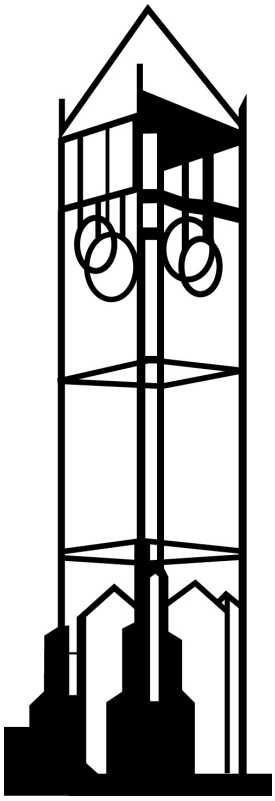
Is Self-Sufficiency for Women'S Collegiate Athletics a Hoop Dream?: Willingness to Pay for Men'S and Women'S Basketball Tickets

Juan (Francisco) Rosas, Joseph A. Herriges, Peter Orazem



Working Paper No. 11010
May 2011

IOWA STATE UNIVERSITY
Department of Economics
Ames, Iowa, 50011-1070

Is Self-Sufficiency for Women's Collegiate Athletics a Hoop Dream?: Willingness to Pay for Men's and Women's Basketball Tickets

Francisco Rosas, Joseph A. Herriges, Peter F. Orazem

Iowa State University

May 2011

Universities spend almost $2 billion subsidizing their collegiate sports programs. Even the most popular women's sport, basketball, fails to break even. An application of Becker's theory of customer discrimination is used to calculate the relative preference for men's basketball for both men and women. Median willingness to pay for men's basketball relative to women's basketball is 180% greater for men and 37% greater for women. Pricing each sport at its revenue maximizing price, revenues from women's basketball are only 43% of that for men, even at a school with historically strong demand for women's sports.

JEL: L83; D12; M31

Francisco Rosas is a PhD. candidate in the Department of Economics. Tel.: (515) 294-6357, Email: frosas@iastate.edu.
Joseph A. Herriges is a professor in the Department of Economics. Tel.: (515) 294-4964, Email: jaherrig@iastate.edu,
Peter F. Orazem is a professor in the Department of Economics. Tel.: (515) 294-8656, Email: pfo@iastate.edu.

Corresponding Author: Peter F. Orazem, 267 Heady Hall, Department of Economics, Iowa State University, Ames, IA 50011-1070, pfo@iastate.edu. Tel.: (515) 294-8656. Fax: (515) 294-0221. We thank Stephanie Bridges and Alexandra Weaver for assistance in collecting the data and Darin Wohlgemuth for assistance in deriving the sample.

I. INTRODUCTION

NCAA sports are extremely expensive. Average annual budgets at schools in the top five divisions average $72 million per year, and yet most sports do not break even. *USA Today* estimated that annual subsidies for NCAA sports total $1.8 billion per year.[1] When university budgets and tuitions face increased scrutiny by legislators and taxpayers, these sports will face increasing need to generate revenues sufficient to cover these expenses.

Basketball is the most common revenue generating men's and women's NCAA sport. There are 325 men's and 343 women's teams that compete at the Division I level. While men's basketball often raises sufficient revenue to meet expenses, this is rarely the case for women's basketball (Zimbalist, 1999). The reason is readily apparent—the men's sport is more popular. In the 2010-11 season, average attendance at men's games was 5,025 but only 1,566 at women's games despite much lower ticket prices for the women's games.

Why that should be the case is not clear. If, for example, women supported women's basketball and men supported men's basketball, there would be similar markets supporting both sports. Clearly there must be differences in willingness to pay for men's and women's basketball tickets. It is possible that both men and women prefer the men's game; that men support men's sports while women support neither; or even that men have stronger tastes than women for both men's and women's sports.

This study evaluates this question using a novel application of Becker's customer discrimination theory to evaluate relative tastes for men's and women's sports. We demonstrate that willingness to pay for men's and women's sports can be measured using decisions to accept or reject randomly priced men's and women's basketball tickets in a simulated market. The parameters allow us to predict the probability of ticket purchase at any given price, and so we

[1] "Rising salaries of coaches force colleges to seek budget patch" *USA Today* 4/12/2010

can estimate the reservation prices at which each individual is indifferent between buying a men's or women's basketball ticket. The ratio of these reservation prices yields a pecuniary measure of the relative preference for men's versus women's basketball for every individual in the market. That information allows us to calculate total surplus for each college-basketball game, which can be interpreted as the maximum potential revenue available for each men's and women's basketball game under the assumption that the seat availability is supplied inelastically in the short-run.

Both male and female customers consistently prefer men's basketball over women's basketball. At the median, men are willing to pay 180% more for a men's college-basketball ticket than for a women's basketball ticket. The median woman is willing to pay a 37% premium for men's basketball. Aggregating over individual preferences, the maximum possible revenue that can be generated from a women's basketball games is only 53% of a men's game if the Athletic Department can perfectly price discriminate. At the revenue maximizing single price for each sport, a women's game can only generate 43% of the revenue for a men's game. As these estimates were derived at a school with unusually strong attendance at women's games, these estimates are at the lower-bound of relative preferences for and relative revenues from men's versus women's basketball. The findings illustrate why women's basketball faces an uphill battle in attaining revenue self-sufficiency.

II. LITERATURE REVIEW

Becker's (1957) seminal work showed that customer discriminatory preferences are revealed by a higher willingness to pay for goods or services provided by favored relative to unfavored groups. These discriminatory preferences will result in higher revenues for firms that

employ members of the favored group.[2] Holzer and Ihlanfeldt (1998) showed that retail firms do employ workers whose demographics match the racial composition of their local customers. Borjas and Bronars (1989) found that self-employed minorities earned less than observationally equivalent whites, consistent with customer discrimination against minority proprietors.

Our empirical approach takes its inspiration from three strands of the literature. The first examines evidence of customer discrimination in professional sports. Nardinelli and Simon (1990) and Anderson and La Croix (1991) reported that in markets for baseball trading cards, black player cards commanded lower prices paid by the predominantly white customer base. Later studies failed to corroborate their findings.[3] Brown and Jewel (1995) and Kanazawa and Funk (2001) present evidence that 'whiter' college and professional players generate more revenue than comparable 'black' teams. Corroborating evidence by Kahn and Shah (2005) found that black NBA players are paid less than comparable white players.[4]

A second strand of the literature used audit studies which test for the existence of discriminatory tastes in simulated market transactions. Audit studies have been applied most commonly in studies of discrimination in labor and product markets.[5] In a series of parallel job searches, by applicants who have identical credentials and other observable attributes except race, Hispanic and black job searchers experienced lower success at both the interview and the job offer stages than their white counterparts (Mincy, 1993). Similarly, Neumark, Bank and Van Nort (1996) found that women had a lower probability than their paired male counterpart of receiving restaurant job interviews and job offers. Bertrand and Mullainathan (2004) found that

[2] While market competition tends to drive out discriminatory outcomes when employers or employees are the source of discriminatory tastes, customer discrimination can persist over time (Kahn, 1991).
[3] Stone and Warren (1999) and Gabriel, Johnson and Stanton (1995) concluded that baseball card prices are not influenced by race.
[4] A different form of discrimination in sport was investigated by Price and Wolfers (2010) who showed that referees call more fouls in NBA games when the team differs in race from the referee crew.
[5] Heckman (1998) presents a critical view of the conclusions derived from audit studies.

employers gave fewer interviews to applicants with "black" first names. Yinger (1998) reports that whites received more favorable treatment from real estate and rental agencies than did their paired Black and Hispanic housing seekers.

A third strand involves the use of contingent valuation methods which have been used to estimate public willingness to pay to attract or retain professional sports teams. Applications include measuring willingness to pay for basketball and baseball venues (Johnson and Whitehead, 2000); for attracting a professional hockey team (Johnson, Groothuis, and Whitehead, 2001); for retaining professional football and basketball teams (Johnson, Mondello, and Whitehead, 2007); and for supporting amateur sports and recreation programs (Johnson et al. 2007). These studies used aggregated willingness to pay to assess whether sports generated sufficient positive externalities to justify government finance.

The few previous papers investigating differences in the demand for sports between men and women have focused on psychological factors. Madrigal (1995) argued that fans attended women's basketball games to bask in the reflected glory of successful teams. Pan and Baker (1999) reported that students attend sporting events for entertainment, stress release, and socializing with friends. These factors apparently affect men and women differently, even when men and women express similar interest in sports. Thus, Dietz-Uhler et al (2000) found that men and women identified themselves as sport fans in equal proportions, but men were more intense in their support of teams.

This study examines gender differences in demand for sports from an economic perspective. We use simulated market transactions as are commonly employed in audit studies to elicit willingness to purchase randomly priced tickets for men's and women's basketball games. Willingness to purchase declines in market price, generating implied demand curves for

men's and women's basketball. Implied reservation prices for each individual are used to create a pecuniary measure of taste for men's basketball relative to women's basketball that is equivalent to Becker's formulation of a customer discrimination coefficient. These estimates are then used to calculate total surplus for men's and women's basketball game, a measure of the maximum revenue that could be derived from each sport if the Athletic Department could perfectly price discriminate. The distribution of reservation prices also can be used to identify the revenue maximizing price for each sport if price discrimination is impossible. At maximum potential revenue (i.e., with price discrimination) women's basketball can earn only 53% of the revenue for the men's game or 43% with the optimum single prices.

