# **DISCUSSION PAPERS IN ECONOMICS**

Working Paper No. 02-20

# Modeling and Estimating Preferences Over Treatment Programs for Depression

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October 2002

## **Center for Economic Analysis**

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# Modeling and Estimating Preferences Over Treatment Programs for Depression

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October 28, 2002

#### Abstract

Choice questions are used to estimate preferences over treatment programs for depression as a function of individual characteristics such as age, income, gender and current level of depression. Each choice pair presents the respondent with two treatment options that vary in terms of their effectiveness, money costs, time costs, use of psychotherapy, use of anti-depressants and side effects. After the individuals chooses their preferred alternative, they are asked whether their preferred treatment option is preferred to remaining depressed. Each respondent was presented with 5 choice pairs. The data is used to estimate 3 random-utility models. Preliminary findings include: (1) The value of consuming market goods is less when one is depressed. This drives a wedge between willingness-to-pay, WTP, to eliminate one's depression and willingness-to-accept, WTA, it. (2) WTP to avoid sexual and weight-gain side effects can be high but varies extensively across individuals as a function of observable characteristics. (3) At sufficiently high costs in terms of money and side effects, some individuals will prefer to remain depressed.

Depression makes people worse off, as do the side effects associated with using anti-depressants. Depression treatment can also involve substantial money and time costs. A discrete-choice randomutility framework is used to model and estimate preferences over treatment programs for depression as a function of the characteristics of the treatment program and characteristics of the individual. Characteristics of treatment include effectiveness, money cost, time cost, use of psychotherapy, use of anti-depressants, and sexual and weight-gain side effects. How an individual trades off these treatment characteristics, including cost, is modeled as a function of severity of depression, income, age, gender, and previous experience with side effects. Issues investigated include: (1) the extent to which the value of market goods is affected by one's level of depression; (2) income effects; (3) willingness-to pay (WTP) to eliminate or reduce depression versus willingness-to-accept (WTA) it; and (4) WTP to avoid side effects. Preliminary findings include: (1) The value of consuming market goods is less when one is depressed. This drives a wedge between WTP to eliminate one's depression and WTA. (2) WTPto avoid sexual and weight-gain side effects can be high but varies extensively across individuals as a function of observable characteristics. (3) At sufficiently high costs in terms of money and side effects, some individuals will prefer to remain depressed.

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The data used to estimate the models come from a choice question survey administered to depressed patients at a mental health facility in Colorado.<sup>1</sup> A choice question asks an individual to choose her preferred alternative from some discrete number of alternatives, each described in terms of the levels of a common and finite site of characteristics. Figure 1 is an example choice question.

If you had to choose, would you prefer Alternative A or

Alternative B?

	Alternative A	Alternative B	
Effectiveness	Not Depressed	Not Depressed	
Hours of psychotherapy per month	6 hours	4 hours	
Use of anti-depressants	Yes	Y es	
Your monthly cost for treatment	\$300	\$300	
Weight gain from treatment	None	5% weight gain	
Little or no interest in sex	No side effect	No side effect	
Inability to achieve an orgasm	No side effect	No side effect	
Check the box of the alternative you <sup>—</sup> prefer	•		
	I prefer Alternative A	I prefer Alternative B	
g If you had to choose, would you prefer the alternative you chose			

If you had to choose, would you prefer the alternative you chose in question 8 or would you prefer to receive no treatment and stay at your current level of depression? *Check the appropriate box.* 

 1
 I prefer the alternative that I chose in question 8, including the costs and side effects, to my current condition

 2
 I prefer to receive no treatment and stay at my current level of depression

Figure 1: Example Choice Question

In this study, the individual is presented with five pairs of treatment programs and chooses her preferred alternative in each pair. Each treatment is described in terms of its money cost, hours of psychotherapy, use of anti-depressants, and side effects experienced if the treatment includes antidepressants. The three side effects considered are loss of sex drive, becoming non orgasmic, and extent of weight gain. After each choice pair, the individual is asked to indicate whether she prefers the chosen alternative with its costs and side effects to remaining depressed and untreated.

