). Each individual is assigned a payoff rule indicating the amount of money he or she will receive for various outcomes of the social decision process. As long as the individual prefers more money to less, a preference ordering is induced over the outcomes of the social decision process.

Once preferences are controlled, laboratory methods can be used to study the comparative performance of survey instruments. The research objective in comparative studies is to understand how and why different field instruments solicit messages from individuals by conducting similar surveys in the laboratory. Fortunately, the results of these types of studies usually provide insights for modifying existing institutions and direct future research. Subsequently, testing of new questionnaire classes with novel allocation rules may be quickly and inexpensively accomplished in the laboratory.

Additional research directives also may be forthcoming from public choice modeling endeavors. Theory may suggest that possible survey mechanisms with certain socially desirable outcomes may exist. Survey instruments which mimic these models may be designed, tested, and compared to traditional results.

Voluminous processes for allocating both private and collective goods have been proposed in the economic literature over the past 25 years. To us, the implications of this literature suggest a set of well defined guidelines for improving both the accuracy and validity of contingent valuation methods. However, these processes have been largely ignored by economists who design public choice questionnaires. We close this section of the paper with a brief discussion of proposed designs of mechanisms for resource allocation and and explanation of why these proposals deserve high priority in future contingent valuation research. This discussion also highlights the potential afforded by laboratory experimental methods in the survey design process.

The most important concept in the evaluation of an allocative system, and the concept which has driven institutional theorists is that of incentive compatibility. An institution's rules are incentive compatible # . . . if the information and incentive conditions that it provides individual agents are compatible with (i.e., support) the attainment of socially preferred outcomes. . . . This means that the rules specified in the institution in conjunction with the maximizing behavior of agents yields a choice of messages which constitute a Nash equilibrium whose outcomes are [socially desirable]." (Smith, 1982, p. 927.)

Vickrey (1961) published the first article in which a mechanism for achieving optimal allocations was proposed. His sealed-bid auction mechanism had the property that each participant had a dominant bidding strategy to truthfully reveal demand. Vickrey's fundamental and

path-breaking result has recently enjoyed a renaissance and has precipitated considerable attention on designing demand-revealing mechanisms: Shubik (1975), Dubey and Shubik (1980), Cox, Roberson, and Smith (1982), Forsythe and Isaac (1982), and Milgrom and Weber (1982).

Most of this literature analyzes a model in which a single indivisible object is to be sold to one of a group of potential buyers. Each bidder has preferences defined over the object and over risk but not necessarily over the value to other bidders. The auction is assumed to be a noncooperative game played by the bidders.

Two kinds of auction mechanisms have been considered in the theoretical literature, oral auctions and sealed-bid auctions. In oral auctions an exchange of messages occurs between individuals according to a set of rules of negotiation. A contract can then occur. In an English auction, bids are announced by the buyers, a bid remains standing until a new higher bid replaces it, and the auction stops when an auctioneer decides that no higher bid is to be forthcoming from the buyers. In a Dutch auction, price is set initially "high" and then lowered automatically in increments until one of the buyers accepts the current value of the object and terminates the auction. In sealed-bid auctions, individuals submit messages to a seller or a representative of the seller who then determine outcomes based upon a set of pre-announced rules. In a first-price auction the buyer who submits the highest bid receives the object and must pay his bid. In a second-price auction the highest bidder also receives the object but only pays what the second highest bidder bid.[14] Several interesting results emerge from the theoretical consideration of these auctions.[15]

1) In first-price auctions the optimal individual bid is less than the value of the auctioned item. That is, an individual has no incentive to reveal demand.

2) The first-price auction does not imply Pareto-optimal allocations.

3) Conclusions concerning the first-price auction also apply to Dutch auctions.

4) In second-price auctions the optimal individual bid is equal to the value of the auctioned item. That is, an individual has every incentive to reveal demand.

5) The second-price auction implies Pareto-optimal allocations.

6) Conclusions concerning the second-price auction also apply to English auctions.

Based upon the results of 12 experiments conducted by Coppinger, Smith and Titus (1980) and 780 experiments conducted by Cox, Roberson and Smith (1982)[16] the above implications were supported for groups of size four or greater except that first-price and Dutch auctions did not appear to be exactly isomorphic. The deviant results for groups of size less than four

were conjectured to be due to a failure in the assumption of noncooperation. An important conclusion resultant from these studies was that not all subjects in a second-price sealed-bid auction realize that bidding full value is a dominant strategy. Some never do. Others require a period of time over a sequence of bidding games to "learn" the strategy. Coppinger, Smith, and Titus ". . . question whether any meaningful one-shot observations can [therefore] be made on processes characterized by a dominant strategy equilibrium." (1980, p. 21.) It appears that the desirable properties of second-price auctions do reveal themselves, but sometimes only in a limiting sense after the subject has time to experience the operation of the mechanism.

Why does the second-price auction have such nice theoretical properties and the first-price auction not have them? Vickrey (1976) has posited the following intuitive explanation:

> "The essence of these cases that admit of the achievement of a Pareto optimal result seems to be the extent that the participants have a choice as to participating or not, it is an all-or-nothing choice. There can be no strategic holding back [of demand]: for an individual to hold back is to achieve a zero-gain for himself." (Vickrey, 1976, p. 15.)

This general result has led researchers to consider the properties of more complex multiple unit auctions. Engelbrecht-Wiggans (1980) have shown that when more than one unit is auctioned in a single sealed-bid auction that the desirable properties of demand revelation break down. Individuals will tend to underreveal demand. If each person can only bid on one unit though, the desirable properties of the second-price auction still hold (Vickrey, 1976). The performance of auction mechanisms which include more complex bidding such as a sealed-bid auction involving a single price for a multiple number of units or a sealed-bid auction in which the individual submits a different bid for each unit is examined in Dubey and Shubik (1980), Palfrey (1980), Smith, Williams, Bratton, and Vannoni (1982), Coursey and Smith (1984), and Miller and Plott (1983).

How can these results from private good auction theory help to provide direction in designing contingent valuation surveys? First, they provide insight concerning how to true elicit valuations. Individuals must be placed in an "all-or-nothing" situation in the questionnaire where no strategic holding back can help them. If the questionnaire can be designed in such a manner that a single unit or a single unit per individual is to be hypothetically auctioned off in a second-price fashion, then more demand-revealing behavior, and therefore information about true valuations, should be expected to occur. Secondly, an iterative auction framework is suggested. Because of the reported demand revelation "learning period" associated with the second-price auction, individuals also should be placed in a survey situation which provides them with tentative information about allocation before results are finalized.[17]

In a series of papers Smith (1977, 1979a, 1979b, 1980), Ferejohn, Forsythe and Noll (1979a, 1979b), and Ferejohn, Forsythe, Noll and Palfrey

(1982) [18, 19] have considered extending an auction mechanism to public goods. This involves designing a process based upon a Groves-Ledyard (1977) mechanism for providing a collective good. In a public good auction individuals submit desired quantities of the commodity and their cost share or contribution for the commodity that they would voluntarily accept. Each individual is reported the average group quantity and his or her share of total cost given the contributions of others in the group. Each individual then has the right to veto or agree to the tentative results. Group agreement prevails if and only if each individual agrees upon the outcome and the group covers the cost of the proposed amount of the public good. If agreement is reached, then each individual receives the public good and must pay his or her cost share.

The no-veto condition means that we have a tatonnement process in the sense that no contracts can occur until all individuals in the group are in equilibrium or agreement. This provides at least a partial solution to the problem of free-riding or the incentive to contribute less than true maximum willingness to pay. One individual can veto the results of the auction even if every other individual in the group agrees about a given quantity and distribution of cost shares.

In experimental examinations of the public good auction mechanism using a tatonnement process, Smith (1979a, 1979b, 1980), Ferejohn, Forsythe, Nell and Palfrey (1982), and Coursey and Smith (1984) found that Lindahl optimal quantities of the public good are provided by groups with up to nine members. These studies and other studies conducted in the field by Bohm (1972), Ferejohn and Nell (1976), and Scherr and Babb (1975) suggest that it is possible to construct decentralized processes for the provision of public goods.

These studies also suggest how an iterative auction framework can be integrated into a questionnaire framework. An iterative or sequential survey can be combined with a tatonnement voting process. Such a unanimity requirement is used in the London gold bullion market, Jarecki (1976), and has been found to improve efficiency and decrease underrevelation in private as well as collective allocation mechanisms (Smith, Williams, Bratton, and Vannoni, 1982; Smith, 1982; Coursey and Smith, 1984; Miller and Plott, 1983; and the earlier pure public good references).

3.4 AN EXAMPLE: REVELATION OF COMPENSATING INCOME VARIATION

In order to illustrate some of the points made in the previous two sections we consider the problem of constructing two different survey instruments which attempt to reveal how much individuals are willing to accept in order to have a factory move into their physical environment. The first survey proposed is structured more or less along the lines of current contingent valuation practice. The second is structured along the lines of current experimental economics practice, using a hypothetical Vickrey second price auction.

Suppose that the environment consists of i = 1, 2 . . ., I individual economic agents who have utility functions defined over income, Y_i, and Q_i, a "bad" commodity such as the smoke produced by the factory. Thus $U_i = U_i(Y_i, Q_i)$ is individual i's utility function with $\partial U_i/\partial Y_i > 0$ and $\partial U_i/\partial Q_i < 0$ for all i. Suppose that there exists an income compensation ΔY_i which would just make an individual i indifferent to a choice between a smoky environment and extra income and a clean environment with no extra income. Or, ΔY_i is implicitly defined by $U_i(Y_i + \Delta Y_i, 1) = U_i(Y_i, 0)$. Thus, ΔY_i is i's willingness to accept monetary payment for the smoke produced by a nearby factory.

Suppose now that the ΔY_i are rank ordered from i = 1, 2, . . ., I, the ranking is denoted by super "r," and that $\Delta Y_1^r \leq \Delta Y_2^r \leq \ldots \leq \Delta Y_I^r$.[20] Then this ranking defines a compensating income variation supply function (see Figure 3.4). This curve may also be thought of as the supply function for pollutable locations. Assume for simplicity that the factory produces an integer N < I total units of pollution and that the maximum consumption of Q is one unit per individual. Each individual who is affected by the factory consumes one unit of pollutant and each individual who is not affected by the factory consumes zero units of the pollutant. The situation described can be imagined as a cloud of smoke which, as it grows in size (N), envelops more and more homeowners (individuals) who surround the factory emitting the smoke. The problem facing the economist is to conduct a survey to determine the damages done by a given factory which produces N units of smoke.

3.4.1 Institutional Proposal: Solicited Compensating Variations

The first approach to this question involves constructing a survey which solicits or asks each i to submit a message m which is his or her willingness to accept an income compensation offer f&r one unit of Q. This involves only one period of data collection and analysis. Allocation of one unit is made to the N individuals who submit the lowest willingness to accept offers. For these individuals $U_i = U_i(U_i + m_i, 1)$. All other individuals receive no units of Q and for this group $U_i = Ui(Yi, O)$.

The problem with this institution is that a dominant strategy equilibrium involves asking for an infinite income compensation.[21] There is no incentive for an individual to provide the surveyor with any accurate information concerning actual willingness to pay except perhaps a desire to be honest, which may conflict with any auction-like experience the respondent may have had. Any auction-like experience would induce the respondent to open with a very large bid (theoretically infinite) to put him or herself in a good negotiating position. This theoretical result is consistent with the large unaccounted for difference between willingness to accept and willingness to pay previously shown in Table 3.2.

3.4.2 Institutional Proposal: Tatonnement Version of the Second-Price Auction

Now consider an alternative iterative survey. During each trial t with t= 1, 2, . . ., T let each individual i submit a message m_i which is

his or her willingness to accept income compensation offer for one unit of Q. Tentative allocation would then occur according to the following rules: First, the offers m_{ir} would be ranked from lowest to highest such that $m_{1}^{r} \leq m_{2}^{r} \leq \ldots \leq m_{I}^{r}$. A reigning offer price for all accepted offers m^{*} would be determined according to rules of second-price auction. Thus $m^{*} = m_{N+1}^{r}$ (see Figure 3.5). If $m_{i}^{r} < m^{*}$ then an individual would be tentatively compensated with a payment of m^{*} and would tentatively have to consume one unit of pollutant. So tentatively for this group $U_{i} = U_{i}(Y_{i} + m^{*}, 1)$. If $m_{i}^{r} \geq m^{*}$ then an individual would be tentatively compensated nothing and tentatively would have to consume zero units of the pollutant. So for this group $U_{i} = U_{i}(Y_{i}, 0)$.

These tentative results of the survey would then have to be put to a vote. All members of the group who were allocated one unit of the pollutant would vote on whether to finalize the allocation results for that trial. If all voted "yes" then everyone would realize their allocations. If at least one individual voted "no" and vetoed the results of the trial then a new trial would be conducted. A second survey would be administered. The survey and voting processes would continue until a unanimous agreement occurred or until a maximum number of surveys T had been performed. In that case some terminal (perhaps random) allocation procedure might be invoked.

Notice that this survey instrument incorporates three elements which theoretically and empirically should allow it to outperform the first survey. It is a second-price auction, iterative learning effects are permitted to occur, and it is a tatonnement process. Its primary disadvantage over the simple survey lies in the cost of performing multiple iterations.

A comparison of the two surveys can easily be accomplished in the laboratory. Monetary value can be induced upon the compensating income level required for each individual to hypothetically consume a fictitious pollutant. In addition, more complicated allocation mechanisms can be constructed and tested for cases where individuals may consume more than one unit of the pollutant or where the pollutant is a pure public good or externality. Similarly, the performance of the relatively simple hypothetical iterative bidding game and other intermediate mechanisms can be contrasted to the Vickrey second price auction. Both of these institutions can be checked for accuracy through laboratory experimentation. Hopefully, this research approach will allow an understanding of the tradeoff between the complexity (and cost) of the survey mechanism and the accuracy of the results.

3.5 CONCLUSIONS

We have implicitly argued in the last section that a dynamic iterative survey mechanism may well need to be employed in the design of contingent valuation survey instruments in order to improve the accuracy of responses. Furthermore, due to the current inaccuracy of hedonic and travel cost approaches for valuing public goods, the least cost method, in our view,

Figure 3.4

Group Willingness to Pay Function
(I = 5 assumed)

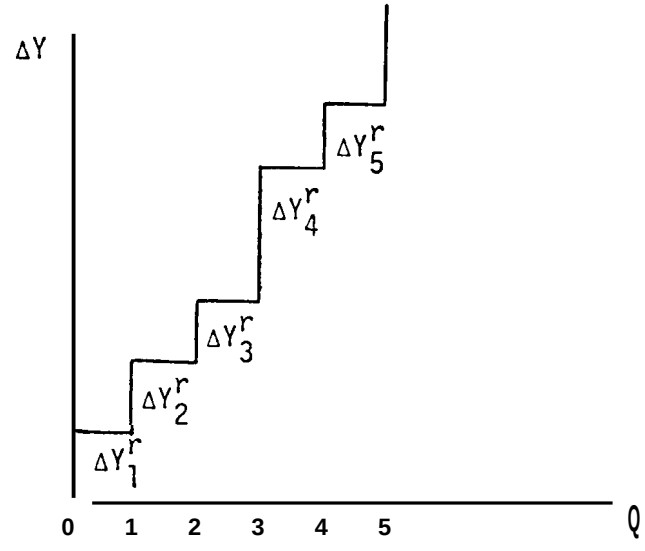
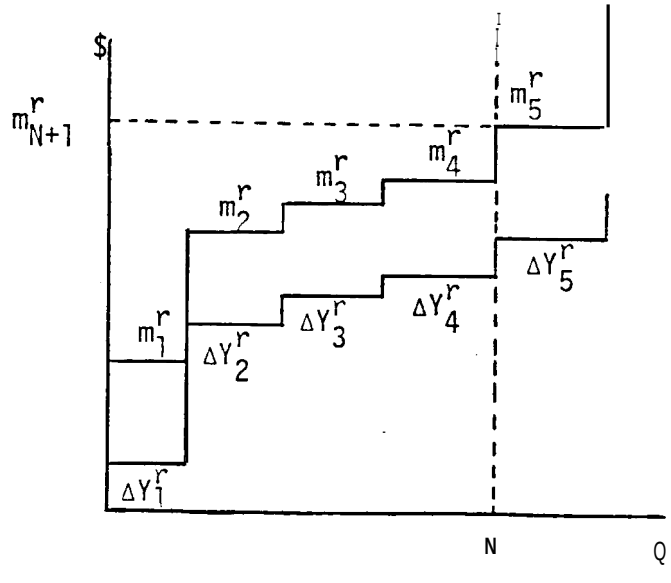


Figure 3.5

Vickrey Auction of N Units
(N = 4, I = 5 assumed)



for establishing anchor or true individual values for testing alternative survey instruments is to use laboratory experiments. The objective of these experiments should be the development of the most simple survey design which gives accurate responses subject to the budget of the investigator. Is a complex iterative voting procedure required? How fast will such a procedure converge to "true" values? What is the effect on incentives of relaxing the unanimity voting feature for large groups? All of these operational questions can at least qualitatively be answered in an experimental laboratory setting.

This approach would allow rapid resolution of a number of problems which have developed in the application of the contingent valuation approach. First, the large difference between economic measures of willingness to accept and willingness to pay may be greatly reduced by application of demand revealing mechanisms. Any remaining difference between the two measures might then be properly attributed to psychological, ethical or other complicating factors.

Second, the consistently large differences between the iterative bidding and payment card measures of willingness to pay suggests that one of the procedures might be more accurate than the other. Laboratory experimentation should be able to quickly identify the superior procedure.

Third, contingent valuation studies which involve uncertainty have not proven successful. In a study of the willingness to pay to contain toxic wastes undertaken by Cummings and reported on in Schulze and Cummings, et al. (1983) nearly half of the respondents were willing to contribute the same amount of money for 50 percent odds of containment as for 100 percent odds of containment. Does this result indicate a failure of the expected utility hypothesis or a failure to perceive or comprehend probabilities by a large subsample of individuals? Or, is the survey at fault? Again the least cost approach for resolving these questions is likely to be a laboratory setting.

Finally, individuals may have severe perception problems with the timing and method of payment used to collect bids for public goods. Schulze and Brookshire, et al. (1983) report on a large divergence in the value of preserving visibility for visitors at the Grand Canyon using monthly payments in the form of higher electric utility bills to collect payment as compared to collecting higher daily entrance fees. Note that the first method hypothetically collects a regular payment on a monthly basis while the second hypothetically collects payments only if respondents visit the Grand Canyon. The first method implied an overall larger total benefit of preserving visibility than the second. Again, laboratory experiments could readily determine the relative accuracy of alternative temporal payment mechanisms.

REFERENCES

1. "After providing [a theory of public expenditure] with its optimal conditions, I went on to demonstrate the fatal inability of any decentralized mechanism to attain or compute this optimum." (Samuelson, 1955, p. 35). See also Samuelson (1958).

2. See Hurwicz (1973) and Smith (1982) for a discussion of the formal structure of designing and evaluation of allocation mechanisms. We have tried to interpret the description of the contingent valuation approach found summarized in Brookshire and Crocker (1981) in terms of this structure.

3. See Brown and Rosen (1982) for a discussion of the failure of the hedonic approach to identify individual demand curves for public goods.

4. For example, Randall et al. (1974) have tried to value the effects of power plant development upon the natural environment. Because their study area was a sparsely inhabited area of the southwestern United States, they could not, for lack of data, apply the standard property value or wage hedonic approaches for valuing amenities commonly used earlier with considerable success in urban areas.

5. An incomplete list includes public television programming, atmospheric visibility, land-form alterations due to strip mining, air pollution-induced health effects, wildlife, water pollution, preservation of river headwaters, urban infrastructure allocations for expenditures and taxes, airplane safety, power plant cooling towers boomtown infrastructure, public parks, odors, and geothermal steam development. See Brookshire and Crocker (1981) for specific references.

6. Brown and Rosen (1982).

7. The iterative bidding approach described here differs slightly from the one originally used by Randall et al. in that the respondent, rather than the surveyor, proposes the opening bid. This rule avoids the problem of starting point bias wherein the suggested initial bid used by the surveyor biases latter responses.

8. Three other studies, although not designed to directly examine the question of validity, shed some light on the accuracy of the contingent valuation approach. See Bishop and Heberlein (1979), Hammack and Brown (1974), and Bohm (1972).

9. The example cited refers to a second-price Vickrey sealed-bid auction. It is a dominant strategy equilibrium for each individual in such an auction to bid full value or reveal demand for the single unit sold in each period. At best, it usually takes subjects a few periods to realize this. Some individuals never totally reveal demand. See Cox, Roberson, Smith (1982) for details.

10. The difference between the two measures is theory due to an income effect. This income effect in practice is usually small. See Willig (1976).

11. Actual in the sense that subjects actually realized the monetary consequences of their actions.

12. See the discussion in Knetsch and Sinden (1984).

13. The introductory remarks of this section draw heavily upon Smith (1982, pp. 928-930) and are verbalized by the authors in terms of field contingent valuation studies and their relationship with experimental economics. See also Plott (1979), Plott (1982), and Isaac (1983).

14. These descriptions are meant to be brief. For a detailed description of the four basic auction types see Cassady (1967) or Coppinger, Smith and Titus (1980).

15. All are derived in Cox, Roberson, and Smith (1982). See also Milgrom and Weber (1982).

16. See also Smith (1967) and Belovicz (1979).

17. Provide the individuals with more than a one-shot survey. Let them answer a survey, report the tentative results of that survey back to them, let them adjust their answers, report the new tentative results, and so forth until an announced stopping time. At this stopping time allow the final results to take effect.

18. See also the special Spring 1977 supplement to Public Choice.

19. Loeb (1977) considers the general comparability problems associated with relating private good auction mechanisms and public good auction mechanisms.

20. This function is in general a step function. The assumption that individual 1 has a lower AY than individual 2 and so forth is only a simplifying assumption to keep the mathematics simple.

21. If i maximizes $U_i(Y_i + m_i, 1)$ then he will select an infinite value for m_i. Only a preference for fairness or equity not modeled in this problem would cause m_i to be bounded.

CHAPTER 4

PRIVATE GOOD EXPERIMENTS: A COMPARISON OF ALTERNATIVE VALUATION MECHANISMS FOR NON-MARKET COMMODITIES

4.1 INTRODUCTION

Can economists provide accurate estimates of the value of commodities not traded in markets? Public choice and environmental economists would certainly answer in the theoretical affirmative. However, consider the empirical record.

Indirect methods such as those used in hedonic property value and travel cost studies have been used to value a variety of public and environmental goods with apparent success (Freeman, 1979). However, values obtained in these studies have come under increasing scrutiny due to the possibility of an identification problem which, up to the present time, has not been resolved (Brown and Rosen, 1982).

A second more direct approach termed contingent valuation has been employed in other cases. This approach uses surveys to ask individuals to attach their own subjective values on alternative provision levels of non-market commodities (Schulze et al., 1981). It has been shown that the results of such contingent valuation (or survey) studies are statistically equivalent to the results obtained from indirect approaches when individuals were asked for their willingness to pay for the good's provision (see Brookshire et al., 1982 and Desvousges et al., 1983). In contrast, values obtained using an identical contingent valuation approach where individuals were asked for their willingness to accept compensation (for the goods nonprovision) are as much as an order of magnitude larger than willingness to pay measures for provision of the same good (Bishop and Heberlein, 1979 and Rowe et al., 1980). This result is at considerable odds with economic theory which predicts that willingness to accept and willingness to pay measures of value should differ by only a (usually) small income effect (Willig, 1976).