III. METHODOLOGY

We begin by showing that Becker's (1957) theory of customer discrimination provides a framework that enables us to assess the extent of each customer's preference for men's versus women's basketball, even if those preferences are not discriminatory. Let d_i be customer i's proportional preference for men's basketball. Let $\tilde{p}_i^m$ be the reservation price for a men's basketball ticket, meaning the price at which an individual is indifferent between buying and not buying the ticket. Similarly, let $\tilde{p}_i^w$ be the individual's reservation price for a women's basketball ticket. Individual i will be equally likely to purchase a men's and women's basketball ticket if the prices are set such that

$$\tilde{p}_i^m = (1 + d_i)\tilde{p}_i^w \quad (1)$$

In Becker's treatment of customer discrimination, d_i measures the customer's taste for discrimination. When $d_i > 0$, the customer has discriminatory preferences toward services provided by men, while $d_i < 0$ reflects preferences for services provided by women. In Becker's formulation, the product is identical other than the demographic attributes of the service

provider, and so d_i could only differ from zero because of discrimination. In our context, while the sport is the same, men's and women's basketball are not identical products, and so d_i may reflect differences in the perceived quality of the men's game relative to the women's game. It may even reflect differences in the quality of the fan environment, advertising, or media exposure. Therefore, a finding that $d_i \neq 0$ does not necessarily imply discriminatory preferences toward women's basketball.[6] Nevertheless, the d_i do quantify the preference each customer places on the men's versus the women's sport, and so d_i will show whether a customer prefers women's or men's basketball and the magnitude of that preference. Because we can estimate the d_i for each individual, we can generate the entire distribution of preferences for men's versus women's sports for both men and women fans, allowing us to show how many men and women would attend either sport at any given price.

This paper exploits the Becker framework to generate estimates of d_i, given information on customer reservation values of $\tilde{p}_i^m$ and $\tilde{p}_i^w$. The data were collected from a random sample of college students attending a university with popular men's and women's basketball teams. Each student was given a randomly drawn ticket price for men's basketball and for women's basketball. Students were asked to respond as to whether they would purchase each ticket. Additional information was elicited on past participation in sports, attendance at sporting events, and whether they grew up as fans of the school as well as demographic and academic characteristics. This information was used in a bivariate probit model predicting willingness to purchase the men's ticket and the women's ticket.

[6] Note that in all empirical applications of Becker's theory of customer discrimination, it is impossible to establish whether the d_i are due to discrimination or service quality. If, for example, customers are willing to pay more for lingerie purchased from a woman, the premium is the same whether attributable to the presumed better service provided by sales staff with knowledge gained from wearing the products or attributable to discriminatory preferences for female attendants regardless of expertise.

To operationalize (1), consider a circumstance where individual *i* faces an exogenously given pair of basketball ticket prices, P_i^m and P_i^w. The choice of purchasing either ticket is given by

$$\begin{aligned} B_i^{m*} &= \beta_0^m + \beta_1^m P_i^m + Z_i\delta^m - \eta_i^m \\ B_i^{w*} &= \beta_0^w + \beta_1^w P_i^w + Z_i\delta^w - \eta_i^w \end{aligned} \tag{2}$$

where B_i^{x*} , *x = m, w*, represents the latent utility associated with purchasing a ticket of gender *x* at the offered price, P_i^x , holding constant a vector of individual characteristics Z_i and unobservable factors represented by η_i^x. In practice, we do not observe B_i^{x*}, but we do observe the choice of whether or not the individual buys each ticket. Let the binary choices be represented by

$$B_i^m = \begin{cases} 1 & if\ B_i^{m*} > 0 \\ 0 & if\ B_i^{m*} \leq 0 \end{cases}$$

$$B_i^w = \begin{cases} 1 & if\ B_i^{w*} > 0 \\ 0 & if\ B_i^{w*} \leq 0 \end{cases}$$

which implies that individual *i* purchases the ticket if it yields positive utility. We assume the unobserved factors in equation (2) are jointly distributed standard normal with correlation coefficient ρ

$$\begin{pmatrix} \eta_i^m \\ \eta_i^w \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right] \tag{3}$$

By calculating the joint probabilities that Pr[B_i^m=1, B_i^w=1], Pr[B_i^m=1, B_i^w=0], Pr[B_i^m=0, B_i^w=1], and Pr[B_i^m=0, B_i^w=0], we find the following log-likelihood function for the model

$$L(B_i^m, B_i^w \mid P_i^m, P_i^w, Z_i, \beta^m, \beta^w, \delta^m, \delta^w, \rho) = \tag{4}$$

$$\sum_{i=1}^{i=n} \log \{\Phi_2 [q_i^m(\beta_0^m + \beta_1^m P_i^m + Z_i\delta^m), q_i^w(\beta_0^w + \beta_1^w P_i^w + Z_i\delta^w), q_i^m q_i^w \rho]\}$$

where Φ_2 is the bivariate standard normal cumulative distribution function, $q_i^m = 2B_i^m - 1$ and $q_i^w = 2B_i^w - 1$.

The parameter estimates from (4) can be used to obtain the estimated willingness to pay for each college sport. Noting that the reservation price will be the price at which individual *i* is indifferent between purchasing and not purchasing the ticket, we can derive an estimate of the reservation price for men's basketball as the value of P_i^m such that Pr[B_i^m=1] = 0.50. Similarly, the reservation price for women's basketball is the value of P_i^w such that Pr[B_i^w=1] = 0.50. Algebraically, the reservation prices $\tilde{p}_i^m$ and $\tilde{p}_i^w$ implicitly solve the joint equations.

$$\begin{aligned} \Pr[B_i^m = 1] &= \Phi\left(\hat{\beta}_0^m + \hat{\beta}_1^m \tilde{p}_i^m + Z_i\hat{\delta}^m\right) = 0.5 \\ \Pr[B_i^w = 1] &= \Phi\left(\hat{\beta}_0^w + \hat{\beta}_1^w \tilde{p}_i^w + Z_i\hat{\delta}^w\right) = 0.5 \end{aligned} \tag{5}$$

where Φ is the univariate standard normal cumulative distribution function and "^" indicates the estimated value of the parameter. Given that the standard normal probability density function is symmetric and centered on zero, the implicit equations for $\tilde{p}_i^m$ and $\tilde{p}_i^w$ simplify to

$$\begin{aligned} \hat{\beta}_0^m + \hat{\beta}_1^m \tilde{p}_i^m + Z_i\hat{\delta}^m &= 0 \\ \hat{\beta}_0^w + \hat{\beta}_1^w \tilde{p}_i^w + Z_i\hat{\delta}^w &= 0 \end{aligned} \tag{6}$$

The estimated values of $\tilde{p}_i^m$ and $\tilde{p}_i^w$ can be inserted into (1). Rearranging, we can solve for d_i as a function of both reservation prices

$$d_i = \frac{\tilde{p}_i^m}{\tilde{p}_i^w} - 1 \tag{7}$$

If $d_i > 0$, individual *i* is willing to pay d_i*100% more for a men's basketball ticket than for a women's basketball ticket. If $d_i = 0$, individual *i* has the same willingness to pay for men's and women's basketball. If $d_i < 0$, individual *i* favors women's basketball over men's. Note that this structure imposes no priors that men's basketball is preferred to women's basketball.

The natural measure of the reservation price is the one that sets the probability of purchase equal to 0.5 as in equation (5). However, in principle we could evaluate (5) at any common probability of ticket purchase. Because the probability of purchasing a ticket is monotonically decreasing in price, the rank order of individual preferences for men's and women's basketball is invariant to the choice of probability, as we show in Appendix A. Furthermore, as shown by Cameron (1988), a contingent valuation approach will yield numerically identical estimates of the willingness to pay and of the coefficient d_i as we derive at the probability of purchase 0.5. A proof is also provided in Appendix A.

IV. DATA

The model requires that each individual be given the opportunity to purchase or refuse a men's basketball and women's basketball ticket. We also require sufficient variation in prices to identify the behavioral responses, $\hat{\beta}_1^m$ and $\hat{\beta}_1^w$ in equation (4). Such data would not be commonly available in market transactions, and so we developed an artificial environment where appropriate data could be obtained.[7]

The universe of potential customers in this study is the undergraduate student population at Iowa State University. Iowa State should be atypically likely to support its women's

[7] To our knowledge, there are no papers that measure the distribution of d_i across individuals in markets subject to discriminatory preferences. Charles and Guryan (2008) use individual responses on survey questions that measure racial animosity to develop proxies for the distribution of discriminatory preferences by state, but that data does not directly measure individual d_i. Pope and Sydnor (2011) examine interest rates charged on person-to-person loans on an internet website that shows the average of the d_i for completed transactions but not for all individual lenders in the market.

basketball program. A perennial power in women's basketball with frequent participation in the NCAA tournament, ISU ranks among the top five schools in attendance at women's games. ISU also has a long history of support for its men's basketball team despite its more modest success. It ranks among the top 30 schools in attendance at its men's games. Compared to other NCAA Division I programs, ISU should be able to generate more revenue than all but a handful of schools.

In 2007, a random sample of 2000 students was invited by Email to participate in a web-based survey. Of these, 470 (23.5%) provided complete responses, and they represent the working sample for this study. The working sample reflected the attributes of the sample universe well as showed in Table 1, and so there does not appear to be any systematic relationship between observable student attributes and the likelihood of survey response.

In addition to demographic information and questions related to participation and interest in sports, each respondent was asked whether they would purchase a men's basketball ticket at a stated price and a women's basketball ticket at a stated price. Prices for men's and women's tickets were generated from independent random draws from uniform price distributions. The men's basketball price was a whole number drawn from U(7, 20). The women's basketball price was a whole number drawn from U(1, 10). The actual price charged to students at the time was the median price in each distribution.[8]

Variable definitions and sample statistics are presented in Table 1. Because each respondent received a randomly drawn price, there is no apparent correlation with the control variables, Z_i. As a result, we get virtually identical response parameters to the prices regardless of whether or not the Z_i's are included in the estimation. Nevertheless, it is useful to highlight

[8] Our results are not driven by the differences in the price ranges for the men's and women's tickets. We get virtually identical results when we limit the price range to the intersection of the two distributions, [7, 10], although we lose precision because of the reduction in sample size.

some of the more interesting control variables used in the analysis. To control for overall interest in sports, we included information on whether the individual played sports in high school and whether the individual participated in intramurals in school. To control for demand for Iowa State sports more specifically, we ask whether the individual was an Iowa State fan before coming to college, whether they grew up in Iowa, and whether they had parents or relatives graduate from Iowa State. The rest of the controls included age and ethnicity, academic major, and college residence. The most critical of these is gender; all of the analysis will be performed separately for men and women because of the interest in assessing whether there are differences in tastes across the sexes for men's and women's basketball.

A useful check on the success of the price randomization is to plot the probability of a positive purchase response by random price offered. If respondents are behaving as expected rational agents, we should be able to trace out standard demand relationships from data plots. Figures 1 and 2 show the fraction of men and women stating they would buy a men's or women's basketball ticket at the randomized offer price. While the relationship is not perfectly monotonic, the fitted bivariate relationship between intent to purchase and price satisfies the law of demand: the higher the price, the lower the proportion of people willing to buy the ticket. It also appears that there are differences in demand relationships between men and women. Men have a more price-inelastic demand for men's basketball and women have a more inelastic demand for women's basketball. That apparent behavioral difference in response to prices explains why we need to conduct the estimation separately for men and women in order to derive accurate measures of d_i in equation (7).

V. RESULTS

A. Point estimates

The analysis begins with the estimation of equation (4). Under the assumption of joint normality of the error terms in (3), we can use seemingly unrelated bivariate probit to yield maximum likelihood estimates. The coefficient estimates are reported in Tables 2 for men and women. For men's and women's basketball, the offered prices have a negative and statistically significant effect on likelihood of purchase for both men and women. The implied analytical demand elasticities for $x = m, w$ are given by

$$\varepsilon_i^x = \frac{1}{\mathrm{n_x}} \cdot \sum_{i=1}^{i=n_x} \left[\frac{\partial \Pr[B_i^x = 1]}{\partial P_i^x} \cdot \frac{P_i^x}{\Pr[B_i^x = 1]} \right]$$

Demand for men's basketball tickets are in the inelastic range for men (-0.91) but in the elastic range for women (-1.64) while both are in the inelastic range for women's basketball tickets (-0.86 for men and -0.39 for women). As with the simple plots, men have more elastic demand for women's basketball tickets and women have more elastic demand for men's basketball tickets

The estimates of $\hat{\beta}_1^m$ and $\hat{\beta}_1^w$ are almost identical whether the control variables are included or excluded as should be the case given the random assignment of prices to the respondents. Nevertheless, control variables may still affect the willingness to purchase men's or women's basketball tickets if demand varies by demographic group or if past experiences in sports or family affiliation with the University. We reject the joint hypothesis that the coefficients on the controls equal zero in the male sample, but we fail to reject the joint hypothesis in the women's sample.[9] We opted to use the results from the regressions including the controls to avoid any potential biases from missing variables.[10]

---

[9] For men, χ^2_{34}= 54.13 with p-value 0.02, and for women, χ^2_{34} = 29.28 with p-value 0.70.

[10] When all controls were eliminated, the estimates of $\hat{\beta}_1^m$ and $\hat{\beta}_1^w$ were respectively, -0.072 and -0.156 in the male equation and -0.108 and -0.089 in the women's equation. All were within one standard deviation of our preferred estimates and none of our conclusions are sensitive to the exclusion of these controls.

We also tried a specification which included both the men's and women's basketball prices. Because the own prices were randomly assigned, the men's and women's prices are uncorrelated and so the estimates of $\hat{\beta}_1^m$ and $\hat{\beta}_1^w$ are almost identical. The women's basketball ticket price has a positive and significant effect on the likelihood of buying the men's ticket, suggesting that men's and women's basketball tickets are substitutes. However, the men's ticket price had an insignificant effect on the probability of buying a women's ticket. These results are presented in Table A1 of the Appendix.[11]

B. Correlation in unobserved demand for men's and women's basketball

For both men and women, the estimated correlation in the errors across the demand equations for men's and women's basketball, ρ, is positive and statistically significant. That implies that unmeasured attributes that increase the likelihood of purchasing a men's ticket also increase the likelihood of purchasing a women's ticket. The correlation is higher for men (0.59) than for women (0.46), but both are sufficiently large to support efforts to cross-market women's tickets to purchasers of men's basketball and vice versa. It is reasonable to presume that the error correlation is due to customers with an unobserved passion for basketball *per s*e, regardless of who is playing the sport.

C. Reservation prices

Given the estimates in Table 2, we use equation (6) to derive implicit estimates of the reservation prices, $\tilde{p}_i^m$ and $\tilde{p}_i^w$ for each individual. The nonparametric estimation of each probability density function is shown in Figure 3. There is considerable overlap in the reservation price distributions for men and women. For men's basketball tickets, the upper tail

[11] The model including cross-price effects yielded estimates of $\hat{\beta}_1^m$ and $\hat{\beta}_1^w$ that were respectively, -0.087 and -0.138 in the male equation and -0.138 and -0.073 in the women's equation. All were within one standard deviation of our preferred estimates and none of our conclusions are sensitive to the inclusion of cross price effects.

of the male distribution is to the right of the women's distribution. For women's basketball, the women's distribution lies to the right of the men's distribution. However, for both men and women, the median reservation price for men's basketball is well to the right of the median for women's basketball.

By drawing a sufficiently large number of deviates from the nonparametric distributions, we can calculate the values of the support that accumulate any given percentile of the probability mass. Tables 3 and 4 report the men's and women's basketball prices at various percentiles of the male and female reservation price distributions. At the median, the reservation price for men's basketball is modestly higher for men ($15.74) than for women ($13.93). For women's basketball tickets, women are willing to pay much more at the median ($10.18 versus $5.44)[12]. The estimated revenue maximizing prices by gender are consistent with the earlier results that men have more elastic demand for women's basketball and women have more inelastic demand for men's basketball.

The existence of large segments of the market with high reservation prices creates opportunities for price discrimination such as charging much higher prices for modest quality improvements (better seat location, better parking, invitations to coach's news conferences). As shown in Figure 3, 26% of men are willing to pay at least $20 for men's basketball tickets and 52% of women are willing to pay at least $10 for women's basketball. We use the term "at least" deliberately, as these groups have projected reservations prices outside the range of the pricing options we presented in the survey. None of the female customers have a predicted

[12] If we consider the model where we drop all individual characteristics, results are very close: for men's basketball, reservation prices for male and female students are $15.87 and $13.64 respectively, while for women's basketball, reservation prices are $5.59 and $10.35 for men and women respectively. It is important to note that in this case, we obtain a degenerate distribution for reservation prices, because the variability in the distribution comes from the observable characteristics of individuals; that is, the reservation price is now defined as $\tilde{p}_i^x = \hat{\beta}_0^x / \hat{\beta}_1^x$.

reservation price above $20 for men's basketball; and only 12% of men have are predicted to pay more than $10 for women's basketball.

None of the men or women required a negative price (effectively a subsidy) to attend men's basketball. However, 12% of men and 3% of the women have estimated reservation prices for men's basketball below $7, the lowest price option available in the survey. Consistent with these findings, only one-third of the men and one-sixth of the women with these extremely low predicted reservation prices had ever attended a men's basketball game. For women's basketball, 3.5% of men and 0.7% of women had negative estimated reservation prices. Of these, half the men and none of the women had ever attended a woman's game.

D. Relative preference for men's versus women's basketball

The reservation prices are used to estimate the d_i using equation (7). A nonparametric estimation of this distribution for men and women is shown in Figure 4; and by drawing a sufficiently large number of random values from this distribution we can calculate more accurate percentiles without imposing any priors on the distribution of the d_i. We report various percentiles between 10% and 90% in Table 5. We are particularly interested in the median value of this distribution denoted by d_{50}. At the median for both men and women, the estimate for d_i is positive, meaning the median customer has a higher reservation price for men's compared to women's basketball. The median man is willing to pay 180% more for a men's basketball ticket than for a women's basketball ticket, whereas the median woman is willing to pay 37% more for a men's basketball ticket than for a women's basketball ticket. [13]

[13] When the Z_i are excluded so that only random prices are used as explanatory variables, very similar results are obtained. At the median, men are willing to pay 184% more for men's basketball and women are willing to pay 32% more. When cross price effects are included also similar results are obtained: men and women are willing to pay more for men's basketball, 182% and 16% respectively.

As the percentiles in Table 5 demonstrate, there are positive values of d_i for almost the entire support for both men and women. Only 2.3% of the men and 11.8% of the women have a higher reservation price for women's than for men's basketball. While women are significantly more likely to prefer women's to men's basketball compared to men, the fraction of women who prefer women's basketball is nevertheless small. To generate a sufficiently large number of fans to women's basketball to make it self-sufficient, it is necessary to induce large numbers of fans to purchase women's tickets who have a preference for the men's game.

Because we have individual estimates for d_i, we can see which individual attributes are associated with atypically low values of d_i (i.e., relatively high willingness to pay for women's compared to men's basketball). One could argue that low value d_i fans should be given particular attention in marketing women's basketball. Low d_i men are atypically those who did not play sports in high school, do not play intramurals in college, were not Iowa State fans before attending college and had no relatives who attended Iowa State. The women with atypically strong tastes for the women's game are very different in that they played sports in high school, play intramurals in college, grew up in Iowa and were Iowa State fans as kids, and have relatives who attended the school. The one key similarity across the genders is the positive correlation in the unmeasured demand for basketball which suggests that one could potentially increase revenue by bundling men's and women's tickets rather than offering them in separate packages.

E. Estimating the available total surplus and revenue maximizing ticket price for men's and women's basketball

Given an estimated reservation price for each individual, we can estimate the fraction of the population that would purchase a ticket at any given price. This gives us the total revenue derived at each price. Tracing out the revenue yielded at each price, we can then identify the

revenue maximizing price for each sport. Results are shown in Figures 6 and 7. For men's basketball, male and female students yield similar maximizing prices ($12 and $11 respectively), and close to the actual prices charged at the moment ($13.50). However for women's basketball, maximizing prices differ greatly by gender: male students' maximizing price is $5 and female's is $9. The actual student price was $5.50.

Assuming that the marginal cost of adding a spectator equals zero (the game will be played regardless of whether there are spectators), total surplus in the market can be calculated as the area under the demand curve, or equivalently, the area to the left of the total revenue curves in Figures 6 and 7. The total surplus for one men's basketball game is $3,810 for our sample of male students and $3,101 for our sample of female students. Scaling up to the total undergraduate population,[14] these estimates suggest that if the university could perfectly price discriminate, it could raise $309 thousand per men's game. The corresponding total surplus for women's basketball is $1,323 for our male sample and $2,340 for our female sample. Scaling up, maximum revenue at a women's basketball game could be of $164 thousand if the university could perfectly price discriminate, or only 53% of the total surplus available for men's basketball.

Of course, the athletic department cannot capture the entire surplus by charging each customer his or her reservation price. The extent of their price discrimination ability is to charge different prices for men's and women's basketball. The actual price policy for men's basketball appropriates 58% of the total surplus or about $179 thousand per game. The actual price policy for women's basketball captures 47% of the total surplus or $77 thousand. The actual revenue maximizing prices implied by our estimates would generate $190 thousand for a men's basketball game and $81 thousand for a women's basketball game, implying that the athletic

[14] Our random sample is 2.2% of the total population.

department is extracting nearly as much surplus as it possibly can from student customers. Nevertheless, a women's game generates only 43% as much revenue as a men's game. Had the women's team not been as strong and the men's team been a power, presumably the difference in revenues would be even larger.

VI. CONCLUSIONS

This study applies the customer discrimination framework developed by Gary Becker to a marketing issue: How much are men and women willing to pay for men's and women's basketball? While the relative preference for men's versus women's basketball is not due to discriminatory preferences *per se*, given the differences in the sports, the framework proves very useful in characterizing the demand for the two sports for the same customer. In fact, this paper provides the first example that we know of that directly measures a reservation price for the same consumer of a comparable product provided by a 'favored' and 'unfavored' group.

We show that the correct reservation prices to use in Becker's coefficient are the ones that make the individual indifferent between buying and not buying a basketball ticket. Holding the predicted probability of purchase at 50%, we show that only 2% of the men and only 12% of the women have a higher willingness to pay for women's basketball relative to men's basketball. At the same time, 12% of the men and 3% of the women have a negative reservation price for women's basketball, meaning that they would require a subsidy to get them to attend a women's game. None of the 470 men and women has a negative reservation price for men's basketball.

The strong preference for men's basketball over women's basketball at a school where the women's team is more successful than the men's is a useful way to frame the challenge for making women's basketball self-sustaining. Our methodology allows us to estimate each potential customer's reservation prices for both men's and women's basketball. The implied

total surplus generated by men's basketball is almost 90% larger than that of women's basketball. Applying the constraint that the same price has to be charged to each customer, women's basketball can only generate 43% of the revenue of a men's basketball game. Television, sponsorships, alumni donations, and concessions would make the differences even greater. The difference in support is larger at most of the other 325 Division I schools, as indicated by the 3.3 to 1 advantage in average attendance at men's versus women's games.

How can a university increase its revenue from women's sports if it is already close to the revenue maximizing price? One possibility we identify is the large positive correlation in the error terms of the men's and women's basketball demand equations for both male and female customers. That implies that unobservable factors that increase the likelihood of buying a men's basketball ticket will also increase the likelihood of buying a women's basketball ticket. However, we also find evidence that men's and women's basketball are substitutes in general: reducing the price of one ticket will lower the demand for the other. Therefore, a strategy of raising demand for women's basketball by lowering its price will cost lost revenue from men's basketball, and vice versa. However, one can use revealed preference to identify customers with strong unobserved taste for basketball. When, for example, a customer buys a men's basketball ticket on line, offering a discount on women's tickets conditional on the men's ticket purchase could potentially increase women's basketball ticket sales.

REFERENCES

Bertrand, M. and S. Mullainathan. "Are Emily and Greg More Employable than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination." *American Economic Review,* **94**(Sept), 2004, 991-1013.

Black, S. E., and E. Brainerd. "Importing Equality? The Impact of Globalization on Gender Discrimination." *Industrial and Labor Relations Review*, **57**(July), 2004, 540-59.

Brown, R. W., and R. T. Jewell. "Race, revenues and college basketball", *The Review of Black Political Economy*, **23**(3), 1995, 75-90.

Cameron, T. "A New Paradigm for Valuing Non-market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression." *Journal of Environmental Economics and Management*, **15**(3), 1988, 355-79.

Charles, K. K., and J. Guryan. "Prejudice and Wages: An Empirical Assessment of Becker's The Economics of Discrimination." *Journal of Political Economy*, **116**(5), 2008, 773-809.

Dietz-Uhler, B., E. A. Harrick, C. End, L. Jacquemotte. "Sex Differences in Sport Fan Behavior and Reasons for Being a Sport Fan." *Journal of Sport Behavior*, **23**(3), 2000, 219-31.

DiNardo, and J., J. Tobias. "Nonparametric Density and Regression Estimation." *The Journal of Economic Perspectives*, **15**(4), 2001, 11-28.

Heckman, J. J. "Detecting Discrimination." *The Journal of Economic Perspectives*, **12**(Spring), 1998, 101-16.

Holzer, H. and K. R. Ihlanfeldt. "Customer Discrimination and Employment Outcomes for Minority Workers." *The Quarterly Journal of Economics*, **113**(August), 1998, 835-67.

Johnson, B. K., P. A. Groothuis, and J. C. Whitehead. The Value of Public Goods Generated by a Major League Team: The CVM Approach.'' *Journal of Sports Economics*, **2**(1), 2001, 6–21.

Johnson, B. K., M. J. Mondello, and J. C. Whitehead. "The Value of Public Goods Generated by a National Football League Team." *Journal of Sport Management*, **21**(1), 2007, 123–36.

Johnson, B. K., and J. C. Whitehead. "Value of Public Goods From Sports Stadiums: The CVM Approach." *Contemporary Economic Policy*, **18**(1), 2000, 48–58.

Johnson, B. K., J. C. Whitehead D. S. Mason, and G. J. Walker. "Willingness to pay for amateur sport and recreation programs." *Contemporary Economic Policy*, **25**(4), 2007, 553–64

Kahn, L. M. "Customer Discrimination and Affirmative Action." *Economic Inquiry*, **29**(3), 1991, 555-71.

Kahn, L. M., and M. Shah. "Race, Compensation and Contract Length in the NBA: 2001-2." *Industrial Relations*, **44**(3), 2005, 444-62.

Madrigal, R. "Cognitive and Affective Determinants of Fan Satisfaction with Sporting Event Attendance." *Journal of Leisure Research*, **27**(3), 1995, 205-27.

Mincy, R. B. The Urban Institute Audit Studies: Their Research and Policy Context. In *Clear and Convincing Evidence: Testing for Discrimination in America*. M. Fix and R. Struyk, eds. Washington, D.C.: Urban Institute Press, 1993

Nardinelli, C. and C. Simon. "Customer Racial Discrimination in the Market for Memorabilia: The Case of Baseball." *The Quarterly Journal of Economics*, **105**(August), 1990, 575-95.

Neumark, D., R. J. Bank, K. D. Van Nort. "Sex Discrimination in Restaurant Hiring: An Audit Study." *The Quarterly Journal of Economics*, **111**(3), 1996, 915-41.

Pan, D. W., J. A. W. Baker. "Mapping of Intercollegiate Sports Relative to Selected Attributes as Determined by a Product Differentiation Strategy." *Journal of Sport Behavior*, **22**(1), 1999, 69-82.

Pan, D. W., T. E. Gabert, E. C. Mcgaugh, S. E. Branvold. "Factors and Differential Demographic Effects on Purchases of Season Tickets for Intercollegiate Basketball Games." *Journal of Sport Behavior*, **20**(4), 1997, 447-64.

Pope, D. G. and J. R. Sydnor. "What's in a Picture? Evidence of Discrimination from Prosper.com." *The Journal of Human Resources*, **46**(1), 2011, 53-92.

Price, J. and J. Wolfers. "Racial Discrimination Among NBA Referees." *The Quarterly Journal of Economics*, **125**(4), 2010, 1859-87.

Yinger, J. "Evidence on Discrimination in Consumer Markets." *The Journal of Economic Perspectives*, **12**(Spring), 1998, 23-40.

Zimbalist, A.S. *Unpaid professionals: Commercialism and conflict in big-time college sports*: Princeton University Press, 1999

Table 1. Summary statistics.

Variable	Male Students		Female Students			Description
	Initial sample	Working sample	Initial sample	Working Sample		
B^w	-	0.510	-	0.661	D	= 1 if buys women's basketball ticket
B^m	-	0.568	-	0.485	D	= 1 if buys men's basketball ticket
P^w	-	5.440	-	5.718		Random price of women's basketball ticket offered
P^m	-	13.333	-	13.987		Random price of men's basketball ticket offered
Year	2.759	2.790	2.798	2.789	C	School year 1=freshman, 4=senior
Dorm	-	0.420	-	0.392	D	= 1 if lives in dormitory
Fraternity	-	0.111	-	0.066	D	= 1 if lives in fraternity
hi_sport	-	0.704	-	0.639	D	= 1 if played varsity sports in high school
isu_intra.	-	0.749	-	0.529	D	= 1 if plays intramurals in school
isu_family	-	0.416	-	0.383	D	= 1 if parents, grandparents or siblings attended ISU
isu_fan	-	0.403	-	0.441	D	= 1 if was a Cyclone fun before attending ISU
LAS	0.229	0.239	0.304	0.339	D	= 1 if college is Liberal Arts
ENG	0.323	0.387	0.065	0.062	D	= 1 if college is Engineering
HS	0.054	0.062	0.262	0.225	D	= 1 if college is Human Sciences
BUS	0.186	0.165	0.136	0.128	D	= 1 if college is Business
AG	0.123	0.078	0.123	0.123	D	= 1 if college is Agriculture
DES	0.085	0.070	0.110	0.123	D	= 1 if college is Design
White	0.829	0.893	0.858	0.912	D	= 1 if white
Black	0.034	0.025	0.026	0.018	D	= 1 if black
Asian	0.040	0.037	0.033	0.026	D	= 1 if Asian
Hisp.	0.022	0.012	0.024	0.009	D	= 1 if Hispanic
Oth_ethn.	0.075	0.033	0.059	0.035	D	= 1 if is from other ethnicity
Resident	0.754	0.737	0.770	0.718	D	= 1 if resident of Iowa
N	1154	243	846	227		

Notes: Values at the sample mean. D = dummy, C = categorical. ISU = Iowa State University

Table 2. Maximum likelihood estimation of seemingly unrelated bivariate probit equation (4).

	Male Students (n_m=243)		*Female Students (n_w=227)*	
	B^m *equation*	B^w *equation*	B^m *equation*	B^w *equation*
Constant	-0.196 (0.558)	0.019 (0.476)	1.951*** (0.545)	1.296*** (0.492)
P^m	-0.088*** (0.022)		-0.124*** (0.023)	
P^w		-0.153*** (0.03)		-0.108*** (0.033)
Year	0.184** (0.094)	-0.011 (0.094)	-0.074 (0.101)	-0.188* (0.102)
Dorm	0.203 (0.228)	0.051 (0.225)	-0.319 (0.239)	-0.169 (0.239)
Fraternity	-0.161 (0.309)	-0.143 (0.301)	0.162 (0.389)	-0.481 (0.38)
hi_sport	0.093 (0.212)	-0.109 (0.214)	0.023 (0.201)	0.186 (0.205)
isu_intra	0.497** (0.224)	0.271 (0.229)	0.201 (0.194)	0.356* (0.196)
isu_family	0.188 (0.197)	-0.034 (0.197)	-0.192 (0.225)	-0.016 (0.23)
isu_fan	0.598*** (0.202)	0.433** (0.200)	0.252 (0.230)	0.432* (0.235)
Resident	-0.124 (0.217)	0.432** (0.218)	-0.048 (0.232)	-0.095 (0.233)
ρ	0.587*** (0.091)		0.461*** (0.105)	
Log likelihood	-265.286		262.674	
Wald χ^2_{36}*(p-value)*	0.000		0.006	
Wald χ^2_{34}*(p-value)*	0.020		0.700	

Notes: Standard errors in parenthesis. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level. Regressions also include controls for college major and ethnicity.

Table 3. Percentiles of the nonparametric density functions, by gender

Reservation prices for men's basketball tickets. Equation (6)									
	p_{10}^{m}	p_{20}^{m}	p_{30}^{m}	p_{40}^{m}	p_{50}^{m}	p_{60}^{m}	p_{70}^{m}	p_{80}^{m}	p_{90}^{m}
Male	6.79	10.11	12.39	14.13	15.74	17.42	19.25	21.27	23.72
Female	10.40	11.80	12.66	13.33	13.93	14.52	15.14	15.82	16.74
Reservation prices for women's basketball tickets. Equation (6)									
	p_{10}^{w}	p_{20}^{w}	p_{30}^{w}	p_{40}^{w}	p_{50}^{w}	p_{60}^{w}	p_{70}^{w}	p_{80}^{w}	p_{90}^{w}
Male	1.36	2.60	3.62	4.54	5.44	6.34	7.26	8.45	10.46
Female	4.23	6.09	7.68	9.05	10.18	11.18	12.17	13.31	14.90
Coefficient of proportional preference for men's basketball. Equation (7)									
	d_{10}	d_{20}	d_{30}	d_{40}	d_{50}	d_{60}	d_{70}	d_{80}	d_{90}
Male	0.59	0.99	1.29	1.55	1.80	2.06	2.38	3.19	6.34
Female	-0.02	0.09	0.19	0.28	0.37	0.49	0.66	1.01	1.73

Notes: 1) Subindices indicate the percentile of the density's support. 2) For male students, d_{min}= -0.76 and d_{max}= 635.21; for female students, d_{min}= -0.27 and d_{max}= 13.51.

Figure 1: Student Demand for Men's Basketball Tickets, by Gender

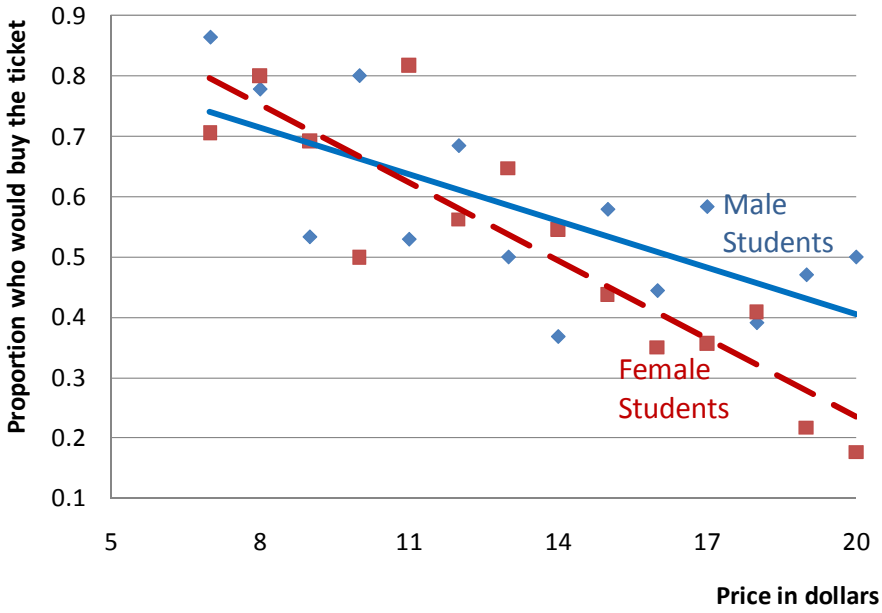


Figure 2: Student Demand for Women's Basketball Tickets, by Gender

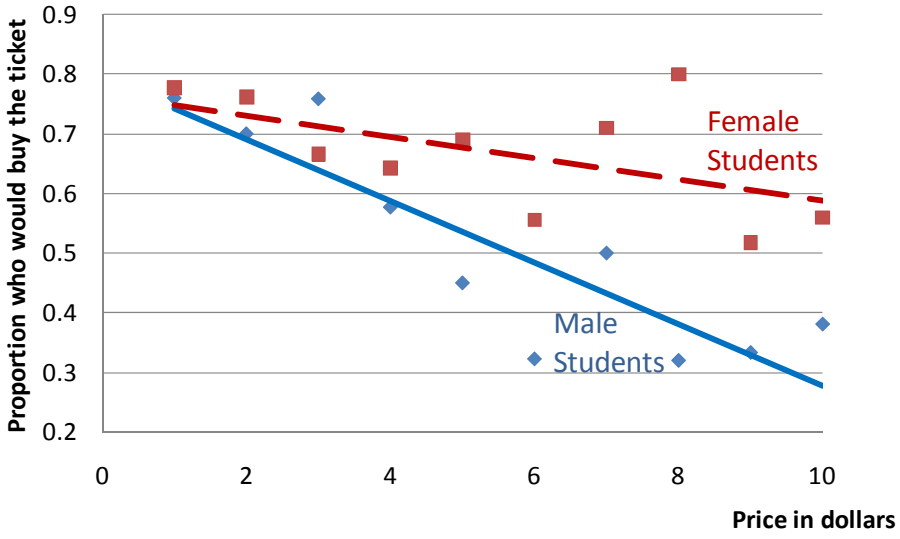
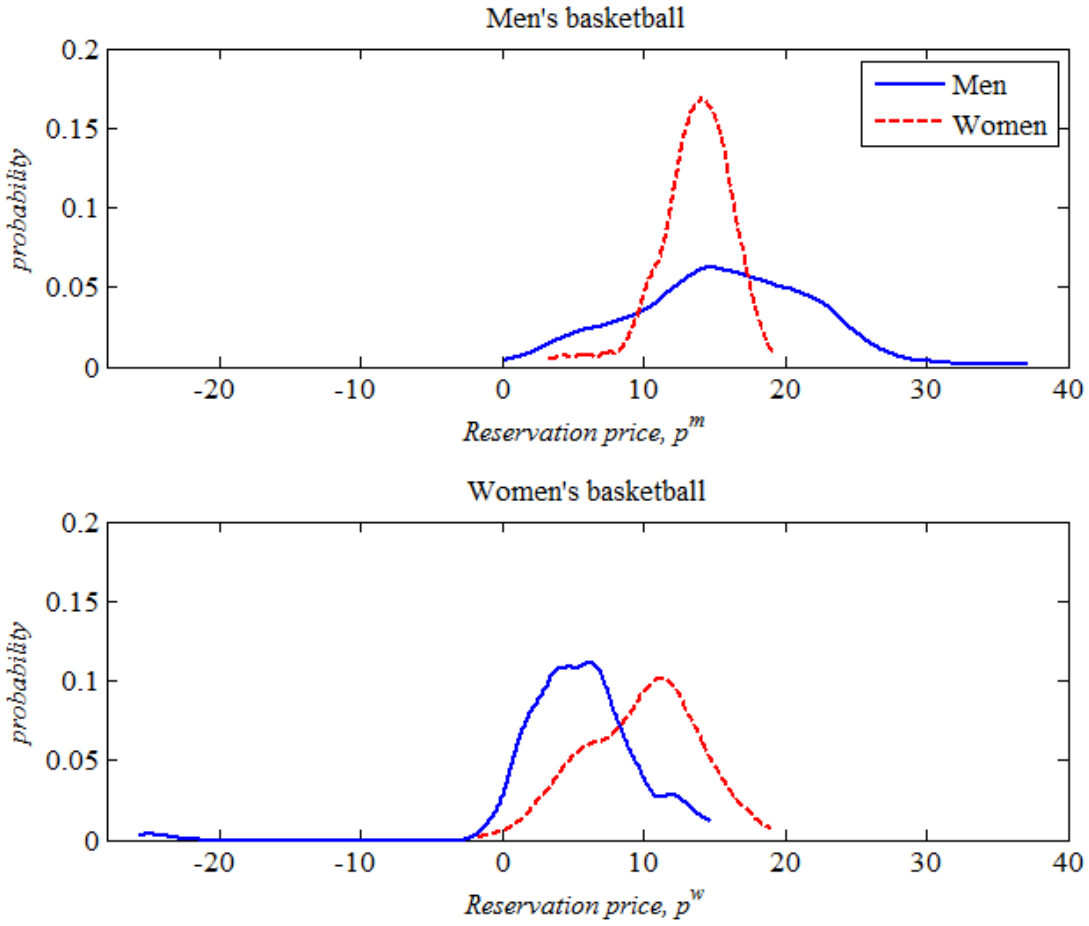
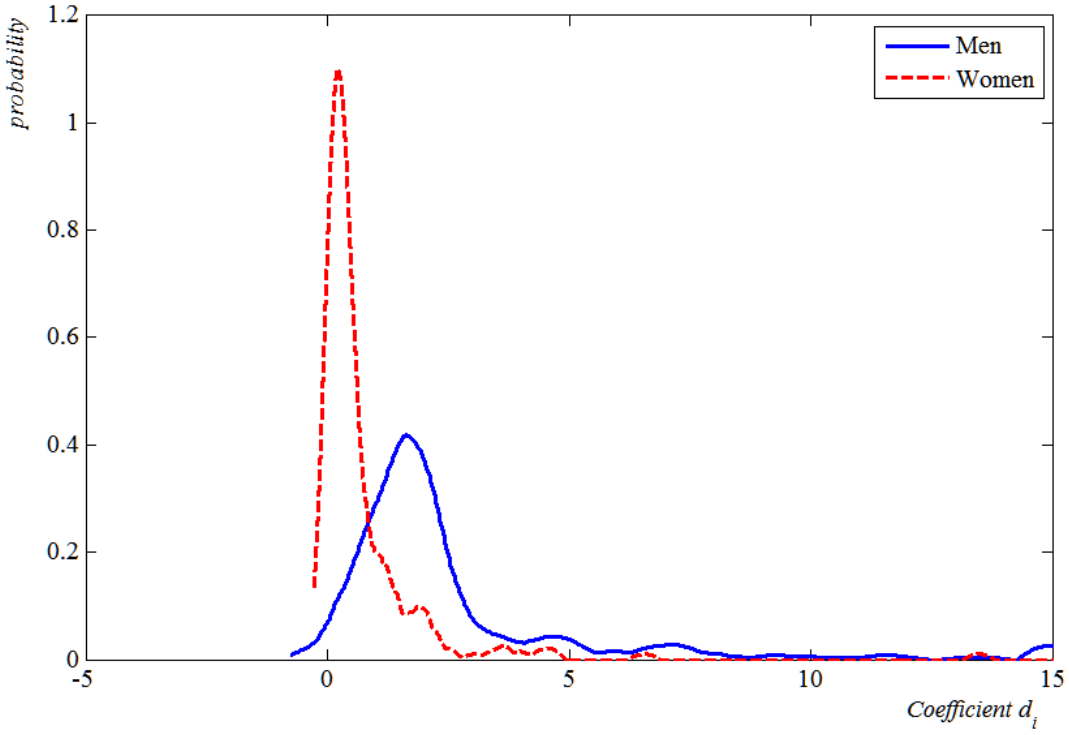


Figure 3. Nonparametric estimation of the probability density functions of the reservation prices for men's and women's basketball tickets, by gender



Note: Distributions estimated using Epanechnicov kernel density with bandwidth = $0.9\left(\min\left\{\hat{\sigma}, \frac{\varphi}{1.34}\right\}\right)N^{-1/5}$ where $\hat{\sigma}$ is the sample standard deviation; φ is the difference between the reservation prices at the 75th versus the 25th percentile, and N is the number of observed reservation prices. See DiNardo and Tobias (2001) for a description of the method.

Figure 4. Nonparametric estimation of probability density functions of the estimated Becker coefficient d_i , by gender.



Notes: d_i represents the relative preference for men's basketball versus women's basketball for each individual in the sample. Distributions estimated using Epanechnicov kernel density with bandwidth = $0.9\left(\min\left\{\hat{\sigma}, \frac{\varphi}{1.34}\right\}\right)N^{-1/5}$ where $\hat{\sigma}$ is the sample standard deviation; φ is the difference between the predicted d_i at the 75th versus the 25th percentile, and N is the number of observed Becker coefficients. See DiNardo and Tobias (2001) for a description of the method.

Figure 5. Revenue generated per capita by men's basketball ticket price and gender of customer base.

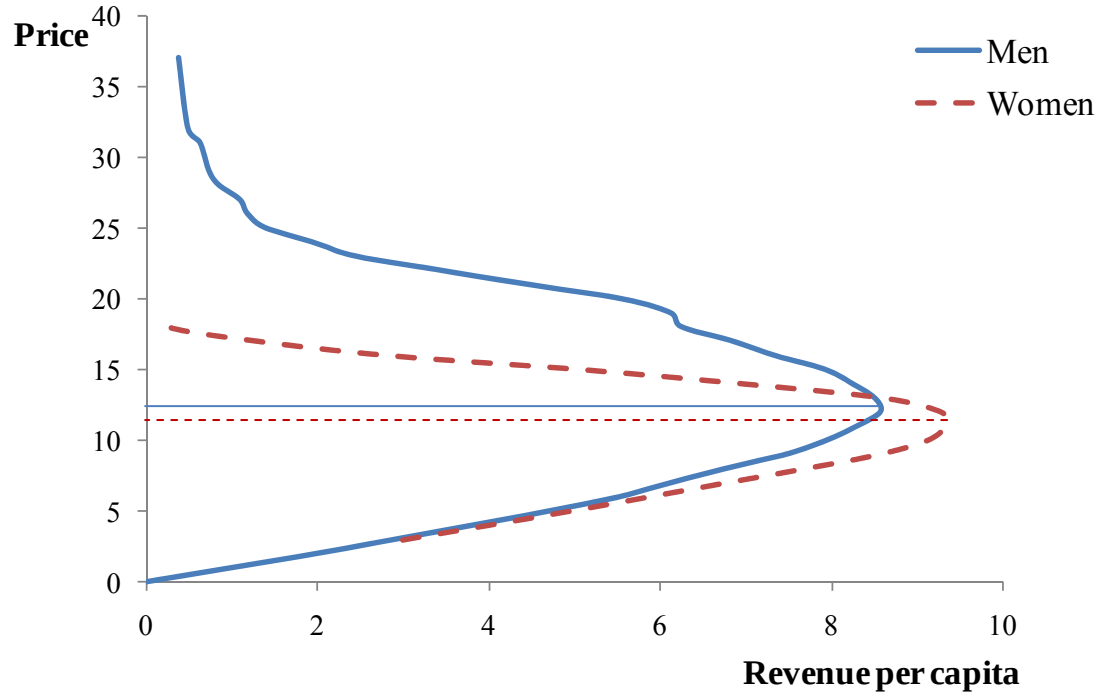
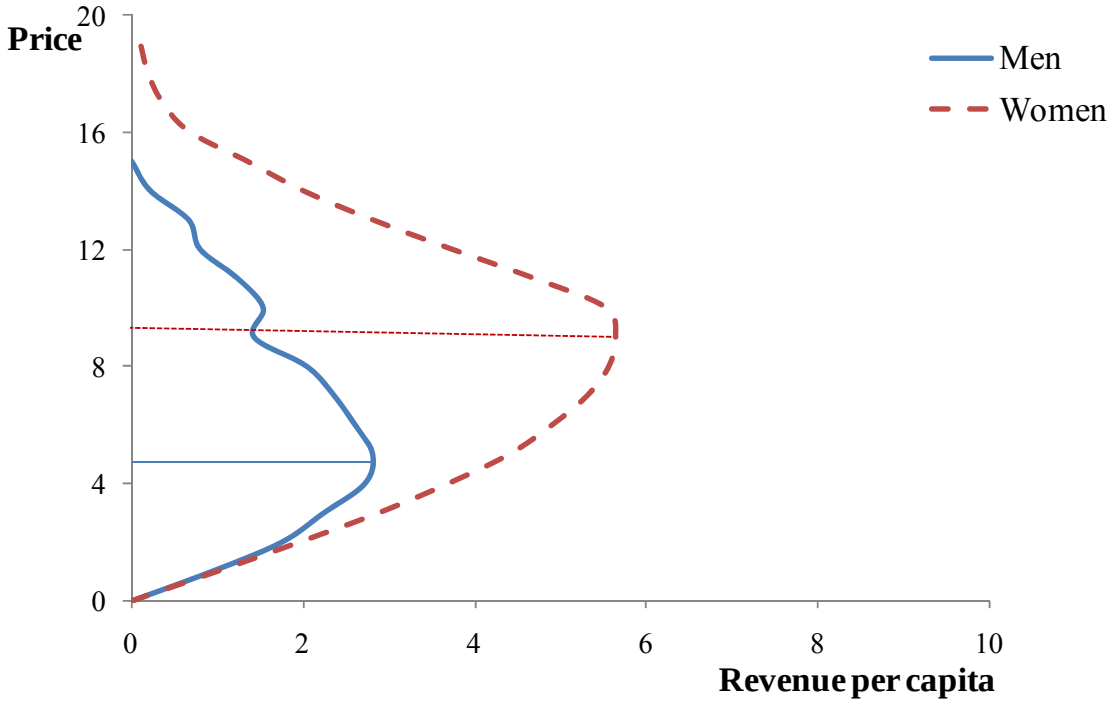


Figure 6. Revenue generated per capita by women's basketball ticket price and gender of consumer base.



APPENDIX A

We will prove that the choice of 0.50 probability of purchasing a ticket yield predicted or reservation prices ($\tilde{p}_i^m$ and $\tilde{p}_i^w$) that are mathematically equal to the willingness to pay (W_i^m and W_i^w) calculated following a contingent valuation approach.

Following Cameron (1988) we can use the contingent valuation approach to directly find the willingness to pay for each sport and for each individual. Suppose that the willingness to pay for a men's college-basketball ticket (W_i^{m*}) and a women's college-basketball ticket (W_i^{w*}) can be represented by the following system of latent variables:

$$\begin{aligned} W_i^{m*} &= \alpha_0^m + Z_i\gamma^m - \varepsilon_i^m \\ W_i^{w*} &= \alpha_0^w + Z_i\gamma^w - \varepsilon_i^w \end{aligned} \tag{A1}$$

where α_0^x and γ^x, x=$\{m,w\}$, are parameters to be estimated, Z_i is a vector of observed individual characteristics and ε_i^x is an error term jointly normal distributed representing unobservable factors:

$$\begin{pmatrix} \varepsilon_i^m \\ \varepsilon_i^w \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^{2\,m} & \rho\sigma^m\sigma^w \\ \rho\sigma^m\sigma^w & \sigma^{2\,w} \end{pmatrix}\right] \tag{A2}$$

But instead of observing the latent variable, we observe a pair binary variables, B_i^m and B_i^w, such that

$$\begin{aligned} B_i^m &= \begin{cases} 1 & if\ W_i^{m*} > P_i^m \\ 0 & if\ W_i^{w*} \le P_i^m \end{cases} \\ B_i^w &= \begin{cases} 1 & if\ W_i^{m*} > P_i^w \\ 0 & if\ W_i^{w*} \le P_i^w \end{cases} \end{aligned} \tag{A3}$$

where B_i^m and B_i^w are the dummy variables that equal 1 if individual *i* purchases the ticket at the offered random price and zero otherwise; P_i^m and P_i^w are the random prices offered to each individual for men's basketball and women's basketball tickets respectively.

By plugging equation (A1) into (A3) we obtain

$$\begin{aligned} B_i^m &= \begin{cases} 1 & if\ \ \varepsilon_i^m < \alpha_0^m - P_i^m + Z_i\gamma^m \\ 0 & if\ \ \varepsilon_i^m \ge \alpha_0^m - P_i^m + Z_i\gamma^m \end{cases} \\ B_i^w &= \begin{cases} 1 & if\ \ \varepsilon_i^w < \alpha_0^w - P_i^w + Z_i\gamma^w \\ 0 & if\ \ \varepsilon_i^w \ge \alpha_0^w - P_i^w + Z_i\gamma^w \end{cases} \end{aligned} \tag{A4}$$

This constitutes a bivariate probit model; we use maximum likelihood procedures to estimate parameters α_0^x, γ^x, σ^x, and ρ, $x = \{m,w\}$, given our data on the binary variables B_i^m and B_i^w, on the random prices P_i^m and P_i^w, on Z_i and our assumption on error terms. Note that in this model it is required to have a different price offered to each individual in order to identify all the parameters we want to estimate. Manipulating this expression and calculating the joint probabilities Pr[B_i^m=1, B_i^w=1], Pr[B_i^m=1, B_i^w=0], Pr[B_i^m=0, B_i^w=1], Pr[B_i^m=0, B_i^w=0], we obtain the following log-likelihood function

$$L\left(B_i^m, B_i^w / P_i^m, P_i^w, Z_i, \alpha_0^m, \alpha_0^w, \gamma^m, \gamma^w, \sigma^m, \sigma^w, \rho\right) = \tag{A5}$$

$$\sum_{i=1}^{i=n} \log\left\{\Phi_2\left[q_i^m\left(\frac{\alpha_0^m}{\sigma^m} - \frac{1}{\sigma^m}P_i^m + Z_i\frac{\gamma'^m}{\sigma^m}\right), q_i^w\left(\frac{\alpha_0^w}{\sigma^w} - \frac{1}{\sigma^w}P_i^w + Z_i\frac{\gamma'^w}{\sigma^w}\right), q_i^m q_i^w \rho\right]\right\}$$

where Φ_2 is the bivariate standard normal cumulative distribution function, $q_i^m = 2B_i^m - 1$ and $q_i^w = 2B_i^w - 1$. The fact that each individual is offered a different random price allows us to identify the coefficient of P_i^m and P_i^w, which turns out to be the negative reciprocal of the standard deviation of the disturbances distributed jointly normal by assumption. If we define, for $x = \{m,w\}$,

$$\tilde{\alpha}_0^x = \frac{\alpha_0^x}{\sigma^x}$$

$$\tilde{\alpha}_1^x = -\frac{1}{\sigma^x} \tag{A6}$$

$$\tilde{\gamma}'^x = \frac{\gamma'^x}{\sigma^x}$$

and rearrange terms, the likelihood in (A5) can be written as

$$L\left(B_i^m, B_i^w / P_i^m, P_i^w, Z_i, \tilde{\boldsymbol{\alpha}}^m, \tilde{\boldsymbol{\alpha}}^w, \tilde{\gamma}^m, \tilde{\gamma}^w, \rho\right) = \tag{A7}$$

$$\sum_{i=1}^{i=n} \log\left\{\Phi_2\left[q_i^m\left(\tilde{\alpha}_0^m + \tilde{\alpha}_1^m P_i^m + Z_i\tilde{\gamma}'^m\right), q_i^w\left(\tilde{\alpha}_0^w + \tilde{\alpha}_1^w P_i^w + Z_i\tilde{\gamma}'^w\right), q_i^m q_i^w \rho\right]\right\}$$

which is the same likelihood function obtained in equation (4). Therefore our estimates of α_0^x and γ'^x, for $x = \{m,w\}$, can be transformed according to (A6) to yield the same estimates obtained from the likelihood of (4).

Now, suppose that we calculate the model in (A.1) with the estimated parameters, yielding the following estimated willingness to pay for men's and women's basketball for individual *i*:

$$\breve{W}_i^m = \breve{\alpha}_0^m + Z_i\breve{\gamma}^m$$

$$\breve{W}_i^w = \breve{\alpha}_0^w + Z_i\breve{\gamma}^w \tag{A8}$$

where "ˇ"denotes the estimated parameters using the contingent valuation approach. We need to show that the reservation prices $\tilde{p}_i^m$ and $\tilde{p}_i^w$ have a similar form as (A8).

Given that the likelihood in (A7) is the same as the likelihood in (4) we can argue, for $x = \{m,w\}$, the following

$$\widetilde{\tilde{\alpha}_0^x} = \frac{\check{\alpha}_0^x}{\check{\sigma}^x} = \hat{\beta}_0^x \tag{A9.a}$$

$$\widetilde{\tilde{\alpha}_1^x} = -\frac{1}{\check{\sigma}^x} = \hat{\beta}_1^x \tag{A9.b}$$

$$\widetilde{\tilde{\gamma}^x} = \frac{\check{\gamma}^{,x}}{\check{\sigma}^x} = \hat{\delta}^{,x} \tag{A9.c}$$

that is, the estimated transformed parameters in (A9) are equal to the estimated parameters yielded by likelihood in (4).

According to equation (6) the reservation prices at the 50% probability of purchasing a ticket implicitly solve the following equation:

$$\begin{aligned} \hat{\beta}_0^m + \hat{\beta}_1^m \tilde{p}_i^m + Z_i \hat{\delta}^m = 0 \\ \hat{\beta}_0^w + \hat{\beta}_1^w \tilde{p}_i^w + Z_i \hat{\delta}^w = 0 \end{aligned} \tag{A10}$$

Solving for $\tilde{p}_i^m$ and $\tilde{p}_i^w$ we obtain

$$\begin{aligned} \tilde{p}_i^m = -\frac{1}{\hat{\beta}_1^m}(\hat{\beta}_0^m + Z_i \hat{\delta}^m) \\ \tilde{p}_i^w = -\frac{1}{\hat{\beta}_1^w}(\hat{\beta}_0^w + Z_i \hat{\delta}^w) \end{aligned} \tag{A11}$$

or

$$\begin{aligned} \tilde{p}_i^m = \left(-\frac{\hat{\beta}_0^m}{\hat{\beta}_1^m}\right) + Z_i \left(-\frac{\hat{\delta}^m}{\hat{\beta}_1^m}\right) \\ \tilde{p}_i^w = \left(-\frac{\hat{\beta}_0^w}{\hat{\beta}_1^w}\right) + Z_i \left(-\frac{\hat{\delta}^w}{\hat{\beta}_1^w}\right) \end{aligned} \tag{A12}$$

Substituting (A9.b) into (A12) we obtain

$$\begin{aligned} \tilde{p}_i^m = \left(\check{\sigma}^m \hat{\beta}_0^m\right) + Z_i \left(\check{\sigma}^m \, \hat{\delta}^m\right) \\ \tilde{p}_i^w = \left(\check{\sigma}^w \hat{\beta}_0^w\right) + Z_i \left(\check{\sigma}^w \, \hat{\delta}^w\right) \end{aligned} \tag{A13}$$

Finally plugging (A9.a) and (A9.c) into (A13) we get our desired result, which completes the proof:

$$\tilde{p}_i^m = \check{\alpha}_0^m + Z_i\check{\gamma}^m$$
$$\tilde{p}_i^w = \check{\alpha}_0^w + Z_i\check{\gamma}^w \quad \text{(A14)}$$

Even though we can show that the correct probability of purchase to use in the analysis is 0.5, our conclusions are not sensitive to that choice. Because purchase probability is monotonic in price, both reservation price series decrease in purchase probability (Figure A1). In addition, measures of the discrimination coefficient also increase for both men and women in similar fashion as probability of purchase increases (Figure A2), and so our conclusions regarding relative strength of demand for men's to women's basketball for men and women remain unaffected by choice of purchase probability.

Figure A1. Median reservation prices for men's and women's basketball at different estimated probability of purchase.

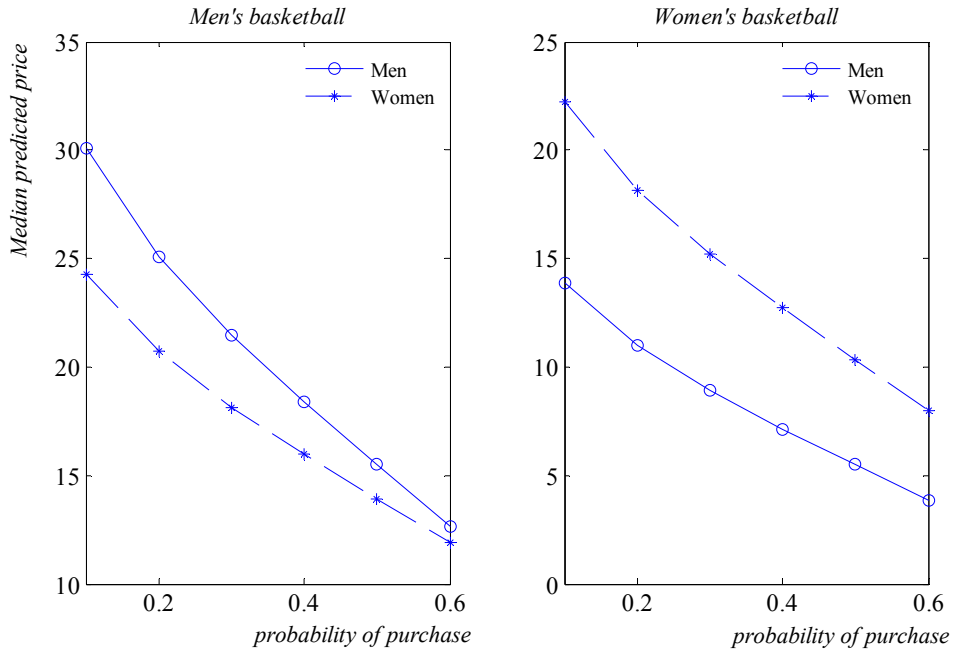


Figure A2. Median values of d_i for men and women at different estimated probability of purchase.

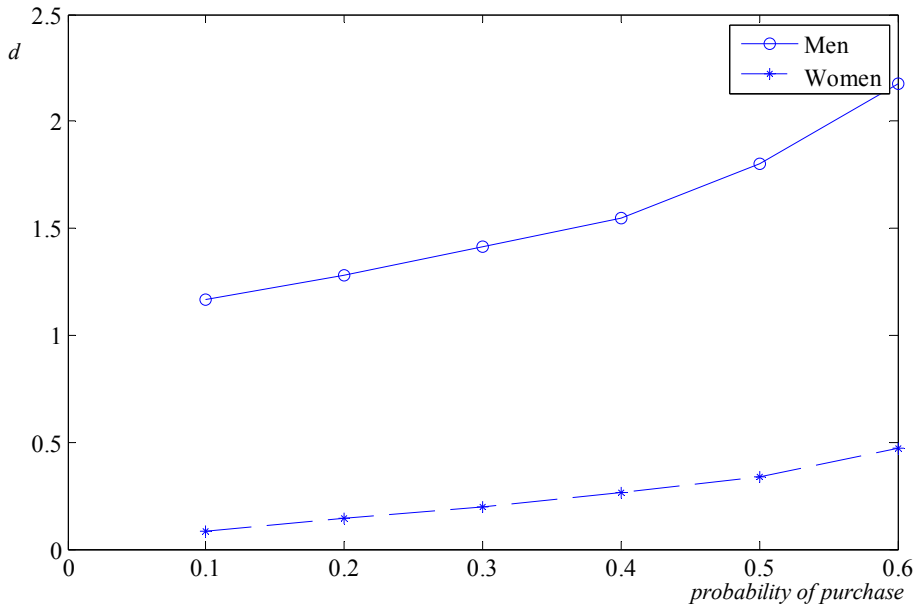


Table A1. Maximum likelihood estimation of seemingly unrelated bivariate probit with cross price effects included.

	Male Students (n_m=243)		*Female Students (n_w=227)*	
	B^m *equation*	B^w *equation*	B^m *equation*	B^w *equation*
Constant	-0.440	-0.074	1.352**	1.231**
	(0.596)	(0.587)	(0.585)	(0.588)
P^m	-0.087***	0.002	-0.138***	-0.010
	(0.023)	(0.023)	(0.025)	(0.023)
P^w	0.046	-0.138***	0.137***	-0.073**
	(0.032)	(0.032)	(0.034)	(0.033)
Year	0.183*	-0.014	-0.049	-0.180*
	(0.094)	(0.094)	(0.104)	(0.102)
Dorm	0.189	0.046	-0.309	-0.169
	(0.228)	(0.225)	(0.248)	(0.241)
Fraternity	-0.168	-0.140	0.290	-0.448
	(0.310)	(0.301)	(0.394)	(0.381)
hi_sport	0.087	-0.111	-0.067	0.169
	(0.214)	(0.214)	(0.208)	(0.206)
isu_intra.	0.473**	0.260	0.180	0.355*
	(0.225)	(0.229)	(0.199)	(0.197)
isu_family	0.173	-0.041	-0.074	0.010
	(0.197)	(0.198)	(0.233)	(0.232)
isu_fan	0.616***	0.438**	0.147	0.401*
	(0.203)	(0.200)	(0.237)	(0.236)
Resident	-0.115	0.439**	-0.124	-0.108
	(0.218)	(0.220)	(0.240)	(0.233)
ρ	0.588***		0.461***	
	(0.091)		(0.103)	
Log likelihood	-265.286		262.674	
Wald χ^2_{38}*(p-value)*	0.000		0.001	

Notes: Standard errors in parenthesis. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level. Regressions also include controls for college major and ethnicity.

Table A2. Comparison of three proposed model specifications. Maximum likelihood estimation of seemingly unrelated bivariate probit.

	Men (n_m=243)		*Women (n_w=227)*	
	B^m *equation*	B^w *equation*	B^m *equation*	B^w *equation*
Model without cross price effect and with individual characteristics.				
P^m	-0.088***		-0.124***	
	(0.022)		(0.023)	
P^w		-0.153***		-0.108***
		(0.03)		(0.033)
ρ	0.587***		0.461***	
	(0.091)		(0.105)	
Model with cross price effects and with individual characteristics				
P^m	-0.087***	0.002	-0.138***	-0.010
	(0.023)	(0.023)	(0.025)	(0.023)
P^w	0.046	-0.138***	0.137***	-0.073**
	(0.032)	(0.032)	(0.034)	(0.033)
ρ	0.588***		0.461***	
	(0.091)		(0.103)	
Model without cross price effects and without individual characteristics				
P^m	-0.072***		-0.108***	
	(0.019)		(0.020)	
P^w		-0.156***		-0.089***
		(0.028)		(0.030)
ρ	0.624***		0.478***	
	(0.078)		(0.097)	

Notes: Standard errors in parenthesis. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.