Choice questions have recently been used to estimate preferences for programs to treat physical illnesses.<sup>2</sup> This paper is, to our knowledge, the first application to design choice questions and use the

<sup>&</sup>lt;sup>1</sup>The terms *choice questions* and *choice experiments* are used interchangeably in the literature. There is an extensive literature on the theory and application of choice questions in marketing, transportation and economics. Wittink and Cattin (1989) survey the commercial use of choice questions; use is widespread. For survey articles see Louviere (1988 and 1992), Green and Srinivasan (1990), and Batsell and Louviere (1991), and Adamowicz et al (1998). Hensher (1994) provides an overview of choice questions as they have been applied in transportation. Louviere (1994) does the same for marketing. Choice questions are increasingly used to estimate the value of public and environmental goods. See, Adamowicz et al. (1994, 1996, 1997), Breffle et al. (2002), Layton and Brown (2000), Magat et al (1988), Morey, Buchanan and Waldman (2002), Morey, Rossmann, Chestnut and Ragland (2002), Viscusi et al. (1991), and Mathews et al. (1997).

 $<sup>^{2}</sup>$ Choice experiments have been used to examine patient treatment preferences over: asthma symptoms (McKenzie et

responses to value, in dollars, treatment programs for depression.

Responses to choice questions are *stated-preference* data (SP data) in contrast to *revealed preference* data (RP data). RP data consists of observed behavior and choices that can be used to infer values. SP data are statements about the respondents' preferences. Existing RP data has limited capabilities to estimate preferences over health treatment programs. Reasons include: the widespread presence of insurance within the US and universal health care systems outside the US, which obscures the supply demand relationship; much of the decision-making is done by the clinician; and the non-participation of certain populations in the health care market (Johnson et al, 2000). For these reasons, market prices are unobserved or do not reflect the full values of the services. In addition, since the researcher cannot control the independent variables in a revealed preference study, the researcher may be unable to determine the relative importance of variables because of correlations.<sup>3</sup> SP studies, such as choice questions, allow the researcher to control the independent variables. By using a choice question survey, individuals make choices over attributes with varying levels, such as presence of side effects, costs, and effectiveness. This allows estimation of the value of each attribute as well as the marginal rate of substitution between attributes. Because the levels vary in choice questions, it is possible to calculate WTP for multiple scenarios, including scenarios that were not presented to individuals. (Morikawa et al, 1990).

While choice questions have not been used in a random-utility framework to value treatment programs for depression, preferences over emotional states and preferences over treatment programs for depression have been researched. Some studies have used a limited choice question format. These studies were not based on a random utility model. A few studies have estimated how mental illness affects quality of life (utility level). The impact of depression on quality of life has been examined by Wells and Sherbourne (1999), Bennett et al (2000), Lenert et al (2000), Dwight-Johnson et al (2000), O'Brien et al (1995), and Revicki and Wood (1998). Bipolar disorder has been examined by Tsevat et al (2000); schizophrenia by Revicki et al (1996), Patterson (1999) and anxiety by Patrick et al (1998). In these studies, the quality of life in different emotional states is estimated using a rating scale, a *Standard Gamble* (SG) estimate, or a *Time-Trade-Off* (TTO), estimate.<sup>4</sup> The data to estimate these measures al, 2001); miscarriage management (Ryan and Hughes, 1997); the diagnosis and treatment of severe knee injuries (Bryan et al, 1998; Bryan et al, 2000); health states involving respiratory and cardiovascular illnesses (Johnson et al, 2000); wait time for treatment (Propper, 1990); cervical cancer screening (Ryan and Wordsworth, 2000); health state preferences (Hakim and Pathak, 1999); the location of surgery facilities (Ryan et al, 2000); rheumatology care (Ryan and Bate, 2001); treatment of menorrhagia (San Miguel et al, 2000).