This apparent divergence between willingness to accept (WTA) and willingness to pay (WTP) measures has lead economists to question or discredit the entire contingent valuation approach (Rowe and Chestnut, 1983). Additionally, psychologists and others who have questioned the feasibility of valuing commodities not traded in markets have used this divergence to attack the traditional economic theory of value (Knetsch and Sinden, 1984). Further, those reporting encouraging comparisons between indirect hedonic approaches and direct contingent valuation approaches soliciting willingness to pay have not statistically resolved the disparity because of the limited accuracy of the indirect measurements.

Fortunately, a third avenue for estimating values is available (Coursey and Schulze, 1986). Economic theorists and experimental economists have demonstrated both the feasibility and accuracy of demand revealing mechanisms such as Vickrey (1961) auctions applied to private goods and Groves-Ledyard (1977) mechanisms applied to public goods. This work has focused on the performance of alternative allocative mechanisms and relies upon controlled or induced individual values rather than on obtaining initially unknown values for market or non-market commodities (Smith 1976, 1982).[1]

Because our experiments are designed to explore the nature of preferences rather than the issue of preference revelation they do not utilize induced value theory. Rather, individuals are assumed to have a state dependent utility function which includes income and also exposure to an unpleasant (bitter) taste experience. Our experiments are designed to determine how individuals value this unusual experience both from the perspective of accepting payment to endure the experience and from the perspective of paying to avoid a bitter tasting experience. The bitter substance used in the experiments, sucrose octa-acetate (SOA), has long been used by psychologists in taste experiments and provides a carefully controlled, safe, but unpleasant experience (Green, 1942 and Linegar, 1943).

The experiments consist of three parts. First, each subject is asked to provide either a hypothetical WTA or WTP for tasting SOA based on only a verbal description of the substance. Second, subjects are allowed to sample a few drops of SOA and are again asked for either WTA or WTP. Third, groups of individuals who were originally asked the WTA questions participate in a Vickrey auction for a fixed supply of the SOA. Low bidders are then actually compensated to taste the substance. For groups originally asked the WTP questions, a similar Vickrey auction is held for not tasting the substance and high bidders actually pay to avoid tasting SOA.

Presumably, the well documented demand revealing properties associated with the competitive Vickrey auction should provide "true" values in the form of individual bids. These values, unlike those used in previous economic laboratory experiments, are not known in advance as is the case with induced values. They depend on individual preferences with respect to two states of the world: tasting or avoiding SOA. The fact that individual values are not induced allows the collection of hypothetical values in a controlled laboratory setting. Obviously, if subjects were aware that the value of the commodity in question was known to the experimenter (e.g., a coupon which could be redeemed for a specified dollar value at the end of the experiment) they would be less likely to give strategic, untruthful, or biased hypothetical responses. Our experiments allow comparison not only between hypothetical and market values in a given WTA or WTP setting, but also between WTA and WTP measures of value. Therefore, the reported results are interesting both in terms of measuring the validity of the contingent valuation technique and in terms of validating or rejecting the economic-theoretical hypothesis that WTA and WTP measures of value should coincide. Finally, it should be noted as an

alternative hypothesis that psychologists predict a large difference between WTA and WTP based on cognitive dissonance grounds. We will not present cognitive dissonance theory here since an earlier paper (Akerlof and Dickens, 1982) has discussed it at some length. However, economists view the large predicted psychological differences between WTA and WTP to be a form of "irrational" behavior.

4.2 THEORETICAL STRUCTURE OF THE EXPERIMENT

The following notation will be used to demonstrate the nature of utility maximizing behavior for a rational individual in our experimental setting:

Let Y = individual income

Y° = initial income before the experiment begins

a = taste exposure to SOA (either zero or one cup of the SOA liquid in the experiment, $a = 0, 1$)

B_P = bid to pay to avoid tasting one cup of SOA, a willingness to pay measure

B_a = bid to accept payment to taste one cup of SOA, a willingness to accept measure

M = monetary compensation to take part in the willingness to pay experiment.

Individuals are assumed to have a utility function of the form

$$u = U(Y, a) \tag{1}$$

where the marginal utility of increased income is positive and the marginal utility of tasting SOA is negative.

Willingness to accept compensation to taste SOA, B_a, is then defined implicitly by the relationship

$$U(Y^0 + B_a, 1) = U(Y^\circ, 0) \tag{2}$$

so the utility of receiving B_a dollars in addition to the individuals initial income of Y° dollars for tasting SOA ($a = 1$) is equal to the utility derived from initial income Y^0 when not tasting SOA ($a = 0$). A rational individual would thus require at least B_a dollars to voluntarily taste SOA.

Willingness to pay to avoid tasting SOA, B_P, is implicitly defined by the relationship

$$U(Y^\circ + M - B_P, 0) = U(Y^0 + M, 1). \tag{3}$$

Note that individuals must receive some amount of money M before participating in this part of the experiment since they must taste SOA unless they bid sufficiently to avoid the experience. Obviously, if individuals were not first induced to participate with a value of M sufficiently large, they would not participate in the experiment. Individuals therefore start with an income of Y" + M but may give back B_p dollars to avoid tasting the SOA solution. This yields utility as shown on the left-hand side of (3). Or, individuals can choose to keep an income of Y° + M and taste SOA yielding a level of utility as shown in the right-hand side of (3). A rational individual's maximum willingness to pay to avoid tasting SOA, B_p, is obtained by setting utility levels in these two states equal as shown in (3).

If M were zero, then willingness to accept would clearly be greater than willingness to pay, $B_a > B_p$. However, since bids in the experiment were typically less than $10, this difference should be very small since the income effect at that level is insignificant. However, M is not zero. To examine the affect of M on B_a and B_p note that if M is set equal to B_p in (3) then (3) becomes identical in structure to (2). Consequently, if individuals could a priori be given an amount of money to participate in the willingness to pay experiment exactly equal to their bid, $M = B_p$, then willingness to pay and willingness to accept would be identical, $B_p = B_a$, and the income effect would exactly cancel out. In the actual course of the experiments individuals were given an amount of money M greater than B_p to insure their participation in the willingness to pay experiment. Thus, M more than offsets the income effect in the actual experiment and we would expect $B_p > B_a$. However, as noted above, the income effect should be small in any case since M, B_p, and B_a were all small relative to Y°. The working hypothesis is then that willingness to accept and willingness to pay should be very close, if not identical, in the experiment. Further, if the Vickrey auction is successful in obtaining "true" and rational bids, willingness to pay and willingness to accept measures of the value of tasting SOA should be statistically indistinguishable for a given random sample drawn from a population of subjects.

4.3 EXPERIMENTAL DESIGN

Sixty-four volunteer, full time students recruited from undergraduate business classes at the University of Wyoming participated in eight laboratory experiments dealing with the gustation of the SOA solution. Thirty-two students completed four WTA experiments and thirty-two students completed four WTP experiments. Each of the WTA and WTP experiments consisted of, three parts: Part I: Totally Hypothetical, Part II: Semi-Hypothetical, and Part III: The Auction. Each experiment involved a group of eight individuals. No individuals participated in more than one experiment.

At the outset of each of the three Parts of the experiments each subject was given detailed, written instructions describing that Part which they were instructed to read thoroughly. Then, the monitor of the

experiment orally reviewed the instructions to ensure full understanding prior to the actual elicitation of monetary bids.

Part I (Totally Hypothetical), was designed to elicit traditional survey WTA and WTP monetary responses following Brookshire et al. (1982), Schulze and Brookshire, et al. (1983), and Schulze and Cummings, et al. (1983). In the WTA experiments each individual was asked to determine the minimum amount of money they would hypothetically accept to taste the SOA solution. Similarly, the WTP experiments solicited hypothetical responses representing the maximum amount of money they would pay to avoid tasting the SOA solution.

Part II (Semi-Hypothetical) was designed to elicit hypothetical bids related to tasting after each individual had an opportunity to sample the SOA solution. Each individual was able to respond with hypothetical bids after having limited experience with the discommodity. Thus, Part II was one step removed from the totally hypothetical (H) frame of reference that the subject made responses from in Part 1. We refer to these hypothetical responses as semi-hypothetical (SH) bids.

Two specific questions were addressed to each subject immediately following the sampling procedure. First, the subject was asked the same question as in Part I and asked to record a WTA or WTP bid. Given this new valuation the individual's bid was iterated (see Randall et al., 1974) by the monitor downwards in the WTA experiments by 25c increments until an individual minimum WTA bid was received. Alternatively, in part II of the WTP experiments the individual's new bid was iterated upwards using the same increments in an effort to derive their individual maximum WTP bids. These iterated bids are referred to as semi-hypothetical iterated (SHI) bid responses.

Part III (the Auction) of each experiment involved the construction of a tatonnement version of a Vickrey auction to elicit bid responses from the subjects. Based upon the results of experiments conducted by Coppinger, Smith and Titus (1980) and 780 questions conducted by Cox, Roberson and Smith (1982) the theoretical demand revelation properties of a single unit Vickrey auction have been supported for groups of size four or greater. An important conclusion resultant from these previous studies was that not all subjects in a Vickrey auction realize that bidding full value is a dominant strategy. Some never do. Others require a period of time over a sequence of bidding games to "learn" the strategy. Coppinger, Smith, and Titus

" . . . question whether any meaningful one-shot observations can [therefore] be made on processes characterized by a dominant strategy equilibrium." (1980, p. 21.) It appears that the desirable properties of Vickrey auctions do reveal themselves, but sometimes only in a limiting sense after the subject has time to experience the operation of the mechanism. Appendices C and D present the experimental instructions.

This general result has led researchers to consider the properties of more complex multiple unit auctions. Engelbrecht-Wiggans (1980) have shown that when more than one unit is auctioned in a single sealed-bid auction that the desirable properties of demand revelation break down. Individuals

will tend to underreveal demand. If each person can only bid on one unit though, the desirable' properties of the second-price auction still hold (Vickrey, 1976). Other studies also suggest how an iterative auction framework can be integrated into a questionnaire framework. An iterative or sequential survey can be combined with a tatonnement unanimous voting process. Such a unanimity requirement is used in the London gold bullion market (Jarecki, 1976), and has been found to improve efficiency and decrease underrevelation in private as well as collective allocation mechanisms (Smith, Williams, Bratton, and Vannoni, 1982; Smith, 1982; Coursey and Smith, 1984; Miller and Plott, 1983).

Each of the WTP auctions involved providing each subject in the group with a ten dollar credit (M) from which they would use some, all, or none of to make their WTP bid. During each trial each individual i submitted a message B_{pi} representing that individual's willingness to pay to avoid being allocated one of four units of the SOA discommodity. Tentative allocation of a fixed exogenous supply of N = 4 units then occurred according to preannounced rules. All B_{pi} were ranked from highest to lowest with $B^r_{p1} \geq B^r_{p2} \geq \ldots \geq B^r_{pN}$ where the super r denotes ranking. Then, a price or reigning bid $B^*_p = B^r_{p,N+1}$ was determined from the ranking. Thus B^*_p was the fifth lowest ranked bid (the first rejected bid). B^*_p determines those four agents whose bids are accepted and those four whose bids are rejected. Those individuals submitting $B^r_{pi} > B^*_p$ tentatively would pay price B^*_p to avoid gustation. Those submitting $B^r_{pi} \leq B^*_p$ would pay nothing and would tentatively have to taste the solution. Actual payment and tasting of SOA only occurred when there was a unanimous vote (of individuals with accepted bids) to accept B^*_p as the amount they would each pay to avoid SOA. The allocation rules provide that in any trial t, where $1 \leq t \leq 4$ all outcomes were nonbinding no matter what the vote outcome. For $4 < t \leq 10$ all outcomes were binding implying that when unanimity was reached the auction stopped.[4]

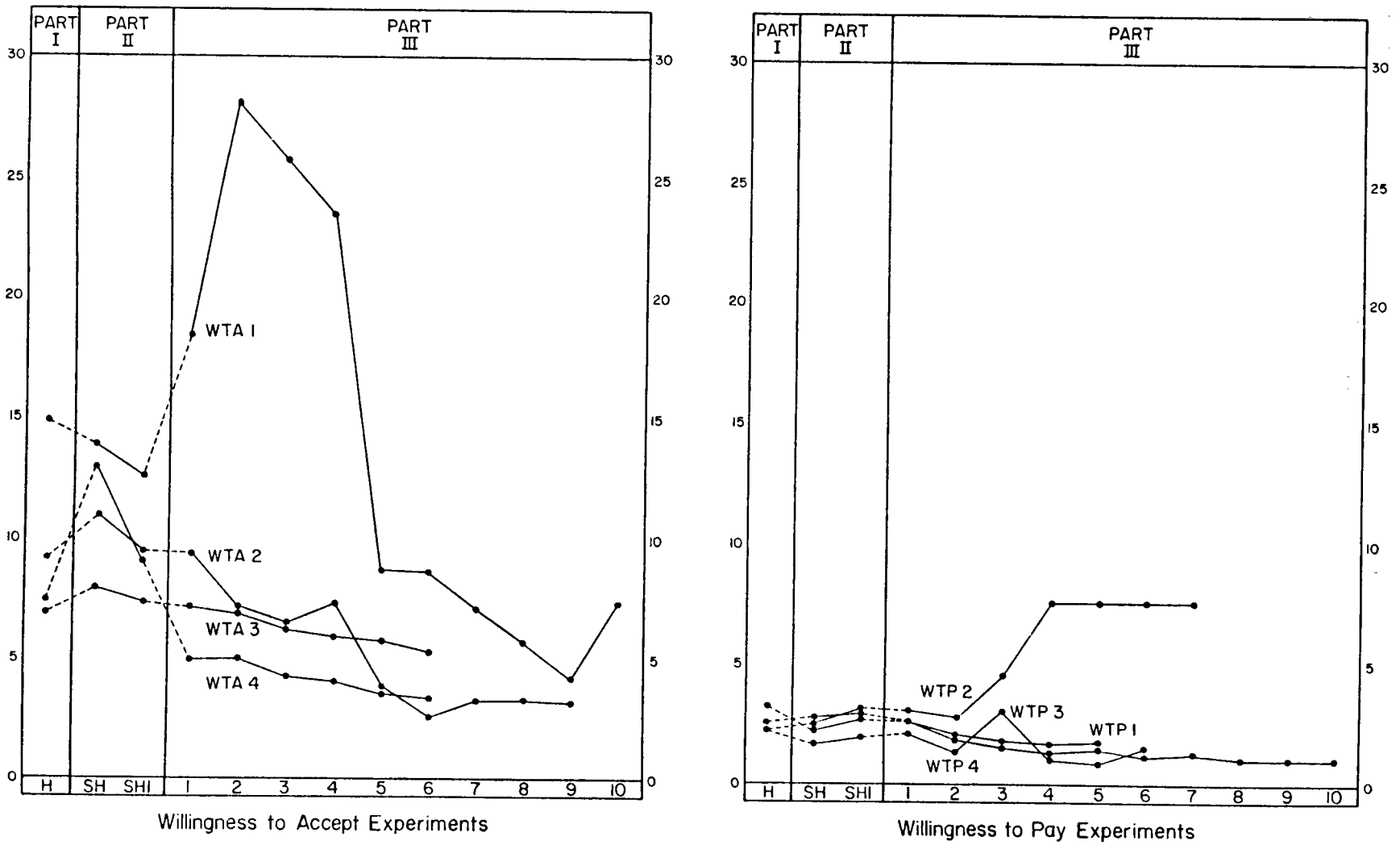
A mirror process was used for the WTA experiments whereby similar institutional rules determine a reigning willingness to accept payment price. However, no initial monetary endowment was given to the subjects.

4.4 EXPERIMENTAL RESULTS

A summary of the results from the four willingness to accept and the four willingness to pay experiments is reported in Figure 4.1. Each point plotted in the two diagrams represents an average bid of the eight subjects who participated in a single experiment. Plotted are Part I hypothetical bids, Part II semi-hypothetical bids and iterated semi-hypothetical bids, and Part III trial-by-trial outcomes. Figure 4.2 reports the same data found in Figure 4.1 but averages are taken across all individuals in both sets of experiments. Part III average trial-by-trial outcomes are reported for the first four trials and, since different experiments concluded on different trials, for the ending trial.

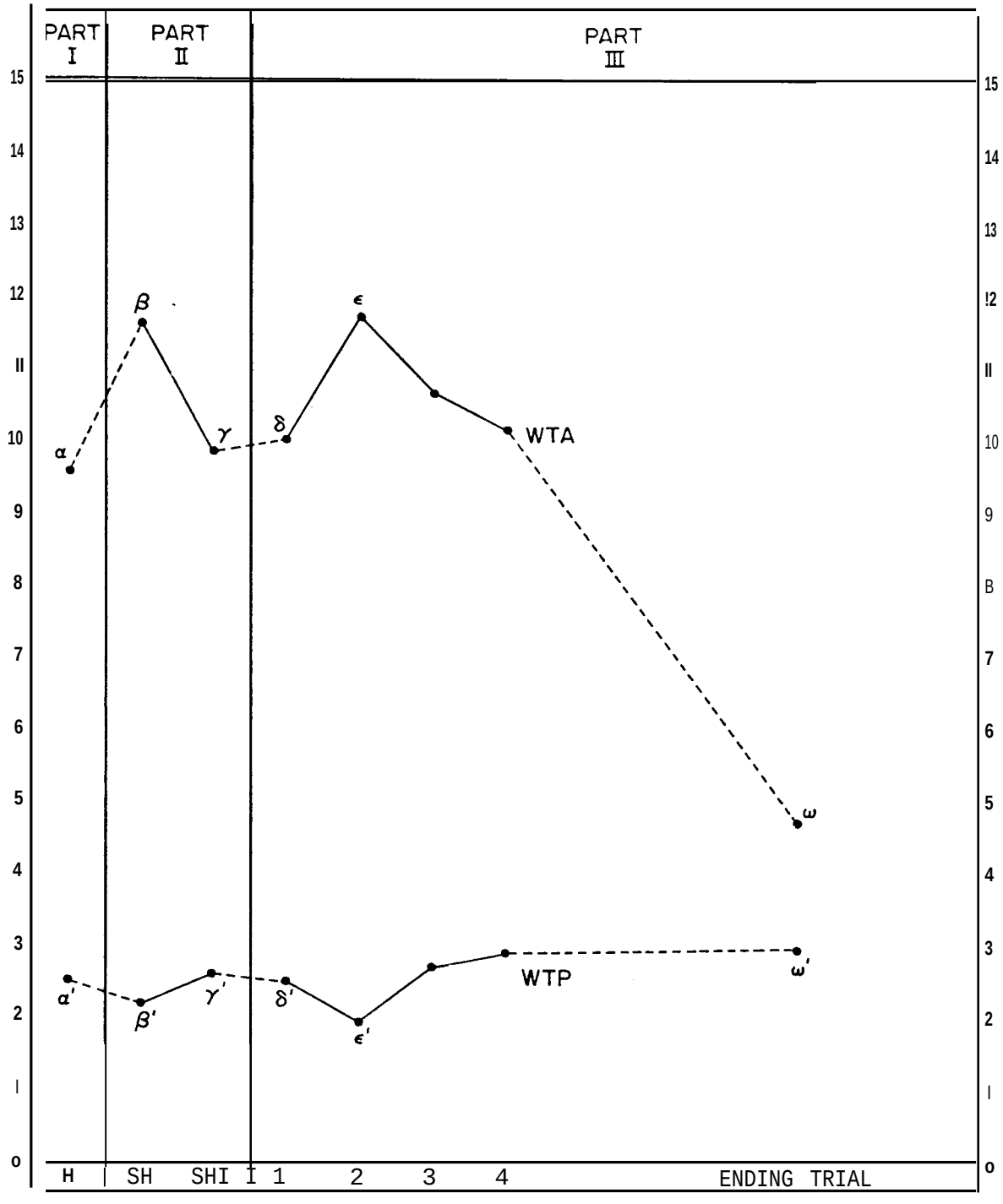
A one-tailed rank-sum test utilizing average data obtained from the eight experiments was conducted at the 99 percent confidence level in order

Figure 4.1: Average Single Experiment Responses



Each point represents average of the eight individuals who participated in a single experiment.

Figure 4.2: Overall Average Experimental Responses



Each point represents overall average of the thirty-two individuals who participated in each of the WTA and WTP experiments.

to compare willingness to accept and willingness to pay measurements obtained in the three parts of our experiment. Applying this test we reject the hypothesis that willingness to accept and willingness to pay measurements obtained in Part I's totally hypothetical setting are equal. That is, points a and a´ are statistically different. This statistical difference extends to Part II's semi-hypothetical bids ß and ß´. After the iterative bidding process was conducted willingness to accept (pay) bids decreased (increased) as expected ($\gamma < \beta$, $\gamma' > \beta'$) but final iterative bids γ and γ' remain statistically different. Only after completion of the auction process can we accept the hypothesis that willingness to accept and willingness to pay measurements ω and ω' are equivalent.

We also used the rank-sum test to consider whether there was a difference between methods used to collect willingness to accept and willingness to pay bids. We cannot reject the hypothesis that any of the three traditional survey methods reported for Parts I and II yields different average willingness to accept or willingness to pay bids. That is, α, β, and γ are statistically equivalent and α', β', and γ' are statistically equivalent. After the auction process was conducted, final willingness to accept bids did collapse to a lower value ω. However, a corresponding phenomena did not occur in the willingness to pay experiments. A statistically significant rise in willingness to pay bids did not occur with the exception of the single experiment WTP2. Thus, competitive pressures do not appear to hold with an equal force in the willingness to accept (supply) and the willingness to pay (demand) auctions. The reported evidence strongly suggests that subjects do decrease their requested payments required to consume the SOA solution. This result does not extend unequivocally or symmetrically to the willingness to pay auction environment.

4.5 DISCUSSION

Results of this experiment provide as many new questions as answers. First note that as one moves from left to right across Figure 4.2, WTA and WTP move in opposite directions through each and every phase of the experiment. The hypothetical WTA and WTP results (expressed as average values across individuals) are initially far apart (points a and a´ respectively). This result is consistent with the existing literature on field application of the survey approach for valuing public goods (Bishop and Heberlein, 1979 and Rowe et al., 1980). Surprisingly, actual experience with the commodity (tasting SOA) drives hypothetical WTA and WTP further apart (points β and β'). We have no conjecture to explain this result.

Iterative bidding as in the Randall tradition causes WTA and WTP to converge (points y and y"). Obviously, this suggests that the iterative procedure may be of some value. As the Vickrey auction begins (points δ and δ'), opening bids for WTA and WTP are similar to, but further apart than, the iterated hypothetical bids. In the second auction trial (E and E") WTA and WTP diverge. This may be the result of some individuals in the experiment attempting to employ dynamic trial strategy not addressed

in the static Vickrey models. In early trials individuals may not initially understand that the best strategy is to reveal true values but ultimately WTA and WTP converge strongly (points ω and ω´). This convergence is, however, strongly asymmetrical in that the WTA measure of value "collapses" downward under the competitive market-like experience of the auction while WTP trial values show only modest upward movement.

Final auction measures of WTA (point u) and WTP (point w") are statistically similar. However, although hypothetical WTA (say that from point y) is not statistically similar to WTA obtained in the auction (point u), hypothetical willingness to pay (say point y-) is statistically similar to WTP obtained from the auction (point ω´).

