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Abstract. We survey concert-goers during the season and gather revealed preference and ex-ante stated preference data. We then survey the same concert goers after the season and gather additional ex-post revealed preference data. Comparing ex-ante stated preference data to the ex-post revealed preference data we find respondents overstate their concert attendance behavior. An ex-ante revealed-stated preference demand model with a stated preference adjustment predicts the revealed preference concerts accurately.

Key words: Revealed preference, stated preference, criterion validity, predictive validity

JEL codes: Z1, D1, D6

Introduction

Economists have a strong preference for revealed preference data because they recognize that values are revealed as economic agents make decisions after considering expected benefits and costs. Yet many situations lack sufficient revealed preference information for economic analysis. For example, suppliers of goods and services may desire ex ante information about how quantity demanded changes with price or how demand changes with quality. In these situations stated preference data may be useful. Stated preference data result from a survey exercise that presents respondents with hypothetical questions about behavior in a variety of situations. Both types of data have limitations. Revealed preference is limited to historical variation in prices and quality and stated preference data is hypothetical and is often biased in favor of good intentions. Combining revealed preference and stated preference data allows incorporation of the strengths of both types of data. Combining data grounds the results from stated preference surveys in the reality of revealed preferences and allows variation beyond the range of prices and quality constrained by history (Whitehead et al. 2008b). The validity of the stated preference data remains a limiting factor. For example, Hausman (2012) cites examples where survey respondents overstate their demand for a proposed product. This study goes beyond the traditional revealed-stated preference approach by including a test of predictive validity, which compares the stated preference data with revealed preference data gathered in a follow-up survey.

The focus of the study is Mountain Home Music (MHM), a non-profit whose goal is to "preserve and honor the music of the Appalachian region." MHM works toward this aim by putting on concerts of a variety of traditional Appalachian styles of music at several locations in

Watauga County, North Carolina. By surveying concert-goers both during and after the 2010 concert season, we gather revealed and stated preference data during the concert season and additional revealed preference data after the concert season. We find some evidence that combined revealed-stated preference models are predictive valid. While individual predictions are not criterion valid, our ex-ante demand model with a stated preference adjustment predicts the actual number of concerts attended accurately.

Literature

Criterion validity is the accuracy of a stated preference measure of value or behavior compared to the actual value or behavior. In the contingent valuation literature, a large number of studies compare actual willingness to pay obtained from laboratory experiments and field surveys with hypothetical willingness to pay obtained from contingent valuation surveys. Divergence in actual and hypothetical willingness to pay is evidence of hypothetical bias. List and Gallet (2001) and Murphy et al. (2005) perform meta-analyses of these studies by regressing study characteristics on the ratio of hypothetical to actual willingness to pay. They find that private goods generate less hypothetical bias than public goods. Questions based on familiar behavior (i.e., behavior that leads to use value) generate less hypothetical bias. These results suggest that SP behavior data should have greater criterion validity than SP willingness to pay responses.

In the contingent behavior literature there have been several tests of criterion validity. Dickie, Fisher and Gerking (1987) test the demand for stated and revealed strawberry purchases and find no statistically significant differences in demand functions. Loomis (1993) compares intended length of recreation trip collected at a lake with a hypothetical water level versus actual

length of recreation trip when the hypothetical water level has been realized at the lake. There is no statistically significant difference between the average intended length of stay of 5 hours and the actual length of stay of 6 hours. Whitehead (2005) finds that survey respondents significantly overstate their hurricane evacuation behavior when compared to their actual behavior.

In contrast to criterion validity, we define predictive validity as the ability of the stated preference data to accurately predict revealed preference choices. There have been two applications of predictive validity tests in the literature. Grijalva et al. (2002) conduct an out-of-sample predictive validity test of rock climbing trip behavior using panel data. Respondents are surveyed about their actual trip behavior and stated preference behavior under future access conditions. Following the realization of the hypothetical scenarios (closure of rock climbing areas), respondents are surveyed again. With hypothetical closure of rock climbing areas, stated preference rock climbing trips fall. When the areas are actually closed, actual trips differ in the expected direction.

Whitehead (2005) compares the within sample and out-of-sample predictive validity of hurricane evacuation behavior with panel data. Respondents are surveyed about their RP evacuation behavior after low-intensity storms, a discrete choice, and SP behavior after hypothetical low-intensity and high-intensity storms. Two hurricanes followed the survey and respondents are surveyed again to determine their actual behavior. Models using actual and stated preference evacuation data forecast actual behavior with prediction error of less than 20%.

Assessing predictive validity in this way involves combining stated and revealed or actual behavior data. Jointly estimating the revealed and stated behavior model combines both types of preference data into a single equation. If the revealed and stated preference data coefficients are

constrained to be equal then the data are stacked and the basic model is estimated. This framework is often naïve in that revealed and stated preference data may diverge for various reasons. If a status quo stated preference scenario is included, the first-order test for divergence is to allow the intercept to vary by the stated preference dummy variable. The coefficients on the stated preference variable and on the stated preference variable interacted with other variables allow tests for compatibility between the data formats. If these coefficients are statistically insignificant then the model collapses to the basic model and the revealed and stated preference data are compatible. If the stated preference regression coefficients are statistically significant then the demand intercept and/or slope differs between the revealed and stated preference data.

A number of studies find that revealed and stated preference data differ in demand intercepts and demand slopes (e.g., Whitehead et al. 2008a). Typically, stated preference demand is higher and more elastic. This indicates that in stated preference surveys, respondents may be motivated by good intentions in terms of consumption and are in fact less responsive to price changes. A simple correction for these biases in stated preference data is to set the stated preference dummy variable equal to zero. The resulting "simulated revealed preference" demand may be devoid of the stated preference bias. Note that when the status quo stated preference scenario is omitted it is not possible to test for the potential bias of stated preference data in the conventional way.

Survey and Data

This analysis assesses both criterion and predictive validity in a model that combines stated and revealed preference data. The data come from a survey that was administered online to MHM concert attendees. We visited ten out of fifteen regular season MHM concerts from

May to December 2010 (see Table 1) and asked concertgoers to provide an email address so we could email them the link to the survey. The surveys were sent out in the week following the concert, and a follow-up email was sent to nonrespondents a week after that. Total concert attendance for the season was 2500 people. An average of 13 people per concert gave their email addresses and the average response rate was about 70% of those who had agreed to be surveyed. A total of 83 usable responses were collected.

The survey asked questions about which concerts the respondents had already attended the current 2010 season, and how many they attended in the 2009 season in order to establish a baseline, revealed preference set of data. Respondents were asked to indicate which concerts they planned on going to for the rest of the 2010 season assuming the price stayed the same. Respondents were asked for the number of concerts during a typical season, and then contingent behavior questions asked respondents to think about the number of concerts they would attend if the price increased by three dollars and then by ten dollars. All of these responses created a pseudo-panel data with five observations per respondent for a total of 415 observations.

After the last concert of the season in December, a final survey was sent to everyone who had responded to the original survey. It asked people which concerts they had gone to during the 2010 season, generating a set of revealed preference data that can be compared to the stated preference data from the original surveys. Out of about 120 people who were sent the follow-up survey, 60 of responded for a 50% response rate, but only 38 responses were usable. Unusable responses include those respondents who attended the last concert and thus did not provide stated preference concert information for the rest of the season and those respondents with missing concert data. Four respondents indicated in the in-season survey a number of concerts attended

that was one greater than the number indicated in their post-season survey. These concert goers may suffer from recall bias (i.e., they forgot about a concert they had attended). We recode their post-season revealed preference concerts by adding one.

Table 2 presents a summary of these data. For those who answered the follow-up survey the average number of concerts attended in 2009 is four, the number of revealed and stated concerts in the current year is 5.74 and the number of concerts in a "typical" year is almost five. With a $3 ticket price increase (i.e., a 20% increase from the $15 price) the number of concerts falls by 24% from the current year and 10% from the typical year baseline. With a $10 ticket price increase (i.e., a 67% increase) the number of concerts falls by 45% from the current year and 34% from the typical year baseline.

Those who attended the final concert or did not answer the follow-up survey are more avid concertgoers with more inelastic demand. These respondents attended an average of almost five concerts in 2009, almost six revealed and stated concerts in the current year and six concerts in a typical year. (Follow-up survey responded attended only three concerts on average.) With a $3 ticket price increase the number of concerts falls by 4% from the current year and 6% from the typical year baseline. With a $10 ticket price increase the number of concerts falls by 26% from the current year and 27% from the typical year baseline.

We describe the samples in Table 3. The average household size is 2 and the number in the party attending the surveyed concert is almost 3. The annual entertainment budget is $520 for those in the follow-up survey and $425 for those not in the follow-up survey. The average respondent age is early to mid-60s. Thirty-nine percent of the follow-up survey respondents and 60% of the other respondents live in the area year round. Fifty percent of the follow-up survey

respondents and 31% of the other respondents are seasonal residents. We did not ask a question about income since this is a local survey and there was concern that it would negatively affect response rates.

Empirical Results

We first consider the criterion validity of the individual demand data. We test for the statistical significance of the difference in stated preference and revealed preference concerts by considering the difference in post-season revealed preference concerts and the sum of in-season revealed and stated preference concerts, $\Delta Q = Q_T^{rp} - \left(Q_t^{rp} + Q_t^{sp}\right)$, where t = 1, …, 8 surveyed concerts with post-season survey respondents and T is the end of the concert season. Of the n = 38 who responded to the follow-up survey, n = 2 correctly predicted and n = 5 understated the number of concerts they would attend by the end of the season. The mean concert difference is a 2.26 overstatement with a median of 2, mode of 1, minimum of -5 and maximum of 8 concerts. The signed rank test indicates that this difference is significantly different from zero at the p = .0001 level.

Regressing the difference in revealed preference trips over the course of the season, $\Delta Q^{rp} = Q_T^{rp} - Q_t^{rp}$, on stated preference trips, Q_t^{sp}, shows that the overstatement increases with the number of stated preference trips with no constant overstatement: $\Delta Q^{rp} = 0.16(0.44) - 0.42(0.08) \times Q_t^{sp}; R^2 = 0.41$, where the numbers in parentheses are standard errors. The inverse of the coefficient on stated preference concerts is equal to the univariate mean concert overstatement. An important feature of our research design is that some respondents were interviewed earlier in the concert season than others, allowing them more scope for guesswork and hypothetical bias from good intentions. Regressing hypothetical bias, i.e., the difference in

the number of revealed and stated concerts, $HB = Q_t^{sp} - \Delta Q^{rp}$, on the portion of the concert season covered by the stated preference question shows that the errors are increasing in the opportunity for errors: $HB = -0.46(0.85) + 4.22(1.19) \times SP; R^2 = 0.26$.

Next we consider the predictive validity of the aggregate demand data. The survey questions provide five data points linking price with quantity for every respondent: one revealed preference point at the actual price, one revealed/stated preference point at the actual price, one typical point at the actual price and two stated preference points at the hypothetical higher prices. Since we do not have a measure of income to fully identify the demand function we estimate fixed effects Poisson panel data models (Englin and Cameron 1996):

$$lnQuantity_{it} = \alpha_i + \beta_P Price + \beta_{SP} SP + \beta_T Typical + \varepsilon_{it} \quad (1)$$

The fixed effects model for individual *i* and scenario *t* employs an implicit individual-specific constant term, α_i. The independent variables are those that change across scenario for each individual: price, stated preference scenarios and the "typical" trip scenario. The marginal effects of each variable on the number of concerts is $\frac{\partial Q}{\partial X} = \beta_X \bar{Q}$ and the elasticity is $e_X = \beta_X \bar{X}$, where Q is quantity and X is an independent variable.

Regression results are presented in Table 4. Survey respondents in both samples have downward sloping demand functions. The demand elasticities for follow-up survey respondents and other respondents are $e_P = -4.54$ and $e_P = -3.49$, respectively. The "typical" season coefficient is not statistically significant for the follow-up survey respondents. The "typical" season marginal effect suggests that other respondents attend 1.21 more concerts each year than their revealed preference concert attendance suggests. The marginal effects of the stated preference scenarios on concert attendance are 1.70 and 1.77 for follow-up survey respondents

and other respondents, respectively. Considering follow-up survey respondents, the 95% confidence interval for the marginal effect is [0.73, 2.67]. Considering their responses to the follow-up survey, the mean concert attendance difference of 2.26 is within the confidence interval predicted from the empirical model that does not use the postseason data. A standard correction for hypothetical bias of setting the stated preference dummy variable equal to zero would produce accurate forecasts of postseason concerts.

Because a log-linear model is used, the inverse of the coefficient on price is an estimate of the consumer surplus per concert attended, $CS = -\frac{1}{\beta}$. The total benefits of MHM for 2010 can be found by multiplying the consumer surplus by the number of people who attended their concerts this year. The demand model yields a consumer surplus of $15 for follow-up survey respondents and $23 for other respondents. The total benefits for the year can be found by multiplying the weighted average consumer surplus per concert by concert attendance from Table 1. This gives a total consumer surplus of $50,116.

Conclusions

In this paper we conduct a unique in-season and postseason survey to test the predictive validity of stated preference survey responses. We find that stated preference concert attendance lacks criterion validity. Respondents tend to overstate their concert attendance behavior. On average, survey respondents are generally accurate when predicting their own behavior *after* a statistical adjustment for hypothetical bias. The stated preference data have some degree of predictive validity which is consistent with two previous studies (Grijalva et al. 2002, Whitehead 2005).

References

Dickie, Mark, Ann Fisher and Shelby Gerking. (1987) "Market Transactions and Hypothetical Demand Data: A Comparative Study." *Journal of the American Statistical Association* 82(397): 69-75.

Englin, Jeffrey and Trudy Ann Cameron, "Augmenting Travel Cost Models with Contingent Behavior Data," Environmental and Resource Economics 7(2):133-147, 1996.