Methodological issues examined include: sensitivity of WTP estimates to attribute levels (Ryan and Wordsworth, 2000), inter-temporal health preferences (van der Pol and Cairns, 2001); assumptions of rationality; symmetry, and continuity (Ryan and Bate, 2001); reliability of estimates (Bryan et al, 2000); application of choice experiments to developing priorities for the future development of clinical services (Farrar et al, 1999); attribute ordering and the assumption that utility is linear in the attributes (McKenzie et al, 2001); ordering of choice questions (Ryan et al, 1998); and comparison with other scaling methods (Hakim and Pathak, 1999).

 $^{3}$ See Mortimer (1997) for a study that uses a revealed preference approach to examine demand for anti-depressants.

<sup>4</sup>The rating scale is simply a visual numerated line with well-defined endpoints (typically death and perfect health) on which individuals are asked to place specific health states (Green et al, 2000). With the rating scale, the measure is the health state's score on the scale. An SG score is estimated by asking individuals to choose between a given health state (less than ideal) and a gamble where the gamble has two possible outcomes: full health or death. The probabilities

are the answers to SP questions. The SG estimate is obtained using answers to probabilistic choice questions while the TTP estimate is obtained by directly soliciting how many lifeyears individuals are WTP in return for a better quality of life. Wells et al (1999) use SG and TTO to calculate utility levels for depression and other chronic diseases for almost 18,000 Health Maintenance Organization (HMO) patients. They find that individuals rank depression as having a lower utility level than other chronic diseases. Bennett et al (2000) examine utility levels for four states: current state and untreated mild, moderate, and severe depression. In comparing their results to previous studies, they found that their study obtains similar utility scores for mild depression as that for kidney dialysis. In addition the utility level associated with moderate depression was lower than that for being "blind, deaf, or dumb". Neither study examines individuals' preferences over depression treatment programs.

Several papers examine preferences over depression treatment programs. Revicki and Wood (1998) examine patient utilities for twelve possible health states that vary by depression severity and three anti-depressants: nefazodone, fluoxetine, and imipramine. Since the study associates each medication with its most common side effect, the health states essentially vary in depression level and side-effects. A SG technique is used to assign utility levels to the different states. They sample from a primary care patient population that had received at least eight weeks of anti-depressant treatment for major depression or dysthymia. Utilities are obtained using the SG technique. The lowest average utility score is for the case of severe, untreated depression. For example, severe depression is regarded as worse than being moderately depressed through the use of imipramine and occasionally experiencing the following side effects: dry mouth, dizziness and lightheadedness, lethargy, daytime drowsiness, blurry vision, constipation, jitteriness, weight gain, and rapid heartbeat. Twenty five percent of patients value severe depression as worse or equal to death. Statistically significant differences are found between moderate and mild depression. No significant differences in health utility levels are found based on gender, age, marital status, or education level. Statistically significant differences are found based on current depression severity. More severely depressed individuals provide a lower utility score for eliminating depression. Differences are found between hypothetical health states that differ only in the type of side effects. Patients who report current side effects have lower utility scores for their current health state than individuals who are not experiencing any side effects.

O'Brien et al (1995) uses a contingent valuation survey to determine the value of a new antidepressant, moclobemide, relative to that of tricyclic anti-depressants (TCAs), an older type of antidepressant. The two anti-depressants have similar efficacy but moclobemide has fewer side effects. The study samples 95 individuals with mild to moderate depression who took TCAs in the previous year. The side effects studied are blurred vision, tremor, sleepiness, dizziness, constipation, sweating, and dry mouth. Individuals are presented with the probability of each side effect occurring under the two different types of drugs. They are then asked if they would take the new drug rather than the old drug if it was available at the same cost and the maximum amount that they would be willing to pay to have associated with the two outcomes are varied across the respondents. The SG score is the probability where individuals are indifferent between the certain and uncertain states. The TTO method compares a health state with perfect health and asks how many fewer years one would be willing to live to experience perfect health rather than the described state. this new drug. This procedure is repeated for each side effect. The occurrence of multiple side effects at the same time is not considered. A lower and upper bound for WTP for multiple risk reduction is estimated. The upper bound is calculated as the average over all respondents of the sum of the WTP for each individual side effect. The lower bound on WTP is calculated by identifying for each individual the side effect over which she had the greatest WTP and then averaging over all individuals. On average, individuals were willing to pay the most (\$Can21.9 per month) to reduce the risk of blurred vision by 5% and the lowest (\$Can11.4 per month) to reduce the risk of dry mouth by 25%.