These results suggest three conclusions. First, given the demand revealing nature of and learning experiences in the Vickrey auction actual average WTA and WTP do not differ significantly in this experiment. This result is consistent with economic theory and suggests that the divergence obtained from hypothetical measures of WTA and WTP may result mainly from lack of a market-like environment. In any case, this result lends considerable support to received economic theory and little to its critics. To wit, if the initial divergence in WTA and WTP measures is due to cognitive dissonance as some psychologists suggest, individuals quickly learn to become more rational under the pressure of a competitive market-like experience. Based upon the results of our reported experiments, cognitive dissonance or any other psychological explanations are of little consequence in explaining observed behavior.

Second, hypothetical measures of value obtained using WTA are likely to be biased upwards from what we would interpret as true values obtained from a market-like auction. Psychological factors may of course explain this bias. However, economists might argue that opening WTA bids might well be biased upwards for simple strategic bidding reasons.

Third, hypothetical measures of value obtained using WTP may correspond more closely than hypothetical WTA measures to true value. This result agrees closely with the favorable comparison studies of contingent valuation with hedonic, property value or travel cost techniques.

4.6 ON THE SUPPOSED DISPARITY BETWEEN WILLINGNESS TO ACCEPT AND WILLINGNESS TO PAY MEASURES OF VALUE

In a recent paper Knetsch and Sinden (198A) report a series of experiments which demonstrate the existence of a large disparity between willingness to accept (WTA) and willingness to pay (WTP) measures of value. They argue that the psychological theory of cognitive dissonance may ' explain this reported difference. However, economic theory would suggest that individuals who exhibit cognitive dissonance are behaving in an irrational manner and will consequently achieve a lower level of utility than if they behaved in a utility maximizing manner (Akerlof and Dickens, 1982). It is important to note that the experimental design utilized by Knetsch and Sinden ignores much of the tradition and procedures developed

in experimental economics. A large body of the experimental economics literature has been focused on the comparison and development of institutions (market-like mechanisms) which are demand revealing (Smith, 1977; Cox, Roberson and Smith, 1982). One such mechanism is the Vickrey or competitive auction (Vickrey, 1961; Vickrey 1976). It is such a mechanism which we employ (in contrast to the Knetsch-Sinden experiment) to obtain what we regard as "true" values for WTA and WTP in the experiment reported herein.

An important observation to be drawn from experimental economics is that individuals participating in a Vickrey auction do not initially reveal "true" values. On a purely theoretical economic basis, they "should" realize that this is their dominant strategy. However, a number of trial iterations are usually required to allow individuals the opportunity to learn that revealing "true" values is their best strategy (Coppinger, Smith and Titus, 1980; Cox, Roberson and Smith, 1982). We show below that although individual opening bids in a Vickrey auction show a large disparity between WTA and WTP, ending bids submitted after a series of learning trials are not significantly different. Thus, the market-like learning experience of the Vickrey auction causes the disparity reported by Knetsch and Sinden to be greatly reduced or disappear. One interpretation of this result is that as individuals evaluate the consequences of their decisions over a series of iterative trial auctions they learn that full demand revelation is their dominant strategy. Since most economic activity takes place in organized markets this result suggests that economic theory is most likely adequate to explain behavior as long as individuals have the opportunity to "learn to be rational" through experience. In other words, economic theory is correct in predicting that WTA and WTP will usually be close in a market setting (Willig, 1976).

Our experiment sheds light on how to obtain market-like values for non-market commodities. It will be shown that hypothetical WTP corresponds closely to both WTA and WTP measures obtained in the ending trial of the Vickrey auction. In other words, the hypothetical WTP measure of value obtained in our WTP experiment is statistically close to final market auction bids. However, hypothetical measures of WTA as well as opening WTA auction bids are both significantly greater than closing auction bids. We therefore argue that hypothetical WTP measures of value obtain close market values for non-market commodities but that hypothetical WTA measures are likely to be biased on cognitive dissonance or other unexplained psychological grounds.

In this context, the purpose of our paper is to use a controlled laboratory environment to test the validity of a contingent valuation technique which employs surveys to obtain hypothetical willingness to pay values for provision of non-market commodities.

Our results are also important from a policy perspective. Contingent valuation has been increasingly employed to value public goods (see Schulze et al., 1981; Brookshire et al., 1982; and Greenley et al., 1981), but has come under substantial criticism both because of the hypothetical nature of the questions asked and because of the disparity between WTA and WTP

measures of value (see Hammack and Brown, 1974; Bishop and Heberlein, 1979; Rowe et al., 1980; and Rowe and Chestnut, 1983).[1] Knetsch and Sinden were the first to demonstrate that the unexpected disparity between WTA and WTP (much larger than any income effect could explain) holds for actual as opposed to hypothetical values. Thus, the disparities previously reported in contingent valuation studies are apparently not due to the hypothetical nature of the procedure. Rather, as we show below, they may be due to a lack of market and learning experience with the commodity.

4.7 EXPERIMENTAL DESIGN

The non-market commodity used in the experiment is a bitter-unpleasant taste experience. Psychologists have traditionally used sucrose octa-acetate (SOA) in taste experiments because it is the only known laboratory substance which is bitter and yet non-toxic. SOA is safe (breaking down into sugar and vinegar in the body) but very unpleasant (Green, 1942; Linegar, 1943). In the WTA experiments, subjects are offered payment to taste SOA. In the WTP experiments subjects offer to pay to avoid tasting SOA. Tasting involves the subject holding a one-ounce cup of a concentrated SOA solution in the mouth for 20 seconds. The SOA taste experience was carefully described both verbally by the experimenter and in the written instruction package each subject received at the start of the experiment.

Four groups of eight full time students recruited from undergraduate business classes at the University of Wyoming participated in the WTA experiments and four similar groups of eight students participated in the WTP experiments. No subject participated in more than one experiment. The first part of each experiment consisted of asking each of eight subjects either how much they must be paid to hypothetically taste SOA (WTA experiments) or hypothetically how much they would pay to avoid tasting SOA (WTP experiments). The bids produced in the first part of the experiment are termed purely hypothetical (H) bids because individuals had not yet tasted the SOA liquid.

The second part of the experiment involved three steps. In the first step individuals tasted a few sample drops of the SOA solution. In the second step individuals were again asked for their WTA or WTP bids to taste a full one-ounce cup of SOA. We refer to these values as semi-hypothetical (SH) bids. In the third step the experimental monitor attempted to lower (raise) the WTA (WTP) bids in 25$ increments. The process was initiated from the level of the individual's semi-hypothetical bid. As soon as an individual refused to further lower (raise) their bid, the monitor recorded the final bid as the individual's semi-hypothetical iterated (SHI) bid. All subjects were addressed on a one-to-one basis. This procedure was designed to conform closely to the procedure used in field contingent valuation as first employed by Randall et al. (1974).

In the third part of the experiment the eight individuals in a group participated in a Vickrey auction designed to elicit individual competitive bids. Four one-ounce cups of the SOA solution were auctioned to the group

of eight individuals. For brevity only the structure of the WTP auction is described below. The WTA auction was conducted in a mirror like manner.

Each individual in the WTP auction was given a ten dollar credit to use in the auction (no credit was given in the WTA auction). During each trial each individual first submitted his or her bid to avoid tasting one cup of the SOA solution. Bids were then collected by the monitor and rank ordered from highest to lowest. The fifth highest bid was then reported back to the eight subjects as the reigning price. The four individuals with bids higher than the reigning price were then able to determine that they have "won" the auction implying that they could pay the reigning price (not their own bid) to avoid tasting SOA. The losers paid nothing but had to taste the SOA solution if the trial was final. To determine if the trial was final, the winners then voted upon whether to accept the results of the trial. Only if a unanimous "yes" vote was obtained was the trial considered final. Further, the first four trials were non-binding in that even if four "yes" votes were obtained, another trial was conducted. Voting during trials five and on could produce a potentially binding outcome. The experiment ended either with a unanimous vote, in which case four individuals paid to avoid tasting SOA and four individuals had to taste the SOA or, in the case where a unanimous vote was not obtained after ten trials, all parties had to taste the SOA solution. Both the unanimity requirement and the nonbinding practice trials have been suggested as ways to improve efficiency, to allow for learning, and to reduce the percentage of underrevelation (Smith, Williams, Bratton and Vannoni, 1982; Smith, 1982; Coursey and Smith, 1984; Miller and Plott, 1983). It is important to note that Knetsch and Sinden did not employ any such mechanism with theoretical demand revealing properties while obtaining bids.

4.8 RESULTS FROM THE EXPERIMENTS

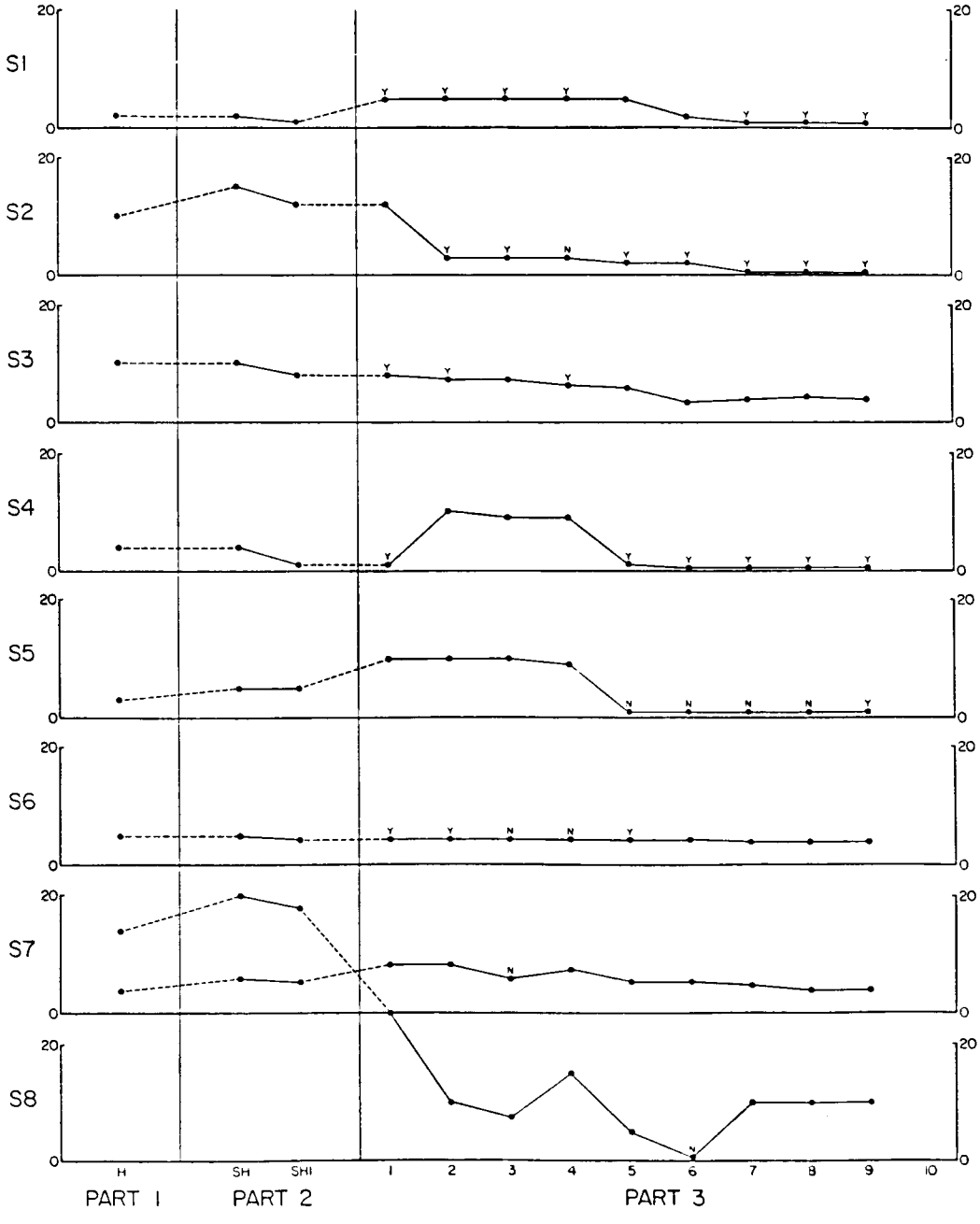
A summary of the individual behavior recorded during the four willingness to accept and the four willingness to pay experiments is reported in Table 4.1. Tabulated are Part 1 hypothetical bids, Part 2 semi-hypothetical and semi-hypothetical iterated bids, and Part 3 initial and ending trial auction bids. Ending trial bids are reported because of the fact that different experimental subject groups reached unanimity in varying amounts of time. Total auctions conducted ranged from a low of five to a high of ten trials before unanimity was reached.

We first considered whether individual bids collected in the willingness to accept experiments were sensitive to the type of survey instrument utilized. Figure 4.3 plots the results from a single experiment, WTA2, which represents well the individual bidding behavior that occurred in the willingness to accept experiments. Subjects begin Part 1 with totally hypothetical bids in the range of two to thirty-five dollars. After limited exposure to the SOA solution in Part 2, semi-hypothetical bids generally increased. However, it was usually possible to iterate subjects down so that their iterated semi-hypothetical bids closely resembled their original Part 1 hypothetical bids. During the first four nonbinding auctions conducted in Part 3 requested bids either do

TABLE 4.1: INDIVIDUAL BIDDING BEHAVIOR, ALL EXPERIMENTS

	WILLINGNESS TO ACCEPT						WILLINGNESS TO PAY					
	Hypothetical	Semi-Hypothetical	Semi-Hypothetical Iterated	Auction: Trial 1	Auction: Ending Trial		Hypothetical	Semi-Hypothetical	Semi-Hypothetical Iterated	Auction: Trial 1	Auction: Ending Trial	
Subject 1	20.00	20.00	19.00	25.00	0.01	WTA1	0.00	5.00	5.75	5.50	2.50	WTP1
Subject 2	2.00	5.00	4.00	5.00	4.00		2.00	1.00	2.00	1.50	1.40	
Subject 3	15.00	20.00	18.00	16.00	1.00		1.00	1.00	1.25	1.00	2.00	
Subject 4	25.00	15.00	15.00	30.00	35.00		0.00	3.00	3.25	3.25	2.00	
Subject 5	35.00	20.00	15.00	15.00	5.00		0.00	0.00	0.00	0.00	0.00	
Subject 6	10.00	15.00	14.00	6.00	0.00		1.00	1.00	1.00	4.00	4.00	
Subject 7	10.00	15.00	15.00	50.00	10.00		20.00	1.00	1.00	1.50	0.50	
Subject 8	2.00	1.00	0.00	0.50	2.50		1.00	5.00	7.00	3.75	1.48	
Subject 1	2.00	2.00	1.00	5.00	1.00	WTA2	0.00	0.00	0.00	0.25	0.05	WTP2
Subject 2	10.00	15.00	12.00	12.00	0.25		5.00	10.00	11.00	10.00	10.00	
Subject 3	10.00	10.00	8.00	8.00	4.00		0.00	1.00	1.00	1.00	0.02	
Subject 4	4.00	4.00	1.00	1.00	0.50		5.00	0.00	1.00	1.00	0.00	
Subject 5	3.00	5.00	5.00	10.00	1.00		2.00	3.00	4.00	0.10	0.00	
Subject 6	5.00	5.00	4.50	4.50	4.00		5.00	5.00	5.00	0.50	0.01	
Subject 7	4.00	6.00	5.50	8.50	3.99		0.02	0.02	0.02	6.50	50.00	
Subject 8	35.00	40.00	38.00	25.00	10.00		0.00	0.00	0.00	0.00	0.00	
Subject 1	5.00	15.00	14.50	6.00	7.50	WTA3	10.00	5.00	5.25	5.25	5.25	WTP3
Subject 2	4.00	10.00	9.75	15.00	15.00		2.00	4.00	4.25	4.00	4.25	
Subject 3	10.00	5.00	4.25	4.25	3.00		2.00	5.00	5.00	5.00	5.00	
Subject 4	9.00	9.00	8.00	5.00	1.25		0.00	3.00	4.00	2.00	4.00	
Subject 5	5.00	5.00	4.75	5.00	3.00		2.00	1.00	2.00	3.00	2.00	
Subject 6	7.00	7.00	6.50	5.00	4.00		0.10	0.50	0.50	0.05	0.50	
Subject 7	5.00	10.00	9.00	10.00	4.00		2.00	2.00	2.00	2.00	2.00	
Subject 8	15.00	10.00	10.00	7.00	4.00		1.50	1.00	1.00	1.00	1.00	
Subject 1	4.00	5.00	4.00	4.00	3.50	WTA4	2.00	3.00	3.50	3.00	5.00	WTP4
Subject 2	15.00	20.00	18.00	10.00	3.95		5.00	3.00	4.00	4.00	4.00	
Subject 3	20.00	50.00	30.00	9.00	3.48		6.00	2.00	2.00	1.00	1.25	
Subject 4	3.00	4.00	3.50	1.00	2.50		1.01	1.00	1.00	0.01	0.75	
Subject 5	4.00	7.00	6.00	6.00	3.50		0.00	0.00	0.00	4.75	0.25	
Subject 6	5.00	5.00	4.75	5.00	3.90		2.00	1.00	1.00	1.00	0.50	
Subject 7	3.00	2.00	1.00	1.50	2.75		0.00	0.00	0.00	0.25	0.00	
Subject 8	5.00	10.00	5.00	4.00	2.98		3.00	3.00	3.50	3.00	0.60	

Figure 4.3: Individual Bidding Behavior: WTA2



Y or N indicates voting behavior of that subject in Part 3.

not change much from earlier Part 1 or Part 2 values or they drop slightly. However, when the full competitive forces of the auction are unleashed starting in trial five, bids usually begin to collapse. In the ending trial individual bids are usually below any previous Part 1, Part 2, or Part 3 values.

These general observations are supported by tests using all four experiments' individual data. These tests are reported in Table 4.2. A nonparametric sign test was conducted for the four experiments at the 99 percent confidence level in order to compare willingness to accept payment measures obtained in the three parts of our experiment. Applying this test we have to reject the hypothesis that hypothetical and semi-hypothetical bids are equal ($WTA_H \neq WTA_{SH}$). We must also accept the hypothesis that iteration does make a difference in lowering semi-hypothetical individual bids ($WTA_{SH} > WTA_{SHI}$). Finally, we must additionally accept the hypothesis that individuals lower their bids even farther than this iterated level by the end of the auction ($WTA_{SHI} \neq WTA_A$).

We next considered whether individual bids collected in the willingness to pay experiments were also sensitive to the type of survey instrument utilized. Figure 4.4 plots the results from a typical willingness to pay experiment, WTP1. Subjects begin Part 1 with totally hypothetical bids in the range of zero to twenty dollars. After limited exposure to the SOA solution in Part 2, semi-hypothetical bids both increase, decrease, and remain the same. It is possible to change these semi-hypothetical bids through the iteration process in a positive direction. During the first four nonbinding auctions conducted in Part 3, requested bids do not change much from this iterated level. Unlike the willingness to accept experiments, this constancy of bidding behavior during the auction process does continue after trial five. In the ending trial individual bids are comparable to previous semi-hypothetical levels.

Again, these general observations are supported with sign tests conducted with data collected from all four of the willingness to pay experiments. We cannot reject the hypothesis that individual hypothetical and semi-hypothetical bids are different ($WTP_H = WTP_{SH}$). Iteration of the semi-hypothetical bids will statistically increase their level ($WTP_{SH} < WTP_{SHI}$), but we must reject the hypothesis that the auction mechanism raises individual bids any farther from the iterated level by the end of the experiment ($WTP_{SHI} = WTP_A$).

Finally, we considered comparisons between willingness to accept payment measures and willingness to accept payment measures for a constant type of survey instrument. We compared the best performing traditional survey instrument, semi-hypothetical iterated bidding, to the end results obtained in the auction. To rank-sum tests utilizing pooled average experimental data obtained from the eight experiments were conducted at the 99 percent confidence level. The results of these tests are reported in Table 4.2. Applying this test we reject the hypothesis that willingness to accept and willingness to pay measurements obtained in Part 2's semi-hypothetical iterated setting are equal ($WTA_{SHI} \pm WTP_{SHI}$). Only after completion of the auction process can we accept the hypothesis that

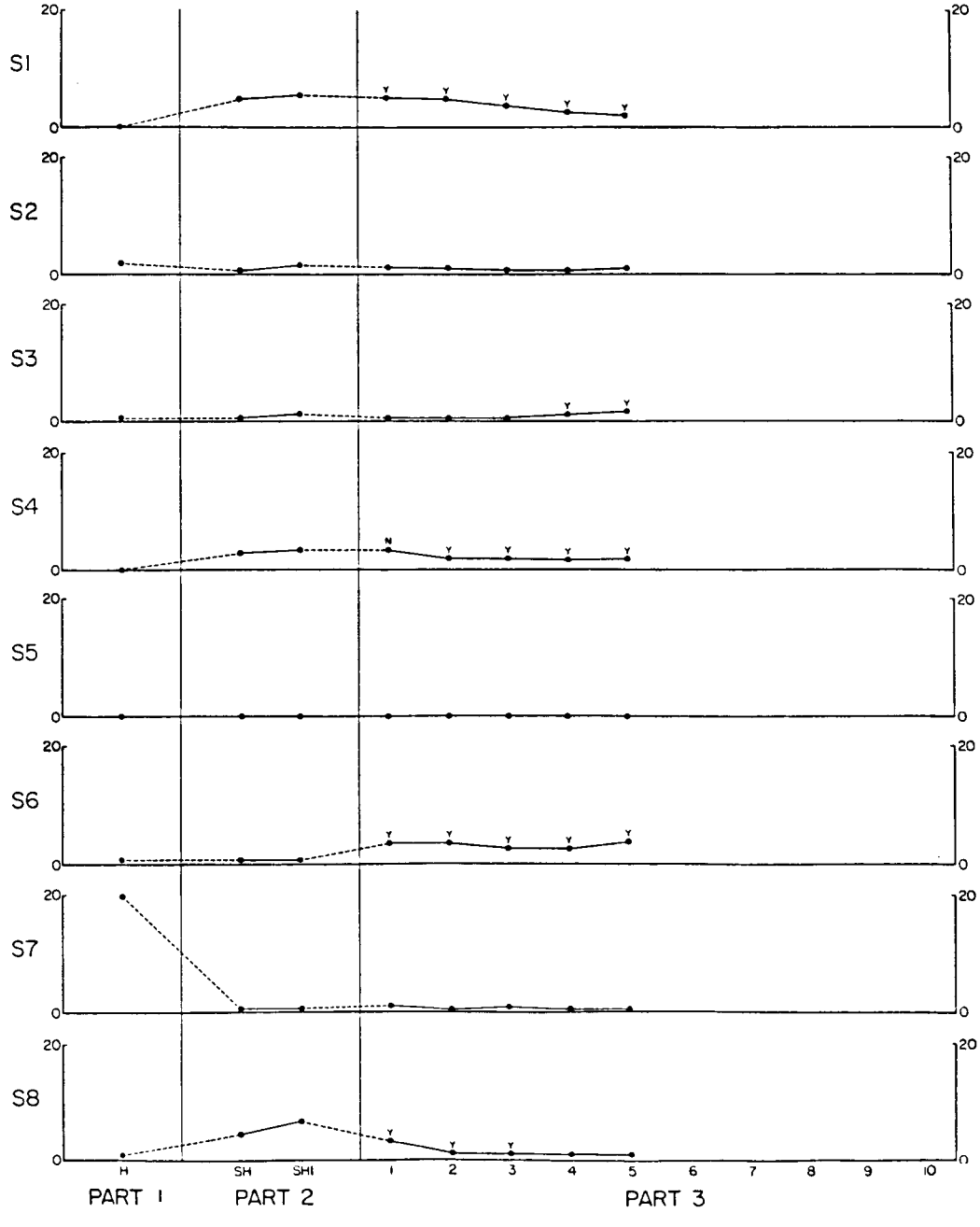
TABLE 4.2: HYPOTHESIS TESTING RESULTS

		TESTS USING INDIVIDUAL DATA		
		HYPOTHETICAL VS SEMI-HYPOTHETICAL BIDS	SEMI-HYPOTHETICAL VS SEMI-HYPOTHETICAL ITERATED BIDS	SEMI-HYPOTHETICAL ITERATED VS END OF AUCTION BIDS
WTA	TYPE OF TEST	SIGN	SIGN	SIGN
	TESTED HYPOTHESIS: H_o	$WTA_H = WTA_{SH}$	$WTA_{SH} = WTA_{SHI}$	$WTA_{SHI} = WTA_A$
	ALTERNATIVE HYPOTHESIS: H_a	$WTA_H \neq WTA_{SH}$	$WTA_{SH} > WTA_{SHI}$	$WTA_{SHI} \neq WTA_A$
	z VALUE OF TEST	2.296*	-4.770**	-3.003*
	RESULT	ACCEPT H_a	ACCEPT H_a	ACCEPT H_a
WTP	TYPE OF TEST	SIGN	SIGN	SIGN
	TESTED HYPOTHESIS: H_o	$WTP_H = WTP_{SH}$	$WTP_{SH} = WTP_{SHI}$	$WTP_{SHI} = WTP_A$
	ALTERNATIVE HYPOTHESIS: H_a	$WTP_H \neq WTP_{SH}$	$WTP_{SH} < WTP_{SHI}$	$WTP_{SHI} \neq WTP_A$
	z VALUE OF TEST	0.353	2.650**	-1.236
	RESULT	ACCEPT H_o	ACCEPT H_a	ACCEPT H_o

	TESTS USING POOLED DATA	
	$\overline{WTA}_{SHI} = \overline{WTP}_{SHI}$	$\overline{WTA}_A = \overline{WTP}_A$
TYPE OF TEST	RANK SUM	RANK SUM
TESTED HYPOTHESIS: H_o	$\overline{WTA}_{SHI} = \overline{WTP}_{SHI}$	$\overline{WTA}_A = \overline{WTP}_A$
ALTERNATIVE HYPOTHESIS: H_a	$\overline{WTA}_{SHI} \neq \overline{WTP}_{SHI}$	$\overline{WTA}_A \neq \overline{WTP}_A$
z VALUE OF TEST	-2.312*	-1.156
RESULT	ACCEPT H_a	ACCEPT H_o

* Significant at 99% level, Two-Tailed Text
** Significant at 99% level, One-Tailed Text

Figure 4.4: Individual Bidding Behavior: WTP1



Y or N indicates voting behavior of that subject in Part 3.

willingness to accept and willingness to pay measurements are equivalent ($WTA_A = WTP_A$) .