Grijalva, T., Berrens, R., Bohara, A., and Shaw, D. (2002) "Testing the Validity of Contingent Behavior Trip Responses." *American Journal of Agricultural Economics.* 84 (2): 401-414.

Hausman, J. (2012) "Contingent Valuation: From Dubious to Hopeless." Journal of Economic Perspectives. 26 (4): 43-56.

List, J. A. and C. Gallet. (2001) "What Experimental Protocol Influence Disparities Between Actual and Hypothetical Stated Values?" *Environmental and Resource Economics* 20(3): 241-254.

Loomis, John B., "An Investigation into the Reliability of Intended Visitation Data," Environmental and Resource Economics 3:183-191, 1993.

Murphy, James J., P. Geoffrey Allen, Thomas H. Stevens and Darryl Weatherhead. (2005) "A Meta-analysis of Hypothetical Bias in Stated Preference Valuation." *Environmental and Resource Economics* 30(3): 313-325.

Whitehead, J. (2005) "Environmental Risk and Averting Behavior: Predictive Validity of Jointly Estimated Revealed and Stated Behavior Data." *Environmental and Resource Economics*. 32: 301-316.

Whitehead, John C., Christopher F. Dumas, Jim Herstine, Jeffery Hill and Bob Buerger, "Valuing Beach Access and Width with Revealed and Stated Preference Data," Marine Resource Economics 23:119-135, 2008a.

Whitehead, J., Pattanayak, S., Van Houtven, G., and Gelso, S. (2008b) "Combining Revealed and Stated Preference Data to Estimate the Nonmarket Value of Ecological Services: An Assessment of the State of the Science." *Journal of Economic Surveys*. 22 (5): 872-908.

Table 1. Concert Attendance and Survey Response Rates

Date	Attendance	Sample Size	Survey Responses	Response Rate (%)
30-May	225	na	10	na
5-Jun	93	12	10	83
12-Jun	182	5	4	80
19-Jun	74	7	5	71
26-Jun	161	14	12	85
3-Jul	440	na	na	na
25-Jul	151	na	na	na
7-Aug	145	11	6	54
14-Aug	134	na	na	na
22-Aug	275	na	na	na
5-Sep	212	22	18	81
9-Oct	98	21	14	67
16-Oct	110	13	6	46
27-Nov	71	na	na	na
18 – Dec	150	12	9	75
Total	2521	127	94	74

Table 2. Concert Demand Data

				Follow-up Survey Respondents (n=38)			
				Stated Preference		Concerts	
Scenario	Year	Price	Typical	Mean	StdDev	Mean	StdDev
1	2009	15	0	0		4.05	2.44
2	2010	15	0	0.65	0.30	5.74	3.14
3	"Typical"	15	1	0		4.79	2.21
4	2011	18	0	1		4.34	1.98
5	2011	25	0	1		3.18	1.78
6	2010	15	0	0		3.58	2.13

				Follow-up Survey Nonrespondents (n=45)			
				Stated Preference		Concerts	
Scenario	Year	Price	Typical	Mean	StdDev	Mean	StdDev
1	2009	15	0	0		4.73	4.74
2	2010	15	0	0.45	0.35	5.91	5.32
3	"Typical"	15	1	0		6.00	4.63
4	2011	18	0	1		5.67	4.62
5	2011	25	0	1		4.36	4.25

Table 3. Sample Characteristics

	Follow-up Survey Respondents (n=38)		Other Respondents (n=45)	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Household Size	2.21	0.70	2.09	0.79
Number in concert party	2.76	1.30	2.89	1.23
Entertainment budget	519.74	516.23	425.00	409.75
Age of the respondent	64.74	10.71	62.33	13.21
Year round resident	0.39	0.50	0.60	0.50
Seasonal resident	0.50	0.51	0.31	0.47

Table 4. Fixed Effects Concert Demand Models

Follow-up Survey Respondents (n=38)

				Marginal	95% Confidence	
	Coefficient	SE	Coeff/SE	Effects	Interval	
PRICE	-0.068	0.013	-5.330	-0.303	-0.414	-0.191
SP=0,1	0.385	0.112	3.440	1.703	0.734	2.673
TYPICAL=0,1	0.161	0.105	1.530	0.712	-0.198	1.622
LL	-239.19					
AIC	484.40					
Cases	38					
Periods	5					

Other Respondents (n=45)

				Marginal	95% Confidence	
	Coefficient	SE	Coeff/SE	Effects	Interval	
PRICE	-0.044	0.011	-4.040	-0.232	-0.345	-0.120
SP=0,1	0.331	0.095	3.480	1.766	0.771	2.760
TYPICAL=0,1	0.227	0.085	2.680	1.213	0.326	2.100
LL	-93.94					
AIC	593.90					
Cases	45					
Periods	5					