Dwight-Johnson et al (2000) find that preferences for depression treatment vary by ethnicity, gender, income, and knowledge about treatment options. Primary care patients who are screened for current depressive symptoms are asked to choose between five possible treatment programs, with one choice being no treatment. The treatment programs vary by cost, number of months spent in treatment, probability of cure, type of treatment, and presence of nausea/headache. All respondents choose over these five treatment plans. Eighty-three percent of participants prefer some type of active treatment. Individuals who prefer treatment tend to be wealthier, have more knowledge about anti-depressants, have a higher probability of also having an anxiety disorder, and tend to have been treated recently. Women, African-Americans, respondents with greater knowledge about counseling, or those without recent antidepressant treatment are more likely to prefer counseling to anti-depressants. Of those respondents who have received counseling in the past six months, those who prefer counseling as their treatment method are more knowledgable about counseling, are less concerned about the stigma associated with depression treatment, are less likely to have recently received treatment with anti-depressants, and are less likely to have young children at home. Individuals who do not receive paid time off from work tend to prefer anti-depressants to counseling.

### 1 Survey and Sample

In this study, the population of interest is a subset of depressed adults who seek treatment for a new episode of depression. Individuals who have other major mental disorders (bipolar disorder, schizophrenia, psychotic features, etc.) in addition to depression or who have substance abuse problems, are not part of the population of interest. Patients who are assessed as suicidal, who require inpatient care or intensive outpatient group care, who are depressed because of a physical illness, or who are deemed not mentally capable of participating are also excluded. The population includes both individuals seeking depression treatment for the first time and individuals who have been treated for previous episodes of depression. The population is limited to individuals who are financially independent of their parents.

Kaiser Permanente, a large HMO, allowed us to survey patients at one of their mental health facilities in Colorado. Kaiser provided an office to conduct the surveys, administrative support, and encouraged their clinicians to recruit eligible patients. Surveys were administered by Jennifer Thacher.

Each morning, clinicians received a note in their box that informed them which intake appointments met the age criteria, 18 and over, and thus were possible candidates for the study. All intake patients, prior to their meeting with the clinician, received a note informing them about the study and telling them that they might be asked to participate. In addition, before meeting with a clinician, all intake patients took the Shedler QuickPsychoDiagnostics (QPD) survey on a handheld device (Schedler et al, 2000). The QPD is an initial evaluation tool that provides, among other things, a depression score for each patient, a listing of depression symptoms, and any co-morbidities, such as anxiety or substance abuse problems. Its use is standard practice at the clinic. All intake patients then met with a clinician who conducted a structured mental health evaluation. Those patients diagnosed as eligible were asked by the clinician to participate in the study.<sup>5</sup> If the patient agreed to participate in the study, the clinician introduced the patient to the survey administrator. If the patient indicated that they were interested in the study but were unable to participate because of time constraints, the clinician followed up with a request that the patient take the survey to fill out at home.<sup>6</sup>