4.9 CONCLUSIONS

The most important result from our experiments is the convergence of WTA and WTP measures of value over the successive trials of the Vickrey auction. All of the convergence movement takes place in the WTA measure. In other w~ds, although the average WTA bid is much higher than the average WTP bid in the first trial of the auction, by the closing trial the average WTA bid has statistically dropped down to the level of the average WTP bid. The average WTP bid remains constant from the first to the closing trial. This suggests that without the competitive pressures of the auction institution WTA measures of value are likely to be highly upward biased. Thus, if repetitive learning is possible (for example, repeated purchases of the commodity are made) consumers are likely to show little divergence between WTA and WTP just as economic theory would predict. Additionally, in any market structured around WTP, measures the likelihood of irrational behavior may be greatly reduced.

The experiments also have several implications for applying survey methods to obtain hypothetical values for public and environmental commodities. First, hypothetical measures of WTA are likely to be biased upwards. Figure 4.5 plots WTP4's supply curves obtained for tasting SOA from both the semi-hypothetical iterated bids and from the bids made during the closing trial of the Vickrey auction. The hypothetical supply curve lies considerably above the actual supply curve of the closing trial. In contrast, the two demand curves for tasting SOA shown in Figure 4.6 derived from the semi-hypothetical iterated bids and the bids from the closing trial of the Vickrey auction of WTP4, are quite similar. Note that the hypothetical bids obtained using WTP and iterative bidding correspond very closely to the closing auction bids. This suggests that the traditional, WTP iterative procedure used in contingent valuation studies may be an inexpensive yet accurate survey instrument (Randall et al., 1974; Schulze et al., 1981).

Figure 4.5

Supply Curve for Tasting SOA: WTA4

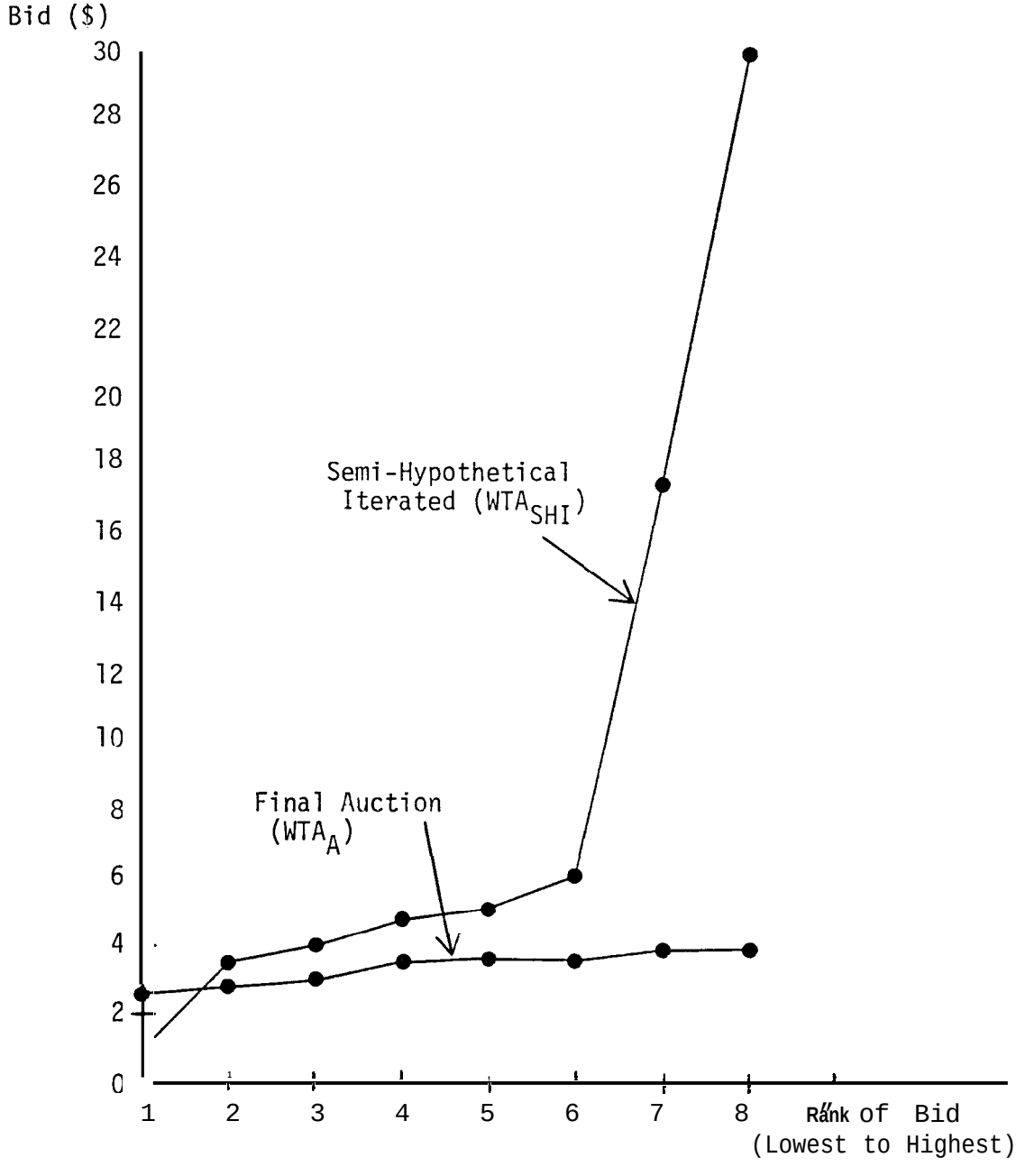
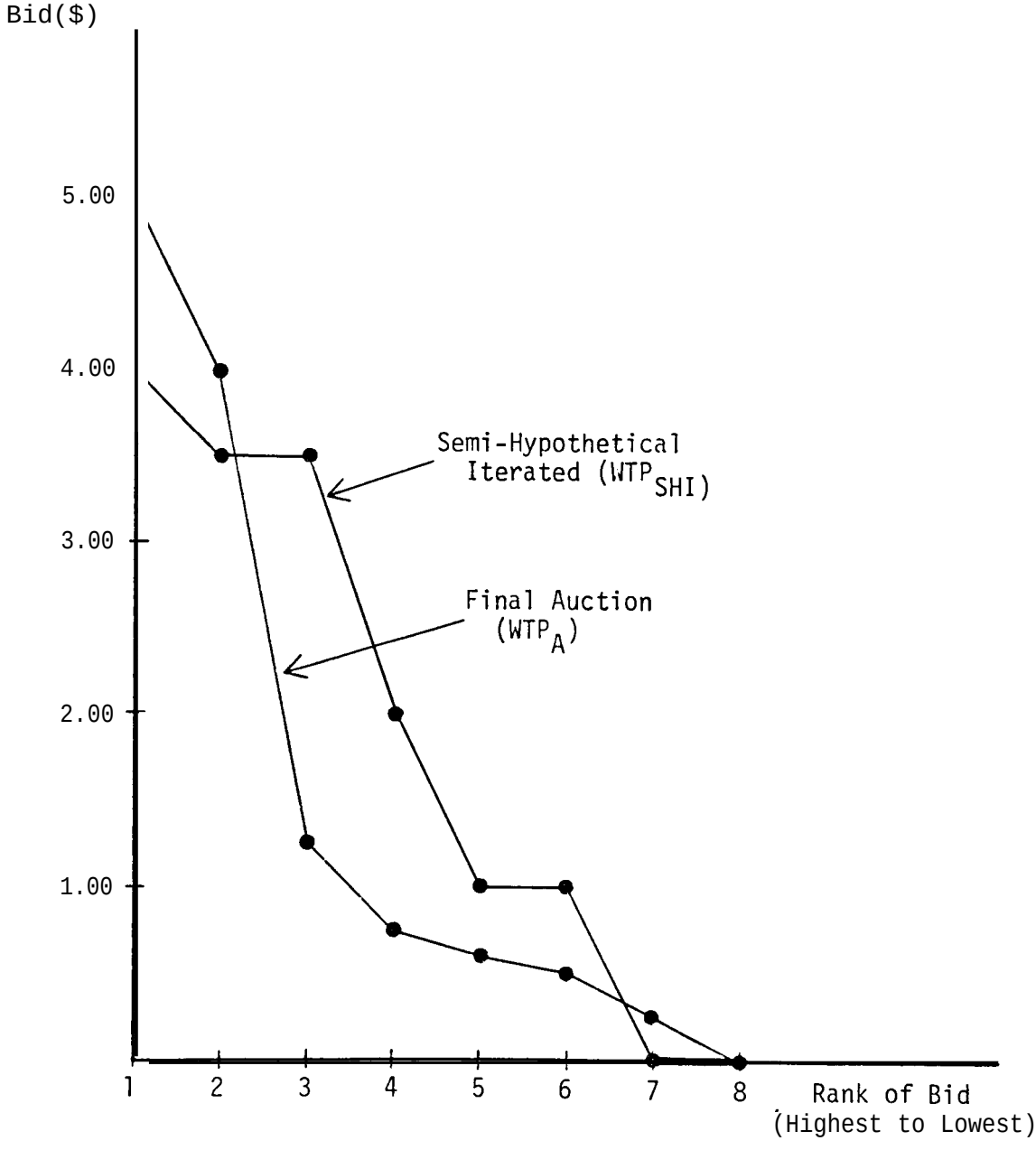


Figure 4.6

Demand Curve for Tasting SOA: WTP4



REFERENCES

1. Included are theoretical discussions of private good demand revelation processes (Vickrey, 1961; Loeb, 1977; Cox, Roberson and Smith, 1982; Forsythe and Isaac, 1982; and Milgrom and Weber, 1982), competitive public good demand revelation processes developed by Clarke (1971), Groves (1973), Groves and Ledyard (1977), and Tideman and Tullock (1976), and the role of unanimity voting in public choice discussed by Wicksell (1896), Buchanan and Tullock (1962), and Smith (1977).

2. Gustation, or tasting, implies holding one one-ounce cup of the SOA solution in the mouth for 20 seconds at a time (and then expectorating the solution). The concentration of the solution used was 0.001 moles per liter.

3. The sampling procedure involved flowing a few drops of the liquid from a dropper pipet onto the individual's extended tongue so that the fluid would be allowed to flow off the tongue.

4. The minimum trial requirement was suggested in Coursey and Smith (1984) as a possible method of increasing the percentage of actual demand revelation behavior.

5. Oddly enough, contingent valuation has in most instances seemed free of problems with strategic bias. The generally accepted explanation is the very hypothetical nature of the procedure gives no incentives for strategic bias. See Schulze et al. (1981).

CHAPTER 5

THE EFFECT OF MARKET EXPERIENCE ON INDIVIDUAL AND GROUP VALUES FOR PUBLIC GOODS: AN EXPERIMENT

5.1 INTRODUCTION

A number of demand revealing mechanisms for valuing and allocating public goods have been proposed and tested in a laboratory setting. These include the Groves-Ledyard incentive compatible mechanism (see Groves and Ledyard, 1977) as well as a number of simpler auction mechanisms (see Smith, 1979, 1980 and Coursey and Smith, 1984). Somewhat surprisingly, the simpler auction mechanisms, although not incentive compatible, seem to perform about as well as the Groves-Ledyard mechanism in the sense that all of the mechanisms closely approach Pareto optimal allocations for public goods. All of these proposed institutional mechanisms have, we will argue, the advantage of placing individual decisionmaking with respect to public goods in a market setting.

Traditional arguments in favor of market institutions focus on efficiency. However, a second role of markets in providing an opportunity for individual learning in the presence of incentives for rational decisionmaking may also be important. An example of the difficulty individuals may have in providing values (and possibly in making voting decisions) is the large divergence found between hypothetical values obtained from surveys for willingness to pay (WTP) to increase the provision of a public good and hypothetical values for willingness to accept compensation (WTA) to decrease the level of provision. For example, Rowe et al. (1980) found that while the average individual WTP to increase visibility from 20 to 40 miles in the Four Corners area was $3.50 per month, the average WTA to allow a decrease from 40 to 20 miles was $60.00 per month. Visibility is, of course, a Pure public good with which individuals have no market experience in the sense of actually paying for alternative levels of provision. One might dismiss this divergence between WTA and WTP measures of value as resulting from the hypothetical nature of the survey questions employed. Certainly the two measures should, from a theoretical perspective, be similar (Willig, 1976). Compensating and equivalent variation measures of consumer surplus should diverge significantly only under unusual circumstances, yet hypothetical survey values always show a large divergence. Unfortunately, it has been shown that the unexpectedly large divergence between WTP and WTA exists for private goods actually traded in experimental markets in the laboratory (Knetsch and Sinden, 1984) and in the field (Bishop and Heberlein, 1984). However, in both the Knetsch and Sinden and in the Bishop and Heberlein studies, the market used was a single period auction which did not allow for repetitive trials and provide opportunities for individuals to learn

from prior decisions and experience. Thus, the large observed difference between WTP and WTA obtained in these studies, although representative of actual rather than hypothetical values, was obtained in circumstances where individuals had little market experience (one trial).

In contrast, experimental economics has shown that demand revealing mechanisms such as the Vickrey auction for private goods do not function well unless individuals are allowed a number of repetitive learning trials where they are allowed opportunities for experience and learning (Coppinger, Smith and Titus, 1980 and Cox, Roberson and Smith, 1982). Thus, we have shown in the laboratory experiment described in the previous chapter that for a private good, using a Vickrey auction with repetitive trials, that the large divergence between WTP and WTA, although initially present, disappears after five or more trials have been conducted.

Since a large unexplained divergence between WTP and WTA would have to be viewed as "irrational" or at least at odds with utility maximizing behavior, it is comforting to note that where individuals have market learning experience, received theory appears to be vindicated. But what of public goods which are not traded in organized markets? How will individuals behave with respect to public commodities when they do not have value related experience, actually having bought and sold the commodity several times, experiencing the consequences of their own decisions? If the allocation of public goods is restricted to voting levels of provision out of a pool of tax funds will individuals vote "irrationally" as compared to their behavior if a public goods market could be created?

Consider the study on the value of visibility cited above. The WTP measure of value was about $3.50 and the WTA measure of value was about $60.00 for a 2O mile change invisibility. Which is the "true" value? The study of a private good reported in the previous chapter strongly suggests that WTP measures are "correct" and the WTA measures are initially biased upwards, coming down with market learning experience over successive trials to meet WTP values which are relatively stable over successive trials. If this is also the case for public goods, then individual behavior in a WTA frame of reference may at least initially be "irrational." Thus, considering the Rowe et al. example again, if a new power plant were proposed for the Four Corners region which would lower visibility by 20 miles as a result of additional air pollution emissions, individuals might behave as though that event would cause them a $60/month loss since that is how much they would initially demand as compensation to voluntarily accept the proposed loss in visibility. If their "true" loss is, however, only $3.50/month then the benefits through increased provision of public services allowed by the increased tax base in the region might well exceed the $3.50/month loss from decreased visibility. Thus, most individuals, given the opportunity, might vote against locating a new power plant in their area if they perceive, in the absence of market learning that their loss is $60/month rather than $3.50/month. Alternatively, if visibility were allocated using a public good market mechanism, we conjecture that individuals would be able to learn their "true" values and the outcome might be reversed. Similarly, losses associated with reductions in entitlement programs might well be irrationally overvalued by recipients

who employ WTA measures of value in the absence of market learning experience.

The purpose of the research reported in this chapter is first to determine if hypothetical values for public goods obtained through contingent valuation are accurate and second, to test the hypothesis, using a set of laboratory experiments, that the proposed market institutions for allocating public goods can in fact induce learning and experience which will cause WTP and WTA measures of the value of public goods to converge, resulting in behavior consistent with utility maximization. If, in fact, this hypothesis is correct, then we can argue that the actual deployment of such mechanisms is essential, not only on efficiency grounds, but also because such markets will induce more rational behavior on the part of participating individuals with respect to public goods.

5.2 EXPERIMENTAL DESIGN

The experimental design for treating sucrose octa-acetate (SOA) as a public good closely follows that presented in the last chapter where, however, the acution mechanism is replaced by EXTERN a procedure developed by Coursey and Smith (1984) to elicit public good values in a much simplified manner as compared to a full Groves-Ledyard incentive compatible mechanism. As noted in the introduction, the EXTERN mechanism performs as well as the more complex Groves-Ledyard mechanism.

Three groups of eight University of Wyoming undergraduate business students participated in willingness to pay (WTP) to avoid tasting SOA auctions and three similar groups of eight students participated in the willingness to accept (WTA) compensation to taste SOA auctions. SOA was made a public good by creating a situation in which subjects had to contribute to a group fund which would allow them to buy their way out of tasting SOA as a group if a predetermined but unknown amount of money was collected in the case of the WTP auctions or in the case of the WTA auctions, subjects could receive compensation from a predetermined fund (of size unknown to the subjects) if the sum of the individual bids was less than or equal in total to the fund. Additionally, if in the case of WTP, the sum of the bids exceeded the predetermined amount, proportional rebates were given to individual bidders. In the case of WTA, if the sum of the bids was less than the available compensation, then the additional compensation was also rebated to individual bidders in proportion to the size of their bid. The voting procedure used was similar to that used in the private good experiment in that, the first four trials were non-binding, and afterwards up to the ninth trial a unanimous vote of all eight subjects was required to finalize an outcome. The auction was terminated in the tenth trial if unanimity was not reached in trials five to nine.

Each of the auctions was preceded by first obtaining totally hypothetical values from each individual where the public good situation along with the nature of the SOA solution was described in detail (Part I). Then subjects were allowed to taste two drops of the solution and asked for

a revised bid. Individuals were then asked if they would lower (WTA) or raise (WTP) their bids through an iterative process (Part II). The public good auction was then conducted as Part III of the experiment. Parts I, II and III of the WTP instructions are included as Appendices at the end of the report.

5.3 RESULTS

Figures 5.1 presents the mean bids both for the three willingness to accept experiments labeled WTA1, WTA2, and WTA3 and for the three willingness to pay experiments labeled WTP1, WTP2 and WTP3. Figure 5.2 presents the mean bids both for WTA and WTP for all experiments. In examining Figure 5.2 the results for the public good case grossly resemble those for the private good case of the last chapter in that, willingness to accept values are initially very much higher than willingness to pay values but appear to converge over the course of repetitive learning trials. However, subtle and important difference exist. First, examining Table 5.1 it appears that although the totally hypothetical WTA bids (WTH_H) are substantially increased by the experience of tasting SOA reflected in the semi-hypothetical bid is not the case since we accept the hypothesis that $WTA_H = WTA_{SH}$. However, iteration does significantly lower bids since $WTA_{SH} > WTA_{SHI}$. Most importantly, the public good auction does succeed in lowering WTA values since both WTA_H and WTA_{SHI} are greater than the final auction values WTA_A. Thus successive learning trials of the auction do apparently generate more reasonable values even using WTA measures.

Turning to WTP measures of value, where, based on the private good SOA experiment, we expected a relatively "flat" curve, we find in Figure 5.2 an obvious declining trend in the WTP auction. All of the hypothetical measures of WTP of Parts I and II are, however, equivalent based on the sign tests reported in Table 5.1. Thus $WTP_H = WTP_{SH} = WTP_{SHI}$. Surprisingly, the iterative procedure long used in contingent valuation does not have a significant effect on the values obtained for this public good. Finally, and this is surprising in light of the results of the last chapter, both relevant hypothetical WTP measures of public good value exceed the final auction value: $WTP_H > WTP_A$ and $WTP_{SHI} > WTP_A$. In other words, based on non-parametric sign tests, none of our hypothetical values is statistically similar to the final public good auction value.

Turning to the tests using pooled data verified, using a non-parametric rank sum test, that the hypothetical measures of WTA exceed WTP: $WTA_H > WTP_H$ and $WTA_{SHI} > WTP_{SHI}$. However, although the public good auction does considerably lower WTA values the final auction value for WTA still exceeds WTP: $\overline{WTA}_A > \overline{WTP}_A$. Thus, the public good auction fails to completely remove the differential between WTA and WTP measures of value.

5.4 CONCLUSION: COMPARISON OF PUBLIC GOOD AND PRIVATE GOOD VALUES

The a priori assumption, based on economic theory, concerning the value of tasting SOA in a private good setting and the value of tasting

Figure 5.1

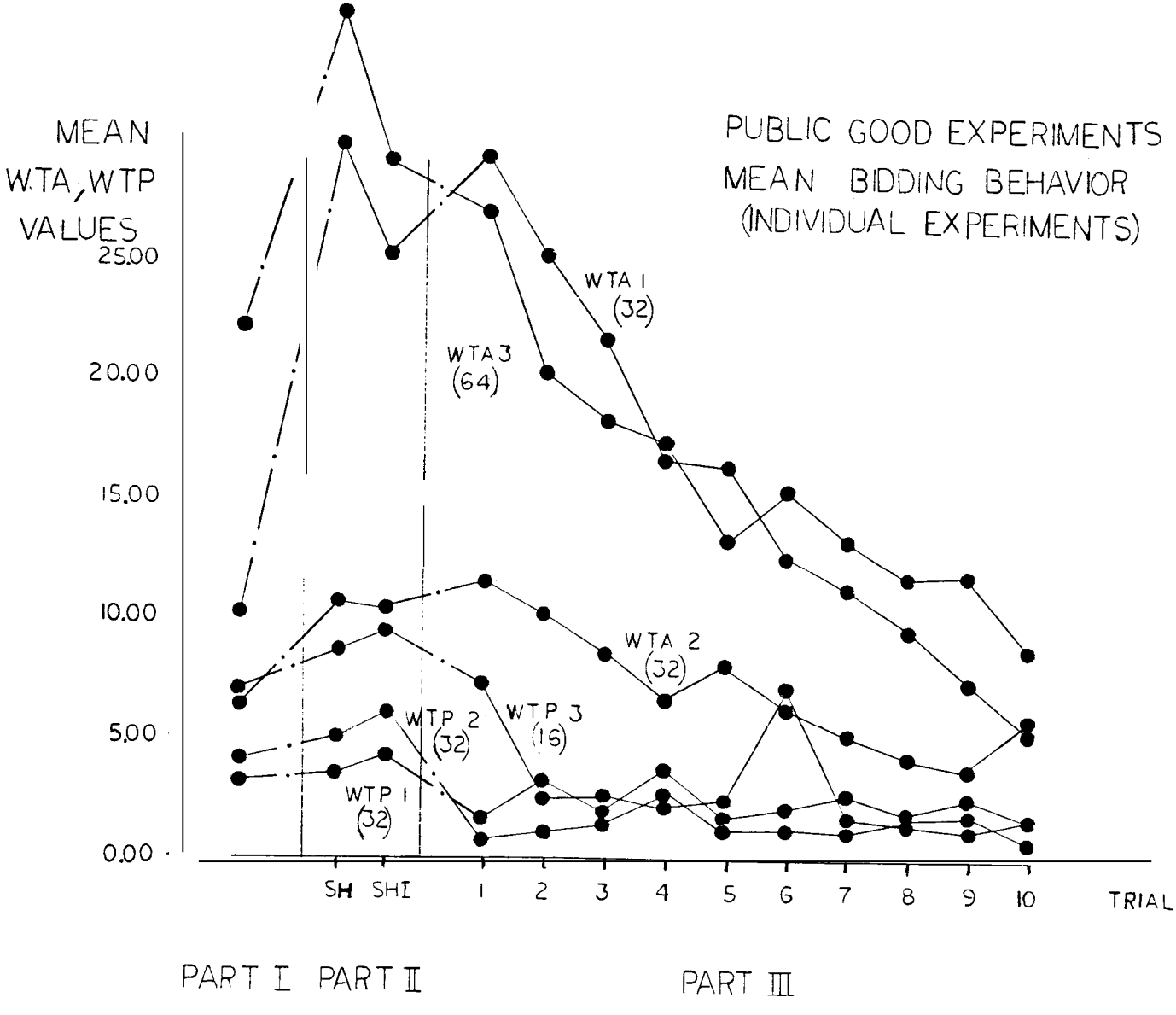

MEAN
W.TA, WTP
VALUES
25.00
20.00
15.00
10.00
5.00
0.00
PUBLIC GOOD EXPERIMENTS
MEAN BIDDING BEHAVIOR
(INDIVIDUAL EXPERIMENTS)
WTA 1
(32)
WTA 3
(64)
WTA 2
(32)
WTP 2
(32)
WTP 3
(16)
WTP 1
(32)
SH
SHI
1
2
3
4
5
6
7
8
9
10
TRIAL
PART I
PART II
PART III

Figure 5.2

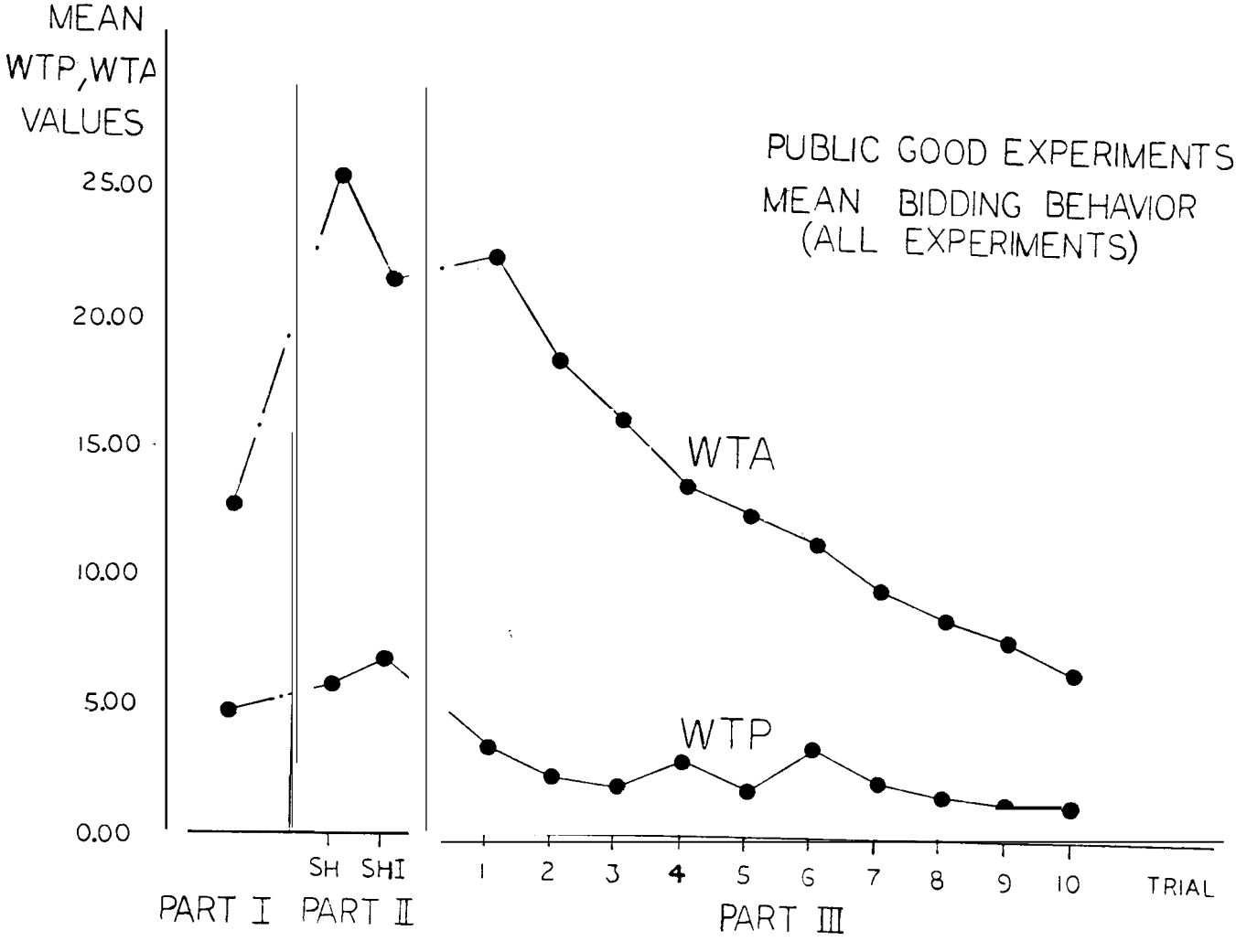

MEAN
WTP, WTA
VALUES
25.00
20.00
15.00
10.00
5.00
0.00
PUBLIC GOOD EXPERIMENTS
MEAN BIDDING BEHAVIOR
(ALL EXPERIMENTS)
WTA
WTP
SH SHI
1 2 3 4 5 6 7 8 9 10
TRIAL
PART I PART II
PART III

TABLE 5.1

HYPOTHESIS TESTING RESULTS

		TESTS USING INDIVIDUAL DATA			
		HYPOTHETICAL VS SEMI-HYPOTHETICAL BIDS	SEMI-HYPOTHETICAL VS SEMI-HYPOTHETICAL ITERATED BIDS	HYPOTHETICAL VS END OF AUCTION BIDS	SEMI-HYPOTHETICAL ITERATED VS END OF AUCTION BIDS
WTA	TYPE OF TEST	SIGN	SIGN	SIGN	SIGN
	TESTED HYPOTHESIS: H_o	$WTA_H = WTA_{SH}$	$WTA_{SH} = WTA_{SHI}$	$WTA_H = WTA_A$	$WTA_{SHI} = WTA_A$
	ALTERNATIVE HYPOTHESIS: H_a	$WTA_H \neq WTA_{SH}$	$WTA_{SH} > WTA_{SHI}$	$WTA_H \neq WTA_A$	$WTA_{SHI} \neq WTA_A$
	z VALUE OF TEST	0.408	-3.062**	-2.042*	-3.267*
	RESULT	ACCEPT H_o	ACCEPT H_a	ACCEPT H_a	ACCEPT H_a
WTP	TYPE OF TEST	SIGN	SIGN	SIGN	SIGN
	TESTED HYPOTHESIS: H_o	$WTP_H = WTP_{SH}$	$WTP_{SH} = WTP_{SHI}$	$WTP_H = WTP_A$	$WTP_{SHI} = WTP_A$
	ALTERNATIVE HYPOTHESIS: H_a	$WTP_H \neq WTP_{SH}$	$WTP_{SH} < WTP_{SHI}$	$WTP_H \neq WTP_A$	$WTP_{SHI} \neq WTP_A$
	z VALUE OF TEST	1.633	1.429	-2.449*	-2.858*
	RESULT	ACCEPT H_o	ACCEPT H_o	ACCEPT H_a	ACCEPT H_a

	TESTS USING POOLED DATA		
	$\overline{WTA}_H = \overline{WTP}_H$	$\overline{WTA}_{SHI} = \overline{WTP}_{SHI}$	$\overline{WTA}_A = \overline{WTP}_A$
TYPE OF TEST	RANK SUM	RANK SUM	RANK SUM
TESTED HYPOTHESIS: H_o	$\overline{WTA}_H = \overline{WTP}_H$	$\overline{WTA}_A = \overline{WTP}_A$	$\overline{WTA}_{SHI} = \overline{WTP}_{SHI}$
ALTERNATIVE HYPOTHESIS: H_a	$\overline{WTA}_H \neq \overline{WTP}_H$	$\overline{WTA}_{SHI} \neq \overline{WTP}_{SHI}$	$\overline{WTA}_A \neq \overline{WTP}_A$
z VALUE OF TEST	-3.630*	-1.990	-3.856*
RESULT	ACCEPT H_a	ACCEPT H_a	ACCEPT H_a

* Significant at 95% level, Two-Tailed Test

** Significant at 95% level, One-Tailed Test

SOA in a public good setting would have to be that the values are identical. Further, we conjecture that the WTP auction results yield true values both for the private and public good cases. Thus, it should be the case that $WTP_A^{Private} = WTP_A^{Public}$. Table 5.2 presents the appropriate rank sum test which accepts this hypothesis. Thus, there is no evidence that the WTP public good auction failed to reveal demand. However, as is also shown in Table 5.2 the same can not be said for hypothetical values. Rather the rank sum test shows that $WTP_H^{Public} > WTP_H^{Private}$. In other words, although hypothetical values for private good WTP seemed valid, the hypothetical public good values for SOA seem to be too high both in this test and in the appropriate sign test of the last section where it was shown that $WTP_H^{Public} > WTP_A^{Public}$ or that for the public good hypothetical values exceeded final auction values. A final check is performed in Table 5.3 where hypothetical public good values are compared to the final private auction values. The rank sum test indicates $WTP_H^{Public} > WTP_A^{Private}$. The private good final auction results for WTP are in all likelihood the least biased measure of value so this last test strongly suggests that hypothetical public good values will be biased upwards.

TABLE 5.2: RANK SUM TESTS BETWEEN PRIVATE AND PUBLIC EXPERIMENTS

	TESTS BETWEEN PRIVATE AND PUBLIC EXPERIMENTS	
	$WTP_H^{PRIVATE} = WTP_H^{PUBLIC}$	$WTP_A^{PRIVATE} = WTP_A^{PUBLIC}$
TYPE OF TEST	RANK SUM	RANK SUM
TESTED HYPOTHESIS H_o	$WTP_H^{PRIVATE} = WTP_H^{PUBLIC}$	$WTP_A^{PRIVATE} = WTP_A^{PUBLIC}$
ALTERNATIVE HYPOTHESIS H_a	$WTP_H^{PRIVATE} \neq WTP_H^{PUBLIC}$	$WTP_A^{PRIVATE} \neq WTP_A^{PUBLIC}$
z VALUE OF TEST	-2.637^*	1.592
RESULT	ACCEPT H_a	ACCEPT H_o

*Significant at 99% level, two-tailed test.

TABLE 5.3

FURTHER TESTS BETWEEN PRIVATE AND PUBLIC EXPERIMENTS

	$WTP_A^{PRIVATE} = WTP_H^{PUBLIC}$
TYPE OF TEST	RANK SUM
TESTED HYPOTHESIS H_o	$WTP_A^{PRIVATE} = WTP_H^{PUBLIC}$
ALTERNATIVE HYPOTHESIS H_a	$WTP_A^{PRIVATE} \neq WTP_H^{PUBLIC}$
z VALUE OF TEST	-2.73
RESULT	ACCEPT H_a

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1. The following studies have shown a large divergence between WTP and WTA measures of value for various public goods: Hammack and Brown (1974), Sinclair (1976), Banford, Knetsch and Mauser (1977), Bishop and Heberlein (1979), Brookshire, Randall, and Stoll (1980), Rowe, d'Arge, and Brookshire (1980), Coursey, Schulze, and Hovis (1983), Knetsch and Sinden (1984), and Carson and Mitchell (1984). No study, to our knowledge, has obtained similar values for WTP and WTA.

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APPENDIX A

COMPLETE PRIVATE GOOD ACTUAL AND HYPOTHETICAL
SALES FORMATS AND ANSWER SHEETS

PRIVATE GOOD ACTUAL SALES

INTRODUCTION

Hello, I am _____ and this is _____. We are out today selling a real summertime treat--fresh strawberries. We would like to speak to someone in your household who regularly shops for groceries. [WAIT FOR A REGULAR SHOPPER BEFORE CONTINUING. IF A REGULAR SHOPPER IS NOT AVAILABLE, THANK RESPONDENT AND MOVE ON.]

During the summer, a variety of fresh fruits are available, even in Laramie. We have here one of many people's favorite summertime fruits, strawberries. [HAND RESPONDENT A PINT OF STRAWBERRIES.] As you can see, these strawberries are quite fresh, and the quality is as good as you would find anywhere in the area.

Each pint is selling today for the price of $_____.

RANGE OF PRICES PER PINT

$.60	$1.00	$1.40
.80	1.20	1.60

Q1. How many pints would you like to purchase at $_____ per pint?

_____QUANTITY _____PRICE

[IF QUANTITY > 0, MAKE EXCHANGE OF MONEY AND STRAWBERRIES AND GO TO PART B ON PAGE 3]

[IF QUANTITY = O, CONTINUE WITH PART A ON PAGE 2]

PART A: ELASTICITY FROM NON-PURCHASING RESPONDENTS

[READ ALOUD] : I am sorry that we could not do business with you, but it would help us a lot if you would answer a couple of questions about why you did not buy any of our strawberries.

Q2: You indicated you would not buy any strawberries at a price of $_____ per pint.

Could you please describe why?

a) You do not like strawberries
b) You already have some strawberries in the house
c) The price was too high
d) Other (describe)_____

_____

[READ ALOUD] : Please remember, we are not trying to sell you strawberries. But suppose our price had been lower, say thirty cents lower.

Q3: How many pints would you have bought if the price had been _____ (starting price - .30)?

_____PRICE _____QUANTITY

[IF QUANTITY = 0, GO TO SURVEY INTRODUCTION ON PAGE 4]

[IF QUANTITY > 0, CONTINUE TO Q4]

Q4: Of these pints, how many would you use for freezing, canning, or preserving? _____NUMBER

[GO TO SURVEY INTRODUCTION ON PAGE 4]

PART B: ELASTICITY FROM PURCHASERS

[READ ALOUD] : Thank you for your business. It would help us a lot if you could answer a couple of questions about your purchase of these strawberries.

Q5: You said you would purchase _____ pints of strawberries at _____ per pint. Of these, how many pints would be for freezing, canning, or preserving?

_____NUMBER

[READ ALOUD] : Please remember, we are not trying to sell you any more strawberries. But suppose our price had been lower, say thirty cents lower.

Q6: How many pints would you have bought if the price had been _____ (starting price - .30)?

_____PRICE _____QUANTITY

[IF QUANTITY HAS NOT CHANGED, GO TO SURVEY INTRODUCTION ON PAGE 4]

[IF QUANTITY HAS CHANGED, CONTINUE WITH Q7]

Q7: Of these additional _____ pints, how many would you use for freezing, canning, or preserving?

_____NUMBER

[GO TO SURVEY INTRODUCTION ON PAGE 6]

SURVEY INTRODUCTION: [READ ALOUD TO RESPONDENT]

Sir/Madam: We are collecting this information as part of a research survey project being conducted by the University of Wyoming, Department of Economics. We are studying how consumers, like you and I, value different market commodities like fruits, and specifically strawberries.

[IF RESPONDENT PURCHASED NO STRAWBERRIES]

[IF RESPONDENT PURCHASED ONE OR MORE PINTS]

I would like to return your money and let you keep the strawberries in exchange for answering a few more questions. Our main objective is not to sell strawberries but to collect important information about the buying and eating habits of households in Laramie. All your responses will be kept completely confidential. It will take about fifteen minutes.

[GO TO Q8 OF PART C ON PAGE 5]

Even though you did not want to purchase any strawberries I would like to give you a few pints, if you would like some, in exchange for answering a few more questions. Our main objective is not to sell strawberries but to collect important information about the buying and eating habits of households in Laramie. All your responses will be kept completely confidential. It will take about fifteen minutes.

[GO TO Q8 OF PART C ON PAGE 5]

PART C: PURCHASING AND CONSUMPTION HABITS

Q8 : How long has it been since you last ate any foods?

_____HOURS

Q9: How long has it been since you last ate a full course meal (main dish, salad, breads, desserts)?

_____HOURS

Q1O: In how many hours will you eat again?

_____HOURS

QIOa: What type of meal will you eat? _____

Qll: How many permanent members are in your household?

_____NUMBER

Q12: How many of the permanent members of your household do you regularly buy groceries for?

_____NUMBER

Q13: Of these, how many eat strawberries? _____NUMBER

Q14: Please give us your age and the ages of each of the permanent members of your household and their relationship, if any, to you.

_____RESPONDENTS AGE _____SEX

Ages	Relationship

Q15: Do you currently have out-of-town visitors staying with you?

If yes,

Q15a: how many? _____NUMBER

[CONTINUE]

I

[READ ALOUD]: It is important for our study that we know whether the permanent members of your household pool their incomes together to meet household expenses or whether they meet these expenses individually. I will read you a list of major household expenses, and I would like you to indicate whether or not the members of your household share these expenses.

Q16: Does your household share FOOD expenses?

_____YES _____NO

Q16a: Does your household share HOUSING expenses, including rent or house payment and utilities?

_____YES _____NO

Q16b: Does your household share TRANSPORTATION expenses, such as vehicle payments, fuel, maintenance, insurance?

_____YES _____NO

[CONTINUE WITH PART D]

PART D: BUDGET SHARE BREAKDOWN

[READ ALOUD TO RESPONDENT]

Before we continue I would like to remind you that all your responses will be kept completely confidential. What we would like you to do now is to complete a Budget Share Breakdown in which you divide up your household's monthly expenditures among various general categories. In other words, we need to know how much you spend on things like food, housing, and transportation, as well as your monthly income and savings.

[NOTE: IF RESPONDENT ANSWERED "YES" TO ALL PARTS OF Q16, MAKE SURE YOU GET THE INCOMES AND EXPENDITURES OF ALL HOUSEHOLD MEMBERS. IF RESPONDENT ANSWERED "NO" TO ANY PART OF Q16, GET HIS INCOME ONLY AND HIS SHARE OF EXPENSES.]

[GO TO BREAKDOWN SHEET]

BREAKDOWN SHEET

INCOME :

IF ALL PARTS OF Q16 ARE "YES, " ASK: What is the total monthly income, after taxes, of your whole household?

IF ANY PART OF Q16 is "NO," ASK: What is your total monthly income, after taxes?

SAVINGS AND INVESTMENTS: Of this amount, how much is saved, or invested in stocks, bonds, annuities, IRA's, etc.?

HOUSING: The housing category includes not only your [OR, DEPENDING ON Q16, "your share of the"] rent or house payment, but also utilities, maintenance, and any homeowners, mortgage, or renters insurance that you may have. How much do you spend monthly on these items?

TRANSPORTATION: By transportation expense, we mean total vehicle payments, fuel, maintenance, and vehicle insurance. How much do you spend in this category on a monthly basis?

PERSONAL CARE: Before we get to the food category, we need to know how much is spent monthly on such "personal care" items as shampoo, toothpaste, cosmetics, and so on. Many people buy these things at the grocery store, so you may have to estimate how much they contribute to your total grocery bill.

FOOD: Finally, the food category. Since this is the main point of our study, we need to get a little more detail here. First, we need to know the amount spent on food for "in-home-use." This is basically your [OR "your share of the"] total monthly grocery bill, after subtracting out all non-food items such as personal care, magazines, pet foods, tobacco, etc., that you may buy at the grocery store.

Next, how much do you spend eating out, per month?

Finally, how much do you spend monthly on alcoholic beverages and tobacco?

[CONTINUE WITH NEXT PAGE]

[READ ALOUD] : Now, focus your attention on the FOOD category and the amount _____ that you indicated as your monthly in home food expense. We would like your answer to some questions about how often you buy and eat fruit.

Q17: Do you buy most of your groceries at one store?

_____YES _____NO

[IF YES GO TO Q18]

[IF NO CONTINUE WITH Q17a]

Q17a: Is most of your grocery shopping done at some of the four largest grocery stores in Laramie (Albertsons, Buttrey's, Ideal, Safeway)?

_____YES _____NO

[IF YES GO TO Q19]

[IF NO CONTINUE WITH Q17b]

Q17b: Do you buy most of your groceries in Laramie?

_____YES _____NO

[GO TO Q19]

Q18: At what store do you buy most of your groceries?

_____

[CONTINUE WITH Q19]

Q19: How many times per month do you make major grocery purchases?

_____NUMBER

Q20: When was the last time you made a major grocery purchase?

_____

Q21: Do you normally make your major fruit purchases at the same time as you make major food purchases?

_____YES _____NO

[IF YES GO TO Q24]

[IF NO CONTINUE WITH Q22]

Q22: How many times per month do you make major fruit purchases?

_____TIMES PER MONTH

Q23: When was the last time you made a major fruit purchase?

_____

[CONTINUE WITH Q24]

Q24: Try to recall your last major fruit purchase. Was this last fruit purchase representative of other purchases over the last month?

_____YES _____NO

[IF YES GO TO Q26]

[IF NO CONTINUE WITH Q25]

Q25: We have here a table which lists fruits that have been available recently in Laramie. [HAND RESPONDENT THE FRUIT TABLE] Please indicate the quantities of fruits you purchased in the past month.

WHEN RESPONDENT COMPLETES FRUIT TABLE, GO TO PART E ON PAGE 12]

Q26: We have here a table which lists fruits that have been available recently in Laramie. [HAND RESPONDENT THE FRUIT TABLE] Please indicate the quantities of fruits you purchased at your last major grocery purchase or the last time you purchased fruits.

WHEN RESPONDENT COMPLETES FRUIT TABLE, GO TO PART E ON PAGE 11]

LIST OF FRUITS AVAILABLE IN LARAMIE

FRUITS	UNITS SOLD BY	QUANTITY PURCHASED
Apples	individually/lb.	
Apricots	individually/lb.	
Avocados	individually/lb.	
Bananas	bunch	
Blueberries	pint	
Blackberries	½ pint	
Cherries	individually/lb.	
Coconut	individually/lb.	
Cantelope	individually/lb.	
Grapes	bunch/lb.	
Grapefruit	individually/lb.	
Honey Dew Melon	individually/lb.	
Kiwi Fruit	individually	
Lemons	individually	
Limes	individually	
Mangos	individually	
Nectarines	individually/lb.	
Oranges	individually/lb.	
Papayas	individually	
Peaches	individually/lb.	
Pears	individually/lb.	
Pineapples	individually/lb.	
Plums	individually/lb.	
Raspberries	½ pint	
Strawberries	pint	
Watermelon	individually/lb.	

PART E: SOCIOECONOMIC QUESTIONS

[READ]: We have just a few more questions.

[IF ALL PARTS OF Q16 WERE "YES"]

[IF ANY PART OF Q16 WAS "NO"]

→ These questions are about your sex, race, education, occupation and the amount of time you spend working.

[GO TO Q28]

→ These questions are about the sex, race, education and occupation of the wage earners in your household, and the amount of time they spend working.

[CONTINUE WITH Q27]

Q27: How many wage-earners are there in your household?

_____NUMBER

Wage Earner #1	Wage Earner #2
Q28: Sex: Male_____ Female_____	Sex: Male_____ Female_____
Q29 : Race: _____White _____American Indian _____Black _____Asian _____Hispanic	Race: _____White _____American Indian _____Black _____Asian _____Hispanic
Q30: How much formal education has this person completed? (Please circle the number)	How much formal education has this person you completed? (Please circle the number)
1 0- 5 GRADES 2 6- 8 GRADES; FINISHED GRADE SCHOOL 3 9-11 GRADES; SOME HIGH SCHOOL 4 12 GRADES; FINISHED HIGH SCHOOL 5 VOCATIONAL PROGRAMS 6 SOME COLLEGE 7 COLLEGE DEGREE; BA OR BS 8 SOME GRADUATE WORK 9 ADVANCED COLLEGE DEGREE OR PROFESSIONAL DEGREE	1 0- 5 GRADES 2 6-8 GRADES; FINISHED GRADE SCHOOL 3 9-11 GRADES; SOME HIGH SCHOOL 4 12 GRADES; FINISHED HIGH SCHOOL 5 VOCATIONAL PROGRAMS 6 SOME COLLEGE 7 COLLEGE DEGREE; BA OR BS 8 SOME GRADUATE WORK 9 ADVANCED COLLEGE DEGREE OR PROFESSIONAL DEGREE

Q31: Is this person presently:

Employed or Unemployed

[IF UNEMPLOYED, GO TO END OF SURVEY]

[IF EMPLOYED, CONTINUE]

Q32: What is this person's occupation? _____

_____

Q33: Is this person paid an hourly wage?

[IF NO GO TO Q34]

[IF YES CONTINUE WITH Q33a]

Q33a: What is the hourly wage?
$_____PER HOUR

[CONTINUE WITH Q34]

Q34: How many weeks per year does this person work?
#_____WEEKS

Q35: On average, how many hours per week does this person work?
#_____HOURS

Q36: Approximately what percentage of household income does this person earn?
_____%

Is this person presently:

Employed or Unemployed

[IF UNEMPLOYED, GO TO END OF SURVEY]

[IF EMPLOYED, CONTINUE]

What is this person's occupation? _____

_____

Is this person paid an hourly wage?

[IF NO GO TO Q34]

[IF YES CONTINUE WITH Q33a]

What is the hourly wage?
$_____PER HOUR

[CONTINUE WITH Q34]

How many weeks per year does this person work?
#_____WEEKS

On average, how many hours per week does this person work?
#_____HOURS

Approximately what percentage of household income does this person earn?
_____%

[READ ALOUD] Your contribution to this effort is very greatly appreciated. If you would like a summary of results, please print your name and address on the back of this stamped post card (NOT on this questionnaire). [HAND RESPONDENT POST CARD] We will see that you receive the results.

Thank you again for your participation.

PRIVATE GOOD HYPOTHETICAL SALES

INTRODUCTION

Hello, I am _____ and this is _____. We are out today with a real summertime treat--fresh strawberries. We would like to speak to someone in your household who regularly shops for groceries. [WAIT FOR A REGULAR SHOPPER BEFORE CONTINUING. IF A REGULAR SHOPPER IS NOT AVAILABLE, THANK RESPONDENT AND MOVE ON.]

During the summer, a variety of fresh fruits are available, even in Laramie. We have here one of many people's favorite summertime fruits, strawberries. [HAND RESPONDENT A PINT OF STRAWBERRIES.] As you can see, these strawberries are quite fresh, and the quality is as good as you would find anywhere in the area.

Now, we are not trying to sell you strawberries, but we would like to know how many you would buy at a certain price, for purposes of market research. You have no obligation to buy anything, but please respond as if you actually were deciding whether to buy strawberries from us at your door, at the stated price.

Suppose each pint is selling today for the price of $_____.

RANGE OF PRICES PER PINT

$.60	$1.00	$1.40
.80	1,20	1.60

Q1. How many pints would you like to purchase at $_____ per pint?

_____QUANTITY _____PRICE

[IF QUANTITY > 0, GO TO PART B ON PAGE 3]

[IF QUANTITY = O, CONTINUE WITH PART A ON PAGE 2]

PART A: ELASTICITY FROM ZERO QUANTITY

Q2: You indicated you would not buy any strawberries at a price of

$_____ per pint.

Could you please describe why?

a) You do not like strawberries
b) You have recently purchased strawberries at the store
c) The price was too high
d) Other (describe) _____

_____

[READ ALOUD] : Please remember, we are not trying to sell you strawberries. But suppose our price had been lower, say thirty cents lower.

Q3: How many pints would you have bought if the price had been _____ (starting price - .30)?

_____PRICE _____QUANTITY

[IF QUANTITY = 0, GO TO SURVEY INTRODUCTION ON PAGE 5]

_____[IF QUANTITY > 0, CONTINUE TO Q4]

Q4: Of these pints, how many would you use for freezing, canning, or preserving? _____NUMBER

[GO TO SURVEY INTRODUCTION ON PAGE 5]

PART B: ELASTICITY FROM PURCHASERS

Q5: You said you would purchase _____ pints of strawberries at _____ per pint. Of these, how many pints would be for freezing, canning, or preserving?

_____NUMBER

[READ ALOUD]: Please remember, we are not trying to sell you strawberries. But suppose our price had been lower, say thirty cents lower.

Q6: How many pints would you have bought if the price had been _____ (starting price - .30)?

_____PRICE _____QUANTITY

[IF QUANTITY HAS NOT CHANGED, GO TO SURVEY INTRODUCTION ON PAGE 4]

[IF QUANTITY HAS CHANGED, CONTINUE WITH Q7]

Q7: Of these additional _____ pints, how many would you use for freezing, canning, or preserving?

_____NUMBER

[GO TO SURVEY INTRODUCTION ON PAGE 4]

SURVEY INTRODUCTION

We are collecting this information as part of a research survey project being conducted by the University of Wyoming, Department of Economics. We are studying how consumers, like you and I, value different market commodities like fruit, and specifically strawberries.

Even though we are not selling strawberries, I would like to give you a few pints, if you want some, in exchange for answering a few more questions. Our main objective is to collect important information about the buying and eating habits of households in Laramie. All of your responses will be kept completely confidential. It will take about fifteen minutes.

[CONTINUE WITH Q8 OF PART C ON PAGE 5]

PART C: PURCHASING AND CONSUMPTION HABITS

Q8: How long has it been since you last ate any foods?

_____HOURS

Q9: How long has it been since you last ate a full course meal (main dish, salad, breads, desserts)?

_____HOURS

Q10: In how many hours will you eat again?

_____HOURS

Q10a: What type of meal will you eat? _____

Q11: How many permanent members are in your household?

_____NUMBER

Q12: How many of the permanent members of your household do you regularly buy groceries for?

_____NUMBER

Q13: Of these, how many eat strawberries? _____NUMBER

Q14: Please give us your age and the ages of each of the permanent members of your household and their relationship, if any, to you.

_____RESPONDENTS AGE _____SEX

Ages	Relationship

Q15: Do you currently have out-of-town visitors staying with you?

_____NO _____YES

If yes,

Q15a: how many? _____NUMBER

CONTINUE]

[READ ALOUD]: It is important for our study that we know whether the permanent members of your household pool their incomes together to meet household expenses or whether they meet these expenses individually. I will read you a list of major household expenses, and I would like you to indicate whether or not the members of your household share these expenses.

Q16: Does your household share FOOD expenses?

_____YES _____NO

Q16a: Does your household share HOUSING expenses, including rent or house payment and utilities?

_____YES _____NO

Q16b: Does your household share TRANSPORTATION expenses, such as vehicle payments, fuel, maintenance, insurance?

_____YES _____NO

[CONTINUE WITH PART D

PART D: BUDGET SHARE BREAKDOWN

[READ ALOUD TO RESPONDENT]

Before we continue I would like to remind you that all your responses will be kept completely confidential. What we would like you to do now is to complete a Budget Share Breakdown in which you divide up your household's monthly expenditures among various general categories. In other words, we need to know how much you spend on things like food, housing, and transportation, as well as your monthly income and savings.

[NOTE: IF RESPONDENT ANSWERED "YES" TO ALL PARTS OF Q16, MAKE SURE YOU GET THE INCOMES AND EXPENDITURES OF ALL HOUSEHOLD MEMBERS. IF RESPONDENT ANSWERED "NO" TO ANY PART OF Q16, GET HIS INCOME ONLY AND HIS SHARE OF EXPENSES.]

[GO TO BREAKDOWN SHEET]

BREAKDOWN SHEET

INCOME :

IF ALL PARTS OF Q16 ARE "YES, " ASK: What is the total monthly income, after taxes, of your whole household?

IF ANY PART OF Q16 is "NO," ASK: What is your total monthly income, after taxes ?

SAVINGS AND INVESTMENTS: Of this amount, how much is saved, or invested in stocks, bonds, annuities, IRA's, etc.?

HOUSING: The housing category includes not only your [OR, DEPENDING ON Q16, "your share of the"] rent or house payment, but also utilities, maintenance, and any homeowners, mortgage, or renters insurance that you may have. How much do you spend monthly on these items?

TRANSPORTATION: By transportation expense, we mean total vehicle payments, fuel, maintenance, and vehicle insurance. How much do you spend in this category on a monthly basis?

PERSONAL CARE: Before we get to the food category, we need to know how much is spent monthly on such "personal care" items as shampoo, toothpaste, cosmetics, and so on. Many people buy these things at the grocery store, so you may have to estimate how much they contribute to your total grocery bill.

FOOD: Finally, the food category. Since this is the main point of our study, we need to get a little more detail here. First, we need to know the amount spent on food for "in-home-use." This is basically your [OR "your share of the"] total monthly grocery bill, after subtracting out all non-food items such as personal care, magazines, pet foods, tobacco, etc., that you may buy at the grocery store.

Next, how much do you spend eating out, per month?

Finally, how much do you spend monthly on alcoholic beverages and tobacco?

[CONTINUE WITH NEXT PAGE]

LIST OF FRUITS AVAILABLE IN LARAMIE

FRUITS	UNITS SOLD BY	QUANTITY PURCHASED
Apples	individually/lb.	
Apricots	individually/lb.	
Avocados	individually/lb.	
Bananas	bunch	
Blueberries	pint	
Blackberries	½ pint	
Cherries	individually/lb.	
Coconut	individually/lb.	
Cantelope	individually/lb.	
Grapes	bunch/lb.	
Grapefruit	individually/lb.	
Honey Dew Melon	individually/lb.	
Kiwi Fruit	individually	
Lemons	individually	
Limes	individually	
Mangos	individually	
Nectarines	individually/lb.	
Oranges	individually/lb.	
Papayas	individually	
Peaches	individually/lb.	
Pears	individually/lb.	
Pineapples	individually/lb.	
Plums	individually/lb.	
Raspberries	½ pint	
Strawberries	pint	
Watermelon	individually/lb.	

[READ ALOUD]: Now, focus your attention on the FOOD category and the amount _____ that you indicated as your monthly in home food expense. We would like your answer to some questions about how often you buy and eat fruit.

Q17: Do you buy most of your groceries at one store?

_____YES _____NO

[IF YES GO TO Q18]

[IF NO CONTINUE WITH Q17a]

Q17a: Is most of your grocery shopping done at some of the four largest grocery stores in Laramie (Albertsons, Buttrey's, Ideal, Safeway)?

_____YES _____NO

[IF YES GO TO Q19]

[IF NO CONTINUE WITH Q17b]

Q17b: Do you buy most of your groceries in Laramie?

_____YES _____NO

[GO TO Q19]

Q18: At what store do you buy most of your groceries?

_____

[CONTINUE WITH Q19]

Q19: How many times per month do you make major grocery purchases?

_____NUMBER

Q20: When was the last time you made a major grocery purchase?

_____

Q21: Do you normally make your major fruit purchases at the same time as you make major food purchases?

_____YES _____NO

[IF YES GO TO Q24]

[IF NO CONTINUE WITH Q22]

Q22: How many times per month do you make major fruit purchases?

_____TIMES PER MONTH

Q23: When was the last time you made a major fruit purchase?

_____

[CONTINUE WITH Q24]

Q24: Try to recall your last major fruit purchase. Was this last fruit purchase representative of other purchases over the last month?

_____YES _____NO

[IF YES GO TO Q26]

[IF NO CONTINUE WITH Q25]

Q25: We have here a table which lists fruits that have been available recently in Laramie. [HAND RESPONDENT THE FRUIT TABLE] Please indicate the quantities of fruits you purchased in the past month.

[WHEN RESPONDENT COMPLETES FRUIT TABLE, GO TO PART E ON PAGE 12]

Q26: We have here a table which lists fruits that have been available recently in Laramie. [HAND RESPONDENT THE FRUIT TABLE] Please indicate the quantities of fruits you purchased at your last major grocery purchase or the last time you purchased fruits.

[WHEN RESPONDENT COMPLETES FRUIT TABLE, GO TO PART E ON PAGE 12]

PART E: SOCIOECONOMIC QUESTIONS

[READ]: We have just a few more questions.

[IF ALL PARTS OF Q16 WERE "YES"]

[IF ANY PART OF Q16 WAS "NO"]

→ These questions are about your sex, race, education, occupation and the amount of time you spend working.

[GO TO Q28]

→ These questions are about the sex, race, education and occupation of the wage earners in your household, and the amount of time they spend working.

CONTINUE WITH Q27]

Q27: How many wage-earners are there in your household?

_____ NUMBER

Wage Earner #1	Wage Earner #2
Q28: Sex: Male_____ Female_____	Sex: Male_____ Female_____
Q29 : Race: _____White _____American Indian _____Black _____Asian _____Hispanic	Race: _____White _____American Indian _____Black _____Asian _____Hispanic
Q30: How much formal education has this person completed? (Please circle the number)	How much formal education has this person you completed? (Please circle the number)
1 0- 5 GRADES 2 6- 8 GRADES; FINISHED GRADE SCHOOL 3 9-11 GRADES; SOME HIGH SCHOOL 4 12 GRADES; FINISHED HIGH SCHOOL 5 VOCATIONAL PROGRAMS 6 SOME COLLEGE 7 COLLEGE DEGREE; BA OR BS 8 SOME GRADUATE WORK 9 ADVANCED COLLEGE DEGREE OR PROFESSIONAL DEGREE	1 0- 5 GRADES 2 6- 8 GRADES; FINISHED GRADE SCHOOL 3 9-11 GRADES; SOME HIGH SCHOOL 4 12 GRADES; FINISHED HIGH SCHOOL 5 VOCATIONAL PROGRAMS 6 SOME COLLEGE 7 COLLEGE DEGREE; BA OR BS 8 SOME GRADUATE WORK 9 ADVANCED COLLEGE DEGREE OR PROFESSIONAL DEGREE

Q31: Is this person presently:

Employed___ or Unemployed___

[IF UNEMPLOYED, GO TO END OF SURVEY]

[IF EMPLOYED, CONTINUE]

Q32: What is this person's occupation? _____

_____

Q33: Is this person paid an hourly wage?

[IF NO GO TO Q34]

[IF YES CONTINUE WITH Q33a]

Q33a: What is the hourly wage?

$_____PER HOUR

[CONTINUE WITH Q34]

Q34: How many weeks per year does this person work?

#_____WEEKS

Q35: On average, how many hours does this person work?

#_____HOURS

Q36: Approximately what percentage of household income does this person earn?

_____%

Is this person presently:

Employed___ or Unemployed

[IF UNEMPLOYED, GO TO END OF SURVEY]

[IF EMPLOYED, CONTINUE]

What is this person's occupation? _____

_____

Is this person paid an hourly wage?

[IF NO GO TO Q34]

[IF YES CONTINUE WITH Q33a]

What is the hourly wage?

$_____PER HOUR

[CONTINUE WITH Q34]

How many weeks per year does this person work?

#_____WEEKS

On average, how many hours does this person work?

#_____HOURS

Approximately what percentage of household income does this person earn?

_____%

[READ ALOUD] Your contribution to this effort is very greatly appreciated. If you would like a summary of results, please print your name and address on the back of this stamped post card (NOT on this questionnaire). [HAND RESPONDENT POST CARD] We will see that you receive the results.

Thank you again for your participation.

PRIVATE GOOD SURVEY ANSWER SHEET

TYPE : 1 ACTUAL 0 HYPOTHETICAL

Survey Team _____

Sampling Area _____

Survey # _____

Date _____

Time _____

Q1: _____ PINTS @ $_____

[IF PINTS = 0]

PART A

Q2: 1 DON'T LIKE

2 RECENT PURCHASE

3 PRICE HIGH

4 OTHER _____

_____

Q3: _____PINTS @ $_____

[IF PINTS = 0, GO TO PART C]

[IF PINTS > 0]

Q4 #_____PINTS

[GO TO PART C, Q8]

[IF PINTS > 0]

PART B

Q5: #_____PINTS

Q6: _____PINTS @ $_____

[IF PINTS HAS NOT CHANGED FROM FROM Q1, GO TO PART C]

[IF PINTS HAS CHANGED GO TO Q7]

Q7: #_____PINTS

[GO TO PART C, Q8]

PART C

Q8: _____HOURS

Q9: _____HOURS

Q10: _____HOURS

Q10a: _____

Q11: _____MEMBERS

Q12: _____MEMBERS

Q13: #_____EAT BERRIES

Q14: _____RESPONDENT AGE _____ SEX

Ages	Relationship

Q15: 1 YES 0 NO ——— [IF NO GO TO Q16]

[IF YES] Q15a: _____VISITORS

[GO TO Q16]

Q16: 1 YES 0 NO

Q16a: 1 YES 0 NO

Q16b : 1 YES 0 NO

PART D: BUDGET BREAKDOWN

INCOME _____

SAVINGS & INVESTMENTS _____

HOUSING _____

TRANSPORTATION _____

PERSONAL CARE _____

FOOD : IN HOME _____
EAT OUT _____
ALC. & TOB. _____

TOTAL FOOD _____

SUBTOTAL _____

OTHER (Our Use Only) _____

Q17: 1 YES 0 NO

→ Q17a: 1 YES 0 NO

[GO TO Q19]

→ Q17b: 1 YES 0 NO

[GO TO Q19]

Q18: _____ (STORE)

Q19: _____ TIMES/MONTH

Q20: _____

Q21: 1 YES 0 NO

Q22: _____ TIMES/MONTH

Q23: _____

[TO TO Q24]

Q24: 1 YES 0 NO

→ Q25: LIST OF FRUITS (MONTH)

Q26: LIST OF FRUITS (LAST TIME)

Q27: _____ NUMBER OF WAGE EARNERS

	WAGE EARNER #1	WAGE EARNER #2
Q28:	1 MALE 0 FEMALE	1 MALE 0 FEMALE
Q29:	1 WHITE 4 AMER. IND. 2 BLACK 5 ASIAN 3 HISPANIC 6 OTHER	1 WHITE 4 AMER. IND. 2 BLACK 5 ASIAN 3 HISPANIC 6 OTHER
Q30:	1 0-5 6 SOME COLLEGE 2 6-8 7 BA or BS 3 9-11 8 SOME GRAD 4 12 9 ADVANCED OR 5 Voc PROFESSIONAL	1 o-5 6 SOME COLLEGE 2 6-8 7 BA or BS 3 9-11 8 SOME GRAD 4 12 9 ADVANCED OR 5 Voc PROFESSIONAL
Q31 :	1 EMPLOYED 0 UNEMPLOYED	1 EMPLOYED 0 UNEMPLOYED
Q32 :	_____	_____
Q33:	1 YES 0 NO → [IF NO GO TO Q34]	1 YES 0 NO → [IF NO GO TO Q34]
	Q33a: $_____ PER HOUR	Q33a: $_____ PER HOUR
Q34 :	_____ WEEKS	_____ WEEKS
Q35 :	_____ HOURS	_____ HOURS
Q36:	_____ %	_____ %

LIST OF FRUITS AVAILABLE IN LARAMIE

FRUITS	UNITS SOLD BY	QUANTITY PURCHASED
Apples	individually/lb.	
Apricots	individually/lb.	
Avocados	individually/lb.	
Bananas	bunch	
Blueberries	pint	
Blackberries	½ pint	
Cherries	individually/lb.	
Coconut	individually/lb.	
Cantelope	individually/lb.	
Grapes	bunch/lb.	
Grapefruit	individually/lb.	
Honey Dew Melon	individually/lb.	
Kiwi Fruit	individually	
Lemons	individually	
Limes	individually	
Mangos	individually	
Nectarines	individually/lb.	
Oranges	individually/lb.	
Papayas	individually	
Peaches	individually/lb.	
Pears	individually/lb.	
Pineapples	individually/lb.	
Plums	individually/lb.	
Raspberries	½ pint	
Strawberries	pint	
Watermelon	individually/lb.	

APPENDIX B

AUCTION INSTRUCTIONS FOR PRIVATE GOOD EXPERIMENT

AUCTION INSTRUCTIONS
AND BIDDING FORM

You are about to begin an experiment designed to determine how people like yourself attach values to different market commodities like fruits, and specifically strawberries. The experiment takes the form of an auction in which you will have the opportunity to actually purchase strawberries. These strawberries have been obtained from stocks of local grocery stores and are guaranteed fresh. The quality is as fine as you would find anywhere in the area.

To begin the experiment, you have a credit of fifteen dollars in hand for participating in the experiment. If you do not purchase any strawberries in the auction, then you will keep your entire fifteen dollars in cash to take home at the end of the experiment.

You, along with the six other individuals participating in the experiment, will take part in an auction for fifteen one-pint containers of fresh strawberries. To explain how the auction works, consider for a moment a simplified example.

Imagine that only three people, person A, person B, and person C take part in the auction. Further, imagine that only two pints are to be auctioned off. The first step is for each individual to submit separate bids for each pint they desire. In other words, each individual submits a bid for the first pint and a second bid for the second pint. The two bids do not necessarily have to be the same. The three people in our example might submit written bids as follows:

Person A bids $3 for the first pint and $1 for the second pint.

Person B bids $5 for the first pint and $4 for the second pint.

Person C bids $2 for the first pint and $0 (nothing) for the second pint.

We would then order all of the bids from the highest to the lowest as follows:

1st highest bid	$5 by person B
2nd highest bid	$4 by person B
3rd highest bid	$3 by person A
4th highest bid	$2 by person C
5th highest bid	$1 by person A
6th highest bid	$0 by person C

Since only two pints of strawberries are being auctioned off in this example, person B has "won" the auction by submitting the two highest bids of $5 and $4 and gets both pints of strawberries.

However, person B does not have to pay the $5 bid for the first pint and the $4 bid for the second pint. Rather, person B has to pay the "market price" for each pint. The market price is determined in this example by the 3rd highest bid which is $3. In other words, the market price is the first bid ranked below the lowest winning bid. Note that no winner has to pay what he or she actually bid unless the last winning bid and the bid ranked next below, which is the market price, are the same or are "tied." If these two bids are tied, the winner is chosen at random from the two identical bids.

The actual auction you are about to participate in has seven participants and is for fifteen pints of strawberries. Thus, you will be asked to submit bids for as many pints as You might care to purchase up to fifteen pints. The “market price” will be the 16th highest bid for an individual pint when all bids from all participants are ordered from highest to lowest. You may receive a pint of strawberries for each of the bids you make if all of your bids are above the market price. On the other hand, you may obtain no pints of strawberries if all of your bids are equal to or below the “market price.” Finally, if some of your bids are above and some below the market price you will obtain a pint of strawberries for each bid you have made above the market price and none for any bids equal to or below the market price. In all cases, if you have submitted a winning bid, you will only pay the “market price” for the strawberries you have purchased. Note that some of your bids may “win” along with some bids of others.

When you have completed reading these instructions please raise your hand to indicate to the experiment monitor that you are finished. The monitor will ask if you have any questions when all participants have finished reading the instructions.

BIDDING FORM

Name: _____

My bids for obtaining pints of fresh strawberries are as follows:

1st pint $_____

2nd pint $_____

3rd pint $_____

4th pint $_____

5th pint $_____

6th pint $_____

7th pint $_____

8th pint $_____

9th pint $_____

10th pint $_____

11th pint $_____

12th pint $_____

13th pint $_____

14th pint $_____

15th pint $_____

APPENDIX C

LABORATORY INSTRUCTIONS FOR INDIVIDUAL DECISION MAKING: WILLINGNESS TO PAY

ECONOMIC EXPERIMENT

University of Wyoming
Department of Economics

PART I

INSTRUCTIONS: TOTALLY HYPOTHETICAL BIDDING GAME

Investigators: John Hovis
Don Coursey
Bill Schulze

THWTPC

You have volunteered to participate in an experiment dealing with economic and psychological decision making. Your responses to each question will be kept completely confidential.

For volunteering to participate in this experiment, which has three parts, you will be paid a minimum of $6.00. In addition, you will be given a credit of $10.00 which you can use in the experiment. Any of the $10.00 credit you do not use during the experiment will be given to you in cash at the conclusion of the experiment unless you decide to withdraw in which case you still keep the original $6.00 for participating. In this first part, Part I, you will be required to make totally hypothetical, monetary responses to different decision making situations which will be described to you in a moment.

When you have finished reading all of the instructions indicate to the experiment monitor that you are ready to proceed with Part I. Please turn the page and continue reading the instructions.

Description of Part I: Bidding Games

In this first part of the experiment you will be asked to make a totally hypothetical, monetary response to a predicament. You will be asked hypothetically how much you would pay to avoid tasting an unpleasant liquid. Tasting the liquid means, in this context, holding a one-ounce volume in your mouth for twenty seconds and then spitting out the liquid. You must not swallow the liquid even though it is not harmful.

The liquid referred to in this part of the experiment is described as having a “bitter-unpleasant" taste which lingers. In fact, sampling this liquid will leave a bitter taste in your mouth until your next meal and probably thereafter. It is nontoxic and poses no health risk to humans. The name of the substance is Sucrose Octa-Acetate (SOA) and is used in many industrial processes such as denaturing alcohol, transparentizing paper, reducing moisture absorption of brakelinings, and to modify the properties of synthetic plastics.

Thus, the hypothetical monetary response that you will make, is the largest amount of money you would be willing to pay to avoid tasting the unpleasant liquid. This situation supposes, therefore, that originally you must taste, by holding in your mouth for 20 seconds, the liquid but you can pay (hypothetically) to avoid such a predicament.

The monitor will explain these conditions once more during the actual experiment. Now, if you do not understand the content of this experiment and would like to re-read this material feel free to do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with part one of the experiment.

ECONOMIC EXPERIMENT

University of Wyoming
Department of Economics

PART II

INSTRUCTIONS: HYPOTHETICAL BIDDING GAME

Investigators: John Hovis
Don Coursey
Bill Schulze

You are about to participate in a second experiment dealing with economic and psychological decision making. As before your responses to each question will be kept completely confidential.

In this second experiment you will be required to again make hypothetical, monetary responses to a decision making situation which will be described to you in a moment. When you have finished reading all of the instructions indicate to the experiment monitor that you are ready to proceed. Please turn the page and continue reading the instructions.

Description of the Bidding Game

In this part of the second experiment you will be asked to actually sample the SOA liquid, and then to make a hypothetical, monetary response representing how much you would pay to avoid tasting the liquid. Remember, these are hypothetical responses not real, but you do have $6.00 for participating in the experiment and a $10.00 credit which you can use later on. Again, you will be asked, hypothetically, the most amount of money you would pay not to have to taste an unpleasant solution. To taste the liquid means you must hold it in your mouth for twenty seconds and then spit out the liquid. As before you would not be allowed to swallow the liquid although it is not harmful.

"Sampling" the SOA solution will involve "flowing" a few drops of the liquid over the tip of the tongue. So, the monitor will then use a "dropper" to flow the solution over your extended tongue, so that the fluid is allowed to fall off your tongue and not remain in your mouth for any length of time.

The hypothetical money offer that you make after having sampled the SOA liquid is therefore the largest amount of money you would pay to not be subjected to prolonged contact with the unpleasant stimulus. This situation supposes, therefore, that you originally would have to taste, by holding in your mouth for 20 seconds, the liquid, but that you can pay (hypothetically) to avoid such a predicament.

The monitor will explain these conditions once more during the actual experiment. Now, if you do not understand the content of this part of the experiment and would like to re-read this material, feel free to do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with the experiment.

ECONOMIC EXPERIMENT

University of Wyoming
Department of Economics

PART III

INSTRUCTIONS: COMPETITIVE AUCTION

Investigators: John Hovis
Don Coursey
Bill Schulze

WTP WC

You are about to begin an experiment in the economics of decision making. Please write your name at the top of your Record Sheet so that any income you earn can be paid to you at the end of the experimental session.

INSTRUCTIONS

This is an experiment in the economics of decision making. You will have an opportunity to earn a considerable amount of CASH through your participation in this experiment. Please follow these instructions carefully and do not hesitate to raise your hand if you have a question.

You have been selected to participate in a group exercise with seven other individuals. Together you form a group of eight individuals which must make a series of decisions. However, you will not be permitted to speak with the other members of the group. The decision making process involved must be carried out in silence. You and your fellow group members will engage in an auction which will be carried out by means of a "sealed bid" process.

Specifically, the experiment consists of three phases. The first phase involves a group bid-making process. This is the Auction Phase. The second phase, the Voting Phase, involves a voting process in which the members of the group who "won" the auction vote on whether to accept the outcome or not. The third and final phase consists of making final allocations of monetary rewards to the group members. This is called the Allocation Phase.

You, as well as each of the group members, will be given a credit of $10.00 which is yours to keep as long as you consent to remain active in this experiment. If you withdraw before completion of the experiment, which is still your freedom, you will receive no money above the $6.00 originally promised to you. If you do remain in the experiment then your objective is to try to keep as much of the $10.00 as you can.

Like any auction in which buyers come together to bid for a desired commodity, your task, as well as the task of the other group members is to make a bid to "buy" the opportunity of avoiding subjection of yourself to an unpleasant taste experience. In other words, you will submit a "dollars and cents" offer which you feel best represent the amount of money you would pay to avoid holding in your mouth for 20 seconds a one-ounce cup of the unpleasant liquid. Because you have already sampled the liquid you should have a good idea of its "flavor."

In this experiment four cups of the unpleasant liquid will be allocated. The most that you or any other participant possibly will have to hold in your mouth for 20 seconds is one cup. This means that, depending on the bidding process, four of the individuals will end up tasting one cup each and the other four individuals will taste nothing.

During the auction phase of the experiment you must determine your bid and then submit that bid to the monitor. This bid indicates the monetary value of your willingness to pay to avoid the liquid. You will write your bid with your name on the Bidding Form provided and hand it to one of the monitors.

Once all bids have been collected, the monitor will rank the eight bids from highest to lowest and determine a "Reigning Bid." This Reigning Bid is important to remember. The Reigning Bid is determined in the following way. Suppose the ranking of the eight bids representing the group members' willingness to pay to avoid the liquid turns out to be (from highest to lowest):

$10, $9, $8, $7, $6, $5, $4, $3.

The Reigning Bid is the fifth highest bid, and in this example is $6. All bids that are greater than the Reigning Bid will be tentatively accepted as winning bids. That is, each group member who bid above the Reigning Bid (those four who bid $10, $9, $8, $7) will tentatively have to pay for not tasting the liquid and, therefore, will not be required to taste the liquid.

However, each member of the group whose bid is accepted will only have to pay a price to avoid the liquid equal to the Reigning Bid. Thus, in the example above, the individuals who bid $10, $9, $8, $7 will tentatively pay only the Reigning Bid, or $6, to avoid the liquid. These "winners" are winners because they are allowed to avoid the liquid by paying from their $10.00 the "Reigning Bid" price and because they don't actually have to pay what they were originally willing to pay to avoid.

Now, on the other hand, all those group members whose bids are equal to the Reigning Bid or less than the Reigning Bid will be tentatively rejected. That is, each member who bid (as in our example above) $6, $5, $4, $3, will tentatively not have to pay to avoid, but must taste the cup of fluid. These people keep the $10.00 they have been given plus the $6.00 for participating but must taste the liquid. If a group members fails to taste the liquid at this point, for whatever reason, he or she must leave the experiment without any income except the $6.00 promised at the outset of the experiments.

With the end of the Auction Phase (that is, the determination of first, the Reigning Bid, and second, those group members whose bids were accepted), the group enters the second phase of the experiment. This second phase is the "Voting Phase." The way in which the experiment has been designed, allows for up to ten trials during which the group would be involved in decision making. In other words, a trial consists of the Auction Phase and the Voting Phase. During each trial those members of the group whose bids were tentatively "accepted" (that is, above the Reigning Bid), and only those members, will then vote on whether to accept results of that trial. The result, here, is the price that each of the "winners" pay to avoid the liquid. In order for this result to be finalized the vote (of accepting to pay the amount of the Reigning Bid to avoid the liquid) must be a unanimous "Yes." If any one or more of the members voting, votes

"no" then a new bidding phase or Auction Phase and Voting Phase will start over again.

Notice on the Record Sheet given to you that the ten possible trials have been divided into two categories. The first four trials are denoted as the "Opening Trials" and the latter trials, Trial 5 through Trial 10, are denoted as the "Closing Trials." In the opening trials, Trials 1 through 4, the voting process will not be binding. Those group members whose bid was above the Reigning Bid will vote on the outcome, and the voting results will be announced but will not be final. Only in the Closing Trials will the voting process be binding. Thus, if in the fifth trial, for example, the vote is unanimously "Yes" to accept the outcome, the Voting Phase stops (that is the trial ends) and the third phase, the "Allocation Phase," begins. Agreement can occur in any of the trials 5 through 10. But, if the group fails to reach agreement by the end of the tenth trial then all eight members of the group will keep their $10.00 but each will be required to taste one cup of the fluid or forfeit the $10.00.

Let us look at one more detailed example of this type of group decision making activity.

I. Auction Phase:

1. Each group member enters his or her name, trial number and bid on one of the Bidding Forms and hands it to a monitor. The monitor will then rank the eight bids to determine the Reigning Bid. Assume the bids are ranked as (from highest to lowest):

   $12, $8, $7.50, $7.25, $5.00, $3.50, $2.00, $1.75

2. The monitor then writes the Reigning Bid, which is $5.00, at the bottom of your Bidding Form and determines on the basis of your submitted bid whether or not your bid "was" or "was not" accepted; that is, was greater than the $5.00 Reigning Bid. These Bidding Forms are returned to each group member with the Reigning Bid being announced to the entire group. The group will know only the Reigning Bid as well as his own bid but not each of his fellow group members' bids.

II. Voting Phase:

1. Your returned Bidding Form will indicate to you whether or not your bid has been tentatively accepted. Assume you bid $7.50 thus you will enter the second phase, the Voting Phase with three other of your group members (those who bid $12.00, $8.00 and $7.25). Those whose bids were less than the $5.00 Reigning Bid will first put their name and trial number on a voting form and then put an-X through it since this phase does not include them.

2. The four members with bids of $12.00, $8.00, $7.50, $7.25 will use one of the Voting forms provided and enter their name, trial

number and vote yes or no on whether to accept the $5.00 Reigning Bid as the price to pay for avoiding the liquid. All the Voting Forms will then be collected by the monitor. The monitor will then announce the outcome of the voting.

3. Assume the votes are recorded as:

Y Y N Y

Then, for this trial, agreement has not been reached and the whole group enters a new trial where each of the eight group members makes a new bid to avoid the liquid. Then, those whose bids are greater than the Reigning Bid are accepted, and move into a new Voting Phase to complete the new trial.

III. Allocation Phase:

1. With the end of each Voting Phase each trial ends. If the trial number is less than or equal to four a new trial automatically begins regardless of the result in the Voting Phase. Above we noted agreement had not been reached. If this nonagreement had occurred in Trials 1-4, the voting would have been nonbinding and a new trial would have begun automatically. If it had occurred in Trials 5-9, the voting would have been binding but due to the nonagreement result in the Voting Phase a new trial would have also begun. If this had been the tenth trial then the vote would be binding but no new trial would begin. Thus, each of the eight members would have to taste one cup of the liquid.

2. Assume for the moment that the above voting result was followed by a new trial, the sixth trial. In this trial new bids and new votes would be taken with, for example, the result being: Y Y Y Y. Because the group is in the Closing Trials part of the experiment the vote is binding and the four group members voting pay the Reigning Bid to avoid the liquid. The remaining four members are then required to taste the liquid. This completes the allocation phase.

Note, you may bid as much or as little as you want. If you do and your bid is less than the Reigning Bid you stand to earn considerable cash for tasting the liquid. If you feel you do not want to be subjected to tasting the liquid and want to pay to avoid it your bid must be above the Reigning Bid. Finally, you may bid more than $10.00 in any trial. If, for example, the reigning price is over $10.00, say $11.00, in the tenth and last trial, and you have bid $13.00, the experiment fails since you cannot afford (given the $10.00 budget we have given you) to “buy” your way out of tasting the liquid. No one would taste the liquid in this situation. Rather everyone would forfeit the $10.00 and keep $6.00 for participating.

If you have any questions you may raise your hand at this time and the monitor will answer them for you.

SUMMARY PAGE

During Each Trial

1. Enter your name, trial number, and bid on the bidding form.

2. Submit your bid by handing it to a monitor.

Reigning Bid is Computed by the Monitor and Announced:

1. Get back Bidding Form and you record on your Record Sheet: (1) My Bid, (2) Reigning Bid, (3) My Bid Accepted or Rejected, in the appropriate columns with respect to the trial the group is in.

2. If your bid is "Accepted" then vote by using the Voting Form provided.

3. If your bid is Rejected put an X through the Voting form.

The Monitor Collects all Voting Forms and Announces the Result

1. On your Voting Form, be sure to enter your name, Trial number and vote (Yes or No).

2. Submit your vote by giving it to the monitor.

If, Trial < 4, continue with a new trial

If, 4 < Trial < 10, and the number of "yes" votes is four, stop and allocate payments and liquid

If, 4 < Trial < 10, and the number of "yes" votes is less than four, continue with a new trial

If, Trial = 10, and the number of yes votes is less than (or equal) to four, stop and allocate payments and liquid

APPENDIX D

LABORATORY INSTRUCTIONS FOR INDIVIDUAL DECISION MAKING: WILLINGNESS TO ACCEPT

ECONOMIC EXPERIMENT

University of Wyoming
Department of Economics

PART I

INSTRUCTIONS: TOTALLY HYPOTHETICAL BIDDING GAME

Investigators: John Hovis
Don Coursey
Bill Schulze

THWTAC

You have volunteered to participate in an experiment dealing with economic and psychological decision making. Your responses to each question will be kept completely confidential.

For volunteering to participate in this experiment, which has three parts, you will be paid $3.00. In this first part, Part I, you will be required to make totally hypothetical, monetary responses to different decision making situations which will be described to you in a moment.

When you have finished reading all of the instructions indicate to the experiment monitor that you are ready to proceed with Part I. Please turn the page and continue reading the instructions.

Description of Part I: Bidding Games

In this first part of the experiment you will be asked to make a totally hypothetical, monetary response to a predicament. You will be asked hypothetically how much we would have to pay you to voluntarily taste an unpleasant liquid. This means you must taste the liquid by holding a one-ounce volume in your mouth for twenty seconds and then spit out the liquid. You must not swallow the liquid even though it is not harmful.

The liquid referred to in this part of the experiment is described as having a "bitter-unpleasant" taste which lingers. In fact, drinking this liquid will leave a bitter taste in your mouth until your next meal and probably thereafter. It is nontoxic and poses no health risk to humans. The name of the substance is Sucrose Octa-Acetate (SOA) and is used in many industrial processes such as denaturing alcohol, transparentizing paper, reducing moisture absorption of brakelinings, and to modify the properties of synthetic plastics.

Thus, the hypothetical monetary response that you will make, is the smallest amount of money you would require to induce you to voluntarily be subjected to tasting the unpleasant liquid. This situation supposes, therefore, that originally you do not have to taste, by holding in your mouth for 20 seconds, the liquid but you can be paid (hypothetically) to accept such a predicament.

Let us give you an example. A construction company submits a monetary offer, or "bid," which they estimate to be their cost (plus profit) to build a highway. In other words, this bid is the least amount of money they would accept for performing a service. In a similar manner then, you are to submit to us your monetary response or "bid" which represents the least amount of money you would accept to voluntarily taste the SOA liquid.

The monitor will explain these conditions once more during the actual experiment. Now, if you do not understand the content of this experiment and would like to re-read this material feel free to do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with part one of the experiment.

ECONOMIC EXPERIMENT

University of Wyoming
Department of Economics

PART 11

INSTRUCTIONS: HYPOTHETICAL BIDDING GAME

Investigators: John Hovis
Don Coursey
Bill Schulze

SHWTAC

You are about to participate in a second experiment dealing with economic and psychological decision making. As before your responses to each question will be kept completely confidential.

In this second experiment you will be required to again make hypothetical, monetary responses to a decision making situation which will be described to you in a moment. When you have finished reading all of the instructions indicate to the experiment monitor that you are ready to proceed. Please turn the page and continue reading the instructions.

Description of the Bidding Game

In this part of the second experiment you will be asked to actually sample the SOA liquid, and then to make a hypothetical, monetary response representing your willingness to be paid to taste the liquid. Remember, these are hypothetical responses not real. Again, you will be asked, hypothetically, the least amount of money we would have to pay you to voluntarily taste an unpleasant solution. This means you must hold the liquid in your mouth for twenty seconds and then spit out the liquid. As before you would not be allowed to swallow the liquid although it is not harmful.

"Sampling" the SOA solution will involve "flowing" a few drops of the liquid over the tip of the tongue. So, the monitor will then use a "dropper" to flow the solution over your extended tongue, so that the fluid is allowed to fall off your tongue and not remain in your mouth for any length of time.

The hypothetical money offer that you make after having sampled the SOA liquid is therefore the smallest amount of money you would require to be voluntarily subjected to prolonged contact with the unpleasant stimulus. This situation supposes, therefore, that you would not originally have to taste, by holding in your mouth for 20 seconds, the liquid, but you can be paid (hypothetically) to accept such a predicament.

The monitor will" explain these conditions once more during the actual experiment. Now, if you do not understand the content of this part of the experiment and would like to re-read this material, feel free to do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with the experiment.

ECONOMIC EXPERIMENT

University of Wyoming
Department of Economics

PART III

INSTRUCTIONS: COMPETITIVE AUCTION

Investigators: John Hovis
Don Coursey
Bill Schulze

WTA WC

You are about to begin an experiment in the economics of decision making. Please write your name at the top of your Record Sheet so that any income you earn can be paid to you at the end of the experimental session.

INSTRUCTIONS

This is an experiment in the economics of decision making. You will have an opportunity to earn a considerable amount of CASH through your participation in this experiment. Please follow these instructions carefully and do not hesitate to raise your hand if you have a question.

You have been selected to participate in a group exercise with seven other individuals. Together you form a group of eight individuals which must make a series of decisions. However, you will not be permitted to speak with the other members of the group. The decision making process involved must be carried out in silence. You and your fellow group members will engage in an auction which will be carried out by means of a "sealed bid" process.

Specifically, the experiment consists of three phases. The first phase involves a group bid-making process. This is the Auction Phase. The second phase, the Voting Phase, involves a voting process in which the members of the group who "won" the auction vote on whether or not to accept the outcome. The third and final phase involves making final the allocations of monetary rewards to the group members. This is called the Allocation Phase.

Your task, as well as the task of the other group members, is to compete for money (or compensation) to be paid to you to subject yourself to an unpleasant taste experience. In other words, you will submit a "dollars and cents" offer which you feel best represents the amount of income you must be paid to hold in your mouth for 20 seconds one one-ounce cup of the unpleasant liquid at its strongest, most intensely bitter level.

Although the object auctioned off is an unpleasant experience and something you would not ordinarily consider doing, you could be paid whatever you feel is the amount that would induce you to taste the liquid.

In this experiment four cups of the unpleasant liquid will be allocated. The most that you or any other participant possibly will have to hold in your mouth for 20 seconds is one cup. This means that, depending on the bidding process, four of the individuals will end up tasting one cup each and the other four individuals will taste nothing. During the auction phase of the experiment you must determine your bid and then submit that bid to the monitor. This bid indicates the monetary value of your willingness to accept payment to taste the liquid. You will write your bid with your name on the Bidding Form provided, fold it once, and place it in the receptacle box in the center of the table.

Once all bids have been collected, the monitor will open all the Bidding Forms that have been placed in the receptacle box and rank the eight bids from lowest to highest and determine a "Reigning Bid." This Reigning Bid is important to remember. The Reigning Bid is determined in the following way. Suppose the ranking of the eight bids representing the group members' willingness to accept payment to taste the liquid turns out to be (from lowest to highest):

$3, $4, $5, $6, $7, $8, $9, $10.

The Reigning Bid is the fifth lowest bid, and in this example is $7. All bids that are less than the Reigning Bid will be tentatively accepted as winning bids. That is, each group member who bid below the Reigning Bid (those four who bid $3, $4, $5, $6) will tentatively be paid to taste the liquid.

However, each member of the group whose bid is accepted will be paid a price to taste the liquid equal to the Reigning Bid. Thus, in the example above, the individuals who bid $3, $4, $5, $6 will tentatively be paid the Reigning Bid, or $7, to taste the liquid. These "winners" are winners because they are allowed to taste the liquid by being paid the "Reigning Bid" price and because they are paid a price greater than what they were originally willing to accept in payment, If a group member whose bid has been tentatively accepted fails to taste the liquid at this point, for whatever reason, must leave the experiment without any income except the $3.00 promised at the outset of the experiment.

Now, on the other hand, all those group members whose bids are equal to the Reigning Bid or greater than the Reigning Bid will be tentatively rejected. That is, each member who bid (as in our example above) $7, $8, $9, $10, will tentatively not be paid to taste the cup of fluid.

With the end of the Auction Phase (that is, the determination of first, the Reigning Bid, and second, those group members whose bids were accepted), the group enters the second phase of the experiment. This second phase is the "Voting Phase." Note, no one has had to taste the liquid as of yet. The way in which the experiment has been designed, allows for up to ten trials during which the group would be involved in decision making. In other words, a trial consists of the Auction Phase and the Voting Phase. During each trial those members of the group whose bids were tentatively "accepted" (that is, below the Reigning Bid), and only those members, will then vote on whether to accept results of that trial. The result, here, is the price that each of the "winners" will be paid to taste the liquid. In order for this result to be finalized the vote (of accepting in payment for tasting an amount equal to the Reigning Bid) must be a unanimous "Yes." If any one or more of the members voting, votes "no" then a new bidding phase or Auction Phase and Voting Phase will start over again.

Notice on the Record Sheet given to you that the ten possible trials have been divided into two categories. The first four trials are denoted as the "Opening Trials" and the latter trials, Trial 5 through Trial 20,

are denoted as the "Closing Trials. " In the opening trials, Trials 1 through 4, the voting process will not be binding. Those group members whose bid was below the Reigning Bid will vote on the outcome, and the voting results will be announced, but will not be final. Only in the Closing Trials will the voting process be binding. Thus, if in the fifth trial, for example, the vote is unanimously "Yes" to accept the outcome, the Voting Phase stops, that is the trial ends, and the third phase, the "Allocation Phase," begins. Agreement can occur in any of the Trials 5 through 10. But, if the group fails to reach agreement by the end of the tenth trial then all eight members of the group will earn no extra income, and no one will be required to taste one cup of the fluid.

Let us look at one more detailed example of this type of group decision making activity.

I. Auction Phase:

1. Each group members enters his or her name, trial number and bid on one of the Bidding Forms and places it in the receptacle box. The monitor will then collect the bids and rank the eight bids to determine the Reigning Bid. Assume the bids are ranked as (from lowest to highest):

   $1.75, $2.00, $3.50, $5.00, $7.25, $7.50, $8.00, $12.00

2. The monitor then writes the Reigning Bid, which is $7.25, at the bottom of your Bidding Form and determines on the basis of your submitted bid whether or not your bid "was" or "was not" accepted; that is, was less than the $7.25 Reigning Bid. These Bidding Forms are returned to each group member with the Reigning Bid being announced to the entire group. The group will know only the Reigning Bid as well as his own bid but not each of his fellow group members' bids.

II. Voting Phase:

1. Your returned Bidding Form will indicate to you whether or not your bid has been tentatively accepted. Assume you bid $5.00 thus you will enter the second phase, the Voting Phase with three other of your group members (those who bid $1.75, $2.00 and $3.50). Those whose bids were greater than or equal to the $7.25 Reigning Bid will wait for the Voting Phase, which does not include them, to terminate.

2. The four members with bids $1.75, $2.00, $3.50, $5.00 will use one of the Voting Forms provided and enters his name, trial number and vote yes or no on whether to accept the $7.25 Reigning Bid as the price to be paid for tasting the liquid. The Voting Forms will again be placed in the Receptacle Box and collected by the monitor. The monitor will then announce the outcome of the voting.

3* Assume the votes are recorded as:

Y Y N Y

Then, for this trial, agreement has not been reached and the whole group enters a new trial where each of the eight group members makes a new bid to avoid the liquid. Then, those whose bids are less than the Reigning Bid are accepted, and move into a new Voting Phase to complete the new trial.

III. Allocation Phase:

1. With the end of each Voting Phase each trial ends. If the trial number is less than or equal to four a new trial automatically begins regardless of the result in the Voting Phase. Above we noted agreement had not been reached. If this nonagreement had occurred in Trials 1-4 the voting would have been nonbinding and a new trial would have begun automatically. If it had occurred in Trials 5-9, the voting would have been binding but due to the nonagreement result in the Voting Phase a new trial would have also begun. If this had been the tenth trial then the vote would be binding but no new trial would begin. Thus, each of the eight members would not have to taste one cup of the liquid and no one would have earned any extra income from the experiment.

2. Assume for the moment that the above voting result was followed by a new trial, the sixth trial. In this trial new bids and new votes would be taken with, for example, the result being: Y Y Y Y. Because the group is in the Closing Trials the vote is binding, and the four group members voting are paid in money the Reigning Bid and actually taste the liquid. The remaining four members are then not compensated anything. This completes the allocation phase.

Note, you may bid as much or as little as you want. If you do and your bid is less than the Reigning Bid you stand to earn considerable cash for tasting the liquid. If you feel you do want to be subjected to tasting the liquid and want to be paid to taste it then your bid must be below the Reigning Bid.

If you have any questions you may raise your hand at this time and the monitor will answer them for you.

APPENDIX E

LABORATORY INSTRUCTIONS FOR THE GROUP DECISION MAKING:
WILLINGNESS TO PAY FRAMEWORK

ECONOMICS EXPERIMENT

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PART I

WTPI

You have volunteered to participate with seven other individuals in an experiment dealing with economic and psychological decision making. Your responses to each question will be kept completely confidential.

The experiment consists of three parts. In this first part, Part I, you will be required to make totally hypothetical, monetary responses to different decision making situations which will affect you and the group. These different predicaments will be described to you in a moment.

When you have finished reading all of the instructions for Part I indicate to the experiment monitor that you are ready to proceed. Please do not talk with any other member of the group now or any other time during the experiment. Please turn the page and continue reading the instructions.

Description of Part I: Bidding Games

In this first part of the experiment you will be asked to make a totally hypothetical monetary response to a predicament which will affect every member of the group. You will be asked how much money you hypothetically would be willing to contribute to a fund which would permit yourself as well as every other individual in the group to avoid tasting an unpleasant liquid. This predicament assumes that only if enough money is contributed to the fund by the entire group that all eight of you will be allowed to avoid having to taste the unpleasant liquid. If there is not enough contributed to the hypothetical fund then everyone in the group must taste the unpleasant liquid.

Tasting the liquid means in this context holding a one-ounce volume in your mouth for twenty seconds and then spitting out the liquid. The hypothetical monetary response that you will make is the largest amount of money that you would be willing to pay as your contribution to the group fund to avoid having the group taste the unpleasant liquid.

The liquid referred to in this part of the experiment is described as having a “bitter-unpleasant” taste which lingers. In fact, sampling this liquid will leave a bitter taste in your mouth until your next meal and probably thereafter. It is nontoxic and poses no health risk to humans. The name of the substance is Sucrose Octa-Acetate (SOA). It is used in many industrial processes such as denaturing alcohol, transparentizing paper, reducing moisture absorption of brakelinings, and to modify the properties of synthetic plastics.

The monitor will explain these conditions once more during the experiment. If you do not understand the content of these instructions and would like to review the material or ask a question feel free to do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with Part I of the experiment. Indicate by raising your hand for the monitor.

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PART II

This is the second of the three parts of the experiment. As before your responses to each question will be kept completely confidential.

In this second experiment you will again be required to make hypothetical monetary responses in a decision making situation. When you have finished reading all of the instructions for Part II indicate to the experiment monitor that you are ready to proceed. As before, please do not talk with any other member of your group.

In this part of the experiment you and the other members of the group will actually sample the SOA liquid and then will be asked to make a new hypothetical monetary response representing the amount of money you would be willing to contribute to a hypothetical group fund which would permit yourself, as well as each of the seven other individuals in your group, to avoid tasting the liquid. Again you will be asked for the maximum amount of money you hypothetically would contribute to prevent the group from having to taste the unpleasant solution.

Sampling the SOA solution will involve flowing a few drops of the liquid over the tip of the tongue. The monitor will use a dropper to flow the solution over your extended tongue so that the fluid is allowed to fall off your tongue and not remain in your mouth for any length of time.

The money offer that you make after having sampled the SOA liquid is therefore the largest amount of money you would contribute to the group fund to not be subjected to the unpleasant stimulus.

The monitor will explain these conditions once more during the actual experiment. Now if you do not understand the content of this part of the instructions and would like to review this material or ask a question feel free to do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with Part II of the experiment.

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PART III

Instructions

This is the third and final part of the experiment. You, as before, are participating in a group exercise with seven other individuals. Together you form a group of eight individuals who must make a series of collective decisions. You and your fellow group members will engage in an auction which will be carried out by means of a sealed bid process. However, you will not be permitted to speak with the other members of the group. The decision making process involved must be carried out in silence. Specifically, this part of the experiment consists of three phases. The first phase involves a group bid-making process. This is the Auction Phase. The second phase, the Voting Phase, involves the members of the group voting on whether or not to accept the outcome of the Auction Phase. The third phase consists of making the final allocations of monetary rewards to the group members. This is called the Allocation Phase.

You, as well as each of the group members will be given a credit of $10.00 which is yours to keep as long as you consent to remain active in this experiment.

Your task, as well as the task of the other group members is to contribute enough money into a group fund which will allow the group, as a whole, to avoid the unpleasant taste experience. In other words, you will submit a "dollars and cents" offer which you feel best represents the amount of money you would pay to a group fund to avoid holding in your mouth for 20 seconds a one-ounce cup of the unpleasant liquid.

If the combined contribution of the group is sufficient to cover the "cost" to the entire group for avoiding the SOA liquid taste experience then all eight of you will not have to taste the SOA. Each of you will tentatively have to pay from your monies the amount of your contributed bid to the group fund.

So, during the auction you must determine your bid and then submit that bid to the monitor. You will write subject number, trial number, and your bid, on the Bidding Form which has been provided. Then hand the form to the monitor. Once all the Bidding Forms have been collected, the monitor will determine whether or not the group, as a whole, has contributed enough to exempt itself from having to taste the SOA.

There are three possible outcomes in the Auction Phase. First, the group sum of the bids from the group is less than the cost of avoiding the SOA. If this is the case, the group will be allowed to bid again in a new trial. Each member will resubmit a new bid on a Bidding Form and the group's total bid will be determined as to whether or not the sum of the bids exceeds the cost. The Auction provides for a maximum of ten trials, where each trial involves this process of collecting and calculating the group's contribution. If at the end of the ten trials, the group fails to cover the cost of avoiding the SOA, then each member must taste the SOA liquid.

The second possible outcome is that when the sum of the trials just equals the total cost for the group to avoid tasting the SOA. In this situation the group is told that they have covered the cost and potentially can avoid tasting the liquid. However, each member of the group must vote on whether or not to accept this outcome. A unanimous vote must occur for the results to be finalized. That is, each member of the group must vote "Yes" on the "Voting Form" that is provided in order for the group to actually avoid tasting SOA.

The third and final possibility is that the sum of the bids made by the group exceeds the cost of avoiding the SOA. In this case each group member receives a "rebate" which is proportional to the amount of money over-bid by you and the other members of the group. For example, assume that there were just four people in the group for a moment. Assume the cost for the group to avoid SOA is set at $10.00 and the group, as a whole, bids $20.00. Suppose that your bid was $6.00 and the other members' bids were $2.00, $4.00, and $8.00. The group over-bid by $10.00. Thus the group over-bid by 100 percent. In that case each person will be rebated one-half of his original bid. That is, your bid was $6.00 but you get back $3.00 through the rebate making your total net bid equal to $3.00. The other members receive $1.00, $2.00 and $4.00 in rebate respectively.

After the rebate, the group is in the same situation as when the sum of the bids by the group just equals the cost. The group must then vote, based upon the adjusted bid value, to determine whether it will accept the outcome. Remember, voting must be a unanimous "Yes" for results to be finalized. If one individual votes "No" then the group enters a new trial in which new bidding and voting phases occur.

Notice on the Record Sheet provided to you that the ten possible trials have been divided into two categories. The first four trials are denoted as the "Opening Trials" and the latter trials, Trial 5 through Trial 10, are denoted as the "Closing Trials." In the opening trials, the voting process will not be binding. The voting results will be announced but <u>will not be final</u>. Only in the Closing Trials can the voting process be binding. For example, if in the fifth trial the vote is unanimously "Yes" to accept the outcome, the Voting Phase. Agreement can occur in any of the trials 5 through 10. However, if the group fails to reach agreement by the end of the tenth trial then all eight members of the group will keep their $10.00 but each will be required to taste on cup of the fluid or forfeit the $10.00.

<u>Summary</u>

I. Auction Phase

1. Each group member enters his or her name, trial number, and bid on one of the Bidding Forms and hands it to a monitor. The monitor will then determine whether or not the group's bid sum is less than, equal to, or greater than the cost of avoiding for the group the SOA tasting experience.

2. The monitor then announces to the group the outcome of the bidding phase and hands back the Bidding Forms to each individual. The group members will know the actual amount that has been totally contributed as well as his own (possibly adjusted) bid, but not the bid of each of his fellow group members.

3. If the sum of bids is less than the cost the group will enter the next trial. If the sum of bids equals or exceeds the cost then the second or voting phase begins. (Bids may be adjusted for rebates.)

II. Voting Phase

1. The voting phase only occurs when the sum of bids from the group equals or exceeds the cost of avoiding the SOA. If this is the case then each individual in the group will write their name and trial number on a Voting Form and vote "Yes" or "No" on whether to accept the outcome of paying the adjusted bid. All voting forms will be collected by the monitor and tabulated. A unanimous vote must occur for the outcome to be accepted by the group.

2. Recall that the first four trials of the Auction are the Opening Trials. If a unanimous vote occurs at this time, a new trial begins automatically. If a unanimous vote occurs in the Closing Trials, trials 5-10, the outcome is binding and all individuals must pay their adjusted bid. If a vote occurs in the closing trials that is less than unanimous, a new trial automatically begins.

III. Allocation Phase

1. The end of each Voting Phase signals the ends of each trial. If the trial number is less than or equal to four, a new trial automatically begins regardless of the result in the Voting Phase.

2. When the group is in the Closing Trials of the experiment and the vote is unanimous, each group member will be required to pay the adjusted bid as indicated on the bidding form for that trial.

If you do not understand the content of these instructions and would like to review the written material or ask a question please do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with Part III of the experiment.

APPENDIX F

LABORATORY INSTRUCTIONS FOR THE GROUP DECISION MAKING:
WILLINGNESS TO ACCEPT FRAMEWORK

ECONOMICS EXPERIMENT

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PART I

WTAI

You have volunteered to participate with seven other individuals in an experiment dealing with economic and psychological decision making. Your responses to each question will be kept completely confidential.

The experiment consists of three parts. In this first part, Part I, you will be required to make totally hypothetical, monetary responses to different decision making situations which will affect you and the group.

When you have finished reading all of the instructions for Part I indicate to the experiment monitor that you are ready to proceed. Please do not talk with any other member of the group now or any other time during the experiment. Please turn the page and continue reading the instructions.

Description of Part I: Bidding Games

In this first part of the experiment you will be asked to make a totally hypothetical monetary response to a predicament which will affect every member of the group. You will be asked how much money we would have to pay you as well as every other individual in the group to voluntarily taste an unpleasant liquid. But, in this fund, there is only a limited amount of money. As long as the total amount of money that the group demands for payment (based on the sum of all the group members' requests) is less than or equal to the amount of money in the fund then everyone will be paid the amount they specify to taste the unpleasant liquid.

Tasting the liquid means you must hold a one-ounce volume in your mouth for twenty seconds and then spit out the liquid. Thus, the hypothetical monetary response that you will make is the smallest amount of money that you would require from the group fund to induce you and the other members of the group to voluntarily be subjected to tasting the unpleasant liquid.

The liquid referred to in this part of the experiment is described as having a "bitter-unpleasant" taste which lingers. In fact, drinking this liquid will leave a bitter taste in your mouth until your next meal and probably thereafter. It is nontoxic and poses no health risk to humans. The name of the substance is Sucrose Octa-Acetate (SOA). It is used in many industrial processes such as denaturing alcohol, transparentizing paper, reducing moisture absorption of brakelinings, and to modify the properties of synthetic plastics.

The monitor will explain these conditions once more during the experiment. If you do not understand the content of these instructions and would like to review the material or ask a question feel free to do so. If you understand the above material please indicate by raising your hand for the monitor that you are ready to proceed with Part I of the experiment.

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PART II

This is the second of the three parts of the experiment. As before your responses to each question will be kept completely confidential.

In this second experiment you will again be required to make hypothetical monetary responses in a decision making situation. When you have finished reading all of the instructions for Part II indicate to the experiment monitor that you are ready to proceed. As before, please do not talk with any other member of your group. Please turn the page and continue reading the instructions.

In this part of the experiment you and the other members of the group will actually sample the SOA liquid and then will be asked to make a new hypothetical monetary response representing your willingness to be paid with the other group members from a general fund to taste the liquid. You will be asked, hypothetically, the minimum amount of money we would have to pay you as well as your group from the fund to voluntarily taste the unpleasant solution.

Sampling the SOA solution will involve flowing a few drops of the liquid over the tip of the tongue. The monitor will use a dropper to flow the solution over your extended tongue so that the fluid is allowed to fall off your tongue and not remain in your mouth for any length of time.

The money offer that you make after having sampled the SOA liquid is therefore the smallest amount of money you would require as a group member from the group fund to be voluntarily subjected to the unpleasant stimulus.

The monitor will explain these conditions once more during the actual experiment. If you do not understand the content of this part of the instructions and would like to review this material or ask a question feel free to do so. If you understand the above material please indicate now to the monitor by raising your hand that you are ready to proceed with Part II of the experiment.

ECONOMICS EXPERIMENT I

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PART III

Instructions

This is the third and final part of the experiment. You, as before, are participating in a group exercise with seven other individuals. Together you form a group of eight individuals who must make a series of collective decisions. You and your fellow group members will engage in an auction which will be carried out by means of a sealed bid process. However, you will not be permitted to speak with the other members of the group. The decision making process involved must be carried out in silence.

Specifically, this part of the experiment consists of three phases. The first phase involves a group bid-making process. This is the Auction Phase. The second phase, the Voting Phase, involves the members of the group voting on whether or not to accept the outcome of the Auction Phase. The third phase consists of making the final allocations of monetary rewards to the group members. This is called the Allocation Phase.

Your task, as well as the task of the other group members is to determine an amount of money (or compensation) to be paid to you to subject the group to the unpleasant taste experience. In other words, you will submit a "dollars and cents" bid which you feel best represents the amount of income you must be paid from the group fund to hold in your mouth for 20 seconds one one-ounce cup of the unpleasant liquid.

If the combined bids of the group are equal to or less than the amount of money in the general fund, then all eight of you will actually be paid the amount you requested to taste the SOA liquid. The amount of money actually in the general fund will not be announced to you by the experimental monitor.

During the first phase of the auction you must determine your bid and then submit that bid to the monitor. You will write your bid with your name, your subject number, and trial number on the Bidding Form provided to you and then hand it to the monitor. Once all the Bidding Forms have been collected, the monitor will compare the amount that the group has requested, as a whole, to the amount of money in the general fund.

There are three possible outcomes in the Auction Phase. First, the group sum of the bids is less than the amount of money in the general fund. If this is the case, no payments can be made but the group will be allowed to try bidding again in a new trial. That is, each member will resubmit a new bid on a new Bidding Form. The group's total bids will be re-added to determine whether or not the sum of the bids can be covered by the general fund. The auction provides for a maximum of 10 trials where each trial involves this process of calculating the group's request for payment. If at the end of ten trials the group fails to request payment supportable by the general fund, then each member will be paid nothing and will not have to taste the SOA.

The second possible outcome is that when the sum of bids just equals the amount of money in the general fund. In this situation each member of

the group votes on whether or not to accept this outcome as final. If the voting is a unanimous "Yes," then each member will be paid the amount that he bid on the Bidding Form for that trial. However, a unanimous vote must occur before any payments are made. That means each member must vote "Yes" on his or her Voting Form in order for the group to actually be paid to taste the SOA liquid.

The third and final possibility is that the sum of bids made by the group is less than the general fund. In this case each group member will receive a "bonus" which is proportional to the amount of money under-requested. Assume for the moment that there were just four people in your group. Assume also that the sum of bids from the group equals $10.00 and the general fund has $20.00. Also assume that your bid was $3.00 and the other members' bids were $1.00, $2.00, and $4.00. The group under requested by $10.00. Thus the group under-requested by 200 percent. In this case each individual will receive a bonus equal to his or her contribution. So, you would receive a total net bid of $6.00 instead of $3.00 to taste the SOA, and the other group members would receive $2.00, $4.00 and $8.00, respectively.

After the bonus, the group is in the same situation as when the sum of the bids by the group just equals the general fund. The group must then vote, based upon the adjusted bid value to determine whether it will accept the outcome. Remember, voting must be a unanimous "Yes" for the results to be finalized. If one individual votes no, then the group enters a new trial in which new bidding and voting occurs.

Notice on the Record Sheet provided to you that the ten possible trials have been divided into two categories. The first four trials are denoted as the "Opening Trials" and the latter trials, Trial 5 through Trial 10, are denoted as the "Closing Trials." In the opening trials the voting process will not be binding. The voting results will be announced but <u>will not be final</u>. Only in the Closing Trials can the voting process be binding. For example, if in the fifth trial the vote is unanimously "Yes" to accept the outcome, the Voting Phase ends. Agreement can occur in any of the Trials 5 through 10. But, if the group fails to reach agreement by the end of the tenth trial then all eight members of the group will earn no money, and no one will be required to taste the fluid.

<u>Summary</u>

I. Auction Phase

1. Each group member enters his or her name, trial number, and bid on one of the Bidding Forms and hands it to a monitor. The monitor will then determine whether or not the group's bid sum is less than, equal to, or greater than the general fund used to pay the group to taste SOA.

2. The monitor then announces to the group the outcome of the bidding phase and hands back the Bidding Forms to each individual. The group members will know the actual amount that has been requested as well as his own (possibly adjusted) bid, but not the bid of each of his fellow group members.

3. If the sum of bids is greater than the general fund the group will enter the next trial. If the sum of requests equals or is less than the general fund then the second or voting phase begins. (Bids may be adjusted for bonuses.)

II. Voting Phase

1. The voting phase only occurs when the sum of bids from the group equals or is less than the general fund used to pay the group to taste SOA. If this is the case, then each individual in the group will write their name and trial number on a Voting Form and vote "Yes" or "No" on whether to accept the outcome of being paid their adjusted bids. All voting forms will be collected by the monitor and tabulated. A unanimous vote must occur for the outcome to be accepted by the group.

2. Recall, that the first four trials of the Auction are the Opening Trials. If a unanimous vote occurs at this time, then a new trial begins automatically. If a unanimous vote occurs in the "Closing Trials," Trials 5-10, then the outcome is binding and all individuals must pay their adjusted bid. If a vote occurs in the closing trials that is less than unanimous, then a new trial automatically begins.

III. Allocation Phase

1. The end of each Voting Phase signals the end of each trial. If the trial number is less than or equal to four, a new trial automatically begins regardless of the result in the Voting Phase.

2. When the group is in the Closing Trials of the experiment and the vote is unanimous, each group member will be paid the adjusted amount indicated on the Bidding Form for that trial.

If you do not understand the content of these instructions and would like to review the written instructions or ask a question please do so. If you understand the above material please indicate now to the monitor that you are ready to proceed with Part III of the experiment.