

**Subject Pool Effects among the General Population and Students:
A Choice Experiment Example**

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Abstract

Rising costs of conducting research coupled with limited budgets are forcing researchers to use samples of convenience. Students represent one such sample, but are students an appropriate population? The objective is to ascertain how students' willingness to pay (WTP) differs from the general public's WTP. Students and county residents are surveyed. Results suggest the study's goal may determine if student responses are generalizable to the general population. The samples are similar in many characteristics, but WTP amounts vary. The student samples show some inconsistencies. If the goal is general behavioral inferences, the results provide support for the use of students. If the goal is to estimate specific WTPs for use in policy analysis, the use of students may not be advisable.

JEL Classification: C80, C25

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“...in this era of tight budgets for education generally, and research specifically, students offer a low cost alternative to investigating nonstudents” (Gordon, Slade, and Schmitt 1986 p. 203).

I. Introduction

Given no foreseeable decline in the continued rising costs of conducting research, researchers will use samples of convenience, including students. Student subjects are used to estimate contingent valuation estimates of willingness to pay (WTP) (Cameron 2005; Corrigan et al. 2009; Johansson-Stenman and Svdesäter 2012). Studies using student samples often make policy recommendations (Hustvedt and Bernard 2010; Bennett and Blaney 2002), usually without making a case for generalizability. Using an applied setting, this paper examines the question of subject pool affects between students and the general population.

Subject pool effects arise when transferring student results to the general public; this issue is an applied issues that is best addressed by comparison of samples. Meta-analyses of hypothetical bias by Schläpfer and Fischhoff (2012) and Horowitz and McConnell (2002) find no statistically significant relationship between bias and student samples, whereas Murphy et al. (2005) find the student variable is significant and negative. The few studies comparing students' and the general populations' WTPs present mixed findings (Depositario et al. 2009). Depositario et al. (2009), Franco et al. (2001), and Maguire, Taylor, and Gurmu (2003) find similar WTPs by students and the public, whereas, Hsu and Shiue (2008) find differences.

II. Methodology

A choice experiment survey concerning improved transportation options for the rural elderly is conducted using university students and residents of three Texas counties. The survey contained six choice scenarios each with different levels of five transportation attributes: (1) addition to the

yearly registration fee; (2) days of operation; (3) hours of operation; (4) type of route; and (5) fare discount given to senior citizens (Israel 2012). Each of the four non-fee attributes had three levels of services: Days of Operation (Monday, Wednesday, Friday (MWF), Monday through Friday (M-F), and Seven Days a Week); Hours of Operation (7AM – 12 Noon, 7AM – 5PM, and 8AM – 12AM); Type of Route (Fixed, Flexible, and Door-to-Door); and Senior Citizen Transportation Fare (Full, 50% Discount, and Free). In each scenario, the attribute levels were independent, randomly drawn; the additional fee was drawn from a continuous, uniformly distribution ranging from \$1 to \$30.

The student survey was distributed to students attending Texas A&M University in spring 2011 and spring 2012 using the same classes. Questionnaires were mailed to residents in Atascosa and Polk Counties in the fall of 2011 and Parker County in the spring of 2012. Based on the random utility model, a mixed logit model (Train 2003) is used estimate a separate model for each of the five samples. Coefficients associated with the transportation variables (except fee) are assumed to be independently, normally distributed, whereas, coefficients associated with socio-demographic characteristics and fee are assumed fixed.

III. Results

Differences in the socio-demographic coefficients among the models do not show a consistent pattern (Israel 2012). The estimated standard deviations of each of the random coefficients are highly statistically significant except for Flexible for the 2011 student sample. Significance of these coefficients supports the validity of the mixed logit model.

In contrast to the socio-demographic coefficients, estimated mean coefficients associated with the transportation options all have the same sign among the five models. The coefficients associated with fee are always negative (fee enters as a positive value) and significant at 5%. In

all models, the other transportation option coefficients are positive and significant at 5%, except for Flexible in the county models (significant at 18, 9 and 15% in the Atascosa, Polk, and Parker models) and the coefficient associated with Monday through Friday in the Atascosa model (8%). Flexible route is the main difference between the student and county models. Students put a higher preference on seven-days-a-week service than county residents. County residents appear to take into account the fact that the elderly can schedule appointments, whereas, students appear to be of the mindset “when I need it, I need it now.”

Magnitudes of the coefficients vary among the models; differences are examined by comparing estimated WTPs. Mean WTPs between the two student models are similar and larger than WTPs from the three county models (Table 1). Differences in standard deviations of the WTP also exist. The null hypothesis that the WTP distributions of the five samples are equal is tested using a two-sample Wilcoxon-Mann-Whitney rank-sum test. Of the 48 pairwise comparisons among students and counties models, only six comparisons are failed to be rejected at 5%. For the eight comparisons between the two student samples, only one is not rejected. Of the 24 pairwise comparisons among the three counties, 14 of the null hypotheses are failed to be rejected at 5%.

As a rough comparison, the WTPs are ranked from the smallest (1) to the largest (8) WTP in Table 2. All three county models ranked four of the eight attributes the same (Flexible, Monday through Friday, and Seven Days a Week are ranked one through three and Free is ranked eighth). All five models had the smallest WTP for Flexible. The most striking difference in the rankings is the ranking for seven-days-a-week service. The county models had this option as the third smallest WTP, but both student models had this attribute as the largest WTP. If the three county WTPs and the two students' WTP are averaged, students on average are willing to

pay between 20 and 232% more than the average county resident depending on the attribute.

For policy makers, in addition to WTP, the percentage of people who support an option provides information. Here, the level of support is given by the percentage of people who have a positive WTP for an attribute. For six of the eight attributes, students have the largest percentage with a positive WTP. Polk County has the largest percentage of positive WTP for 50% discount and door to door. Each of the five samples has for at least one of the attributes the smallest percentage of positive WTP.

IV. Conclusions

As expected, different samples provide different estimates. The similarities in the transportation option coefficients are encouraging in that it appears the respondents in the five samples responded similarly to the choice experiment stimuli – the transportation options and fee.

Heterogeneity of the five samples is expected given the diverse nature of the three counties and students from across Texas in the samples. Similarity between counties occurs even given the long-standing cultural and socio-economic differences between the regions. Atascosa is in south Texas, Polk is in east Texas, and Parker is in north central Texas. Both student samples differ from the county samples. It is not clear why the student samples differ as much as they do between the two samples. Weak evidence is found for inconsistencies between student samples.

Although providing additional insight into subject pool effects, this study provides no clear cut answers. The purpose of the study remains an important component to consider when selecting a sample. If the study is designed to test predictions of general economic theory, the choice of the subject pool may not be viewed as a major concern. Three situations where the use of students may be appropriate are: 1) early in the research process as a relatively cheap first cut; 2) to examine changes over time; 3) when the payment type and good are particularly relevant to

a student population. On the other hand, if the study is designed to provide specific values to inform policy analysis the choice of the subject pool assumes a greater role. In summary, it appears subject pool effects are alive and well; however, there appears to be no fatal flaw in the current system that uses students.

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Table 1. Summary of WTP distributions for various transportation attributes

Statistic	Student Population			County	
	2011	2012	Atascosa	Polk	Parker
			Monday through Friday		
Mean WTP	13.46	10.87	4.27	6.02	7.13
WTP St. Dev.	17.38	12.14	18.21	13.30	9.12
% positive	78	81	59	67	78
			Seven Days a Week		
Mean WTP	24.10	20.87	6.59	6.55	7.15
WTP St. Dev.	26.10	21.92	12.42	13.72	15.89
% positive	87	83	70	68	67
			7AM – 5PM		
Mean WTP	23.55	14.29	11.13	7.74	12.94
WTP St. Dev.	18.99	13.82	15.42	13.46	13.33
% positive	89	85	76	71	83
			8AM – 12PM		
Mean WTP	22.82	18.99	13.56	8.66	9.10
WTP St. Dev.	26.16	17.70	23.21	15.19	13.10
% positive	81	86	72	72	76
			Flexible		
Mean WTP	6.79	8.15	2.87	3.57	2.66
WTP St. Dev.	9.13	10.45	12.71	12.79	13.35
% positive	77	78	59	62	58
			Door to Door		
Mean WTP	12.19	12.24	11.00	10.50	8.84
WTP St. Dev.	29.29	17.64	22.72	12.79	17.43
% positive	66	76	69	79	69
			50% Discount		
Mean WTP	17.66	9.94	10.29	10.06	12.24
WTP St. Dev.	15.93	16.15	11.45	7.79	17.92
% positive	87	73	82	90	75
			Free		
Mean WTP	22.37	17.18	18.18	13.14	13.62
WTP St. Dev.	16.17	16.75	13.55	14.06	12.54
% positive	92	85	91	83	86

The least flexible options within a transportation category are the base variable: Monday, Wednesday, and Friday for days of operation; 7AM-12PM for hours of operations; fixed route for routes; and full fare for fee amounts.

Table 2. Comparisons among the county and student WTPs

Option	Ranking – Smallest to Largest WTP					Average WTP		
	Student 2011	Student 2012	Atascosa	Polk	Parker	County Average WTP	Student Average WTP	Percent of County
Flexible	1	1	1	1	1	3.03	7.47	146.3
Door to door	2	4	5	7	4	10.11	12.22	20.8
Monday through Friday	3	3	2	2	2	5.81	12.17	109.5
50% Discount	4	2	4	6	6	10.86	13.80	27.0
Free	5	6	8	8	8	14.98	19.78	32.0
8AM to 12AM	6	7	7	5	5	10.44	20.91	100.2
7AM to 5PM	7	5	6	4	7	10.60	18.92	78.4
Seven Days a Week	8	8	3	3	3	6.76	22.49	232.5