Individuals age 22 and older were assumed financially independent. Individuals as young as 18 were asked to participate in the study if the intake revealed that they were financially independent. An age cap was not placed on the recruitment. For individuals older than 73, the clinicians were asked to use their own discretion as to the physical and mental capabilities of the patient to participate in the survey. The survey process began by giving the participants a copy of Kaiser's Medical Research Participants Bill of Rights and asking them to sign a consent form. The participants were then instructed to begin the survey and tell the survey administrator if anything was unclear or ask if they had any questions. Additionally, they were asked to stop upon reaching question number eight, the first of the choice questions. At this time, the survey administrator explained the first choice question. After confirming that the patient understood the format of the choice questions, the patient was instructed to complete the remainder of the survey but was encouraged to stop at any time with questions. The administrator's responses were scripted to maintain consistency. With the exception of pretest participants, individuals were not paid. The mail-home surveys included a thank-you note and a nominal gift of \$2.<sup>7</sup>

The survey instrument went through extensive testing and revisions. Initial versions of the survey were pre-tested on University of Colorado students who had been part of a previous study on depression. Pretest participants were administered the Beck Depression Inventory (BDI) and survey. After completing the survey, individuals discussed the survey with the survey administrator.<sup>8</sup> Comments on the survey instrument were obtained from the Kaiser clinicians. A pretest was then conducted at the Kaiser mental health clinic before final implementation.<sup>9</sup> Each stage of the process led to revisions.

The survey consists of 37 questions and took approximately 15 minutes to complete. The overall read-

<sup>8</sup>Participants were paid \$30.

<sup>&</sup>lt;sup>5</sup>There was a standard script. Many intakes appointments at the clinic were for mental disorders orther than depression or for depression combined with other co-morbitities. Each clinican had a list of the eligibility criteria. Only a small proportion of the intake appointments qualified for the study.

<sup>&</sup>lt;sup>6</sup>In cases where the clinician forgot to recruit the individual to the study, the clinician called the patient and asked if they would participate in the study. If the patient agreed and was returning within a week the survey was conducted at the next visit. Otherwise, a survey was mailed to the patient's house.

<sup>&</sup>lt;sup>7</sup>This amount was chosen as previous research has shown that nominal gifts increase the probability that the survey will be completed.

<sup>&</sup>lt;sup>9</sup>The pretest consisted of 12 Kaiser patients. who were were each paid \$20 for participating. After taking the survey, the individual were debriefed. During the debriefing, the patient was asked which questions, if any, were confusing. Patient interpretation of the questions was clarified. The pretest also offered an opportunity to refine the recruitment criteria as well as ensure that clinicians were using the correct criteria. Clinicians were encouraged to stop by and discuss questions or particular cases with the researcher to see if they met the recruitment criteria.

ability level is grade six, as assessed by the Flesch-Kincaid Grade Level score. A representative survey can be found in Appendix 3. The survey has four sections. Section 1 provides background information about psychotherapy and anti-depressants, including side effects associated with anti-depressants. Questions are asked about perceptions and preferences concerning the different elements of treatment and time constraints. This section is intended to get the respondent thinking about trade-offs in terms of treatment programs. The answers to the questions in this section can be compared with the responses to the choice questions. In addition, the answers to these questions can be modeled along with the responses to the choice questions. They can also be used to model preference heterogeneity. Section 2 consists of the five pair-wise choice and follow-up questions, followed by a question (#18) asking the respondent how important each characteristic was in their answers to the choice questions. Section 3 collects demographic information and elicits information about any previous depression treatment. Information in this section will be used to model how preference parameters vary as a function of socioeconomic characteristics of the individual and her household. Section 4 asks a series of questions about the patient's experience at the clinic. This section was added at the behest of the clinicians.

The levels of the seven characteristics in the choice questions are:

- Effectiveness: Not Depressed, Some Depressive Symptoms<sup>10</sup>, Current Level of Depression
- Hours of psychotherapy per month: 0, 2, 4, 6
- Monthly cost for treatment: \$0, \$15, \$30, \$45, \$50, \$60, \$75, \$90, \$100, \$105, \$150, \$200, \$300, \$350<sup>11</sup>
- Use of anti-depressants: Yes, No
- No sex drive side effect: Occurs, Doesn't Occur
- No orgasm side effect: Occurs, Doesn't Occur
- Weight gain side effect: 0%, 5%, 10%, 15% of current weight

The combinations of choice questions used for the survey is called the design. The objective of the design is to choose choice questions with sufficient independent variation in the levels of the seven characteristics to allow for identification of the separate effects of each characteristic. However, it is necessary to make the choice pairs realistic. Thus, the design allows for positive correlation between the cost and the number of hours spent in therapy and does not include combinations of attribute levels that could not occur together. For example, a treatment program that does not involve the use of anti-depressants would obviously not result in any side effects. As noted by both Kuhfeld et al (1994) and Johnson et al (1998), creating a full factorial design and then deleting unrealistic combinations may introduce correlation between the parameter estimates and may limit the ability to obtain parameter estimates for the attributes. Similar to Johnson et al (1998), all reasonable alternatives were generated.

 $<sup>^{10}</sup>$ Some Depressive Symptoms was defined as a reduction in depression where the individual still experiences a few symptoms of depressions. Respondents were told that the symptoms were not as severe as full depression but were more intense than the normal feelings of sadness that non-depressed individuals feel.

 $<sup>^{11}\</sup>mathrm{Kaiser}$  limited the amounts that could be used.

From this, 16 choice sets were selected for the final design. The final design was divided into four blocks of four choice sets, resulting in four different versions of the surveys.<sup>12</sup> Refer to Appendix 2 for the frequency of attribute levels and correlation between attribute differences.

## 2 The Data

107 individuals took the survey. Approximately 75% are female. Eighty-one percent are White, Non-Hispanic. The average age is 40 (s.d.=11). The youngest participant was 18 and the oldest participant was 74. The highest completed level of education for the majority of respondents is some college. The average household income, based on the midpoint of income ranges, is 53,738 (s.d=30,516).

	Number	Percent
Clinician's Assessment of Depression Level		
Mild	22	27%
Mild-Moderate	1	1%
Moderate	50	61%
Moderate-Severe	1	1%
Severe	8	10%
Is This First Treatment For Depression?	48	45%
Currently Taking Anti-Depressants	46	43%
Treatment Experience For Those with Previous Expe	rience	
Previous Depression Therapy	39	66%
Previous Treatment Involved Anti-Depressants	45	76%
Side Effect Experience For Those Who Have Taken A	nti-Depre	ssants <sup>a</sup>
Weight Gain Side Effect	19	42%
Diarrhea Side Effect	5	11%
Orgasm Side Effect	16	36%
Reduced Sex Drive Side Effect	22	56%
Other Side Effect	11	24%
<sup>a</sup> Individuals could experience multiple side effects		

Table 1: Descriptive Statistics: Current Depression and Previous Treatment Experience

Table 1 shows the depression level of patients at the time of the survey and previous treatment experience. For example, of those patients for whom we had information on their depression level at the time of the intake appointment, approximately 27% have mild depression, 61% have moderate depression, and 10% have severe depression level. All individuals were classified by the clinicians as clinically depressed. For 45% of the sample, this was their first treatment for depression.

After the set of choice questions, individuals are asked to identify the important each attribute in answering the choice questions. Individuals are given a five point scale that ranged from Not Important at All (1) to Very Important (5). On average, the most important attribute is treatment effectiveness, with an average score of 4.7 (s.d.=0.5). All of the other attributes, except number of therapy hours,

<sup>&</sup>lt;sup>12</sup>The choice sets were selected using the SAS %choiceff macros. D-optimality was chosen as the measure of a design's efficiency. See Huber and Zwerina (1996) and Zwerina et al (1996) for a discussion of this method. An additional simple first choice question was created by hand and added to each survey. This is because the choice pairs created by the optimal design had more variation in attribute levels. To ease the respondents into the choice experiment questions each survey began with one simple choice question. In addition, these simple questions provided some direct, and easily interpreted, information about patient preferences.

are on average rated as Pretty Important. Number of therapy hours is rated as Somewhat Important. While the average rankings are not significantly different from each other, they vary significantly across individuals.

Forty five percent of respondents would need to take time off work in order to attend therapy sessions while 31% would need to arrange for child care. The most commonly picked descriptions of therapy are: helpful, chance to deal with things, self-exploration, and problem-solving. The most commonly picked descriptions of anti-depressants are: helpful, embarrassing, and common method.

#### 2.1 Summary Statistics

Table 2 shows the share of times that the chosen alternative had certain attributes. For example, 61% of the time, individuals choose a treatment plan that eliminates their depression over a treatment plan that merely reduces it. Table 3 shows how respondents answer the follow-up question on the basis of treatment. In 89% of the follow-up choices, treatment, which either eliminated or reduced depression, is chosen.

	Frequency	Percentage
Eliminated Depression	114	61%
Had Lower Weight Gain Side Effect	262	70%
No Orgasm Side Effect Does Not Occur	149	65%
No Sex Side Effect Does Not Occur	123	51%
Involved Therapy <sup>a</sup>	121	62%
Use of Anti-Depressants <sup>a</sup>	47	40%
Had Lower Cost	105	35%

<sup>a</sup> Treatment program could include both therapy and anti-depressants

Table 2: What Share of Times did the Chosen Alternative Have Certain Attributes?

Followup Choice	Frequency	Percentage
Chose Not Depressed over Current Depression	287	61%
Chose Current depression over Not Depressed	29	6%
Chose Some Depressive Symptoms over Current Depression	134	28%
Chose Current Depression over Some Depressive Symptoms	21	4%

Table 3: Treatment Choices in Follow-up Question

As noted earlier, after the set of choice questions, respondents use a five point scale to identify the importance of each attribute in answering the choice questions. In order to identify potential sources of heterogeneity, OLS regressions were run on how respondents ranked the importance of each attribute as a function of personal characteristics. However, when an individual answers that an attribute was important to him, it is not clear whether it was important in a positive or negative way. Therefore, the expected sign of the preference parameter may be positive or negative.

These regressions show that respondents who are older, more highly educated, work more hours per week, or who have no previous treatment experience feel that treatment effectiveness is relatively more important. There is an inverse relationship between income, education, weekly work hours and how individuals rank the importance of the cost. These explanatory variables are most likely highly correlated. In general, how individuals feel about the side effects is a function of gender and age. For example, compared to men, women tended to rate the weight gain side effect as highly important and the no orgasm and no sex drive side effects as relatively less important. Younger individuals view the side effects as being more important than do older individuals.

It is difficult to interpret answers to the question dealing with the importance of therapy hours as this attribute captures both the use of therapy and the number of hours of treatment. Respondents who have no previous depression treatment experience, are less educated, are White, or who would have to take time off work, rate this attribute as relatively more important.

Individuals who work 40 hours or more per week tend to view the use of anti-depressants as more important. Younger individuals and individuals who have previously used anti-depressants cite the use of anti-depressants as less important in their decision making process.

### 3 Models and Estimation

The intent of this paper is to model and estimate the preferences of individuals over treatment programs for depression using the responses to the choice questions. Assume the utility to individual i of choosing treatment k from the j - th choice set is

$$U_{ijk} = V_{ijk} + \varepsilon_{ijk}, \ i = 1...I, \ j = 1, ...J, \ k \in [A, B, \text{ and no treatment}, NT]$$
(1)

Both the V and  $\varepsilon$  are assumed known to the individual.  $V_{ijk}$  is the deterministic component of utility.  $\varepsilon$  is assumed a random variable from the investigator's perspective such that each  $\varepsilon$  is an independent draw from an Extreme Value distribution. These assumptions imply a standard logit model of discrete choice. For now, three different models are considered. All estimates are based on 486 choices from 102 individuals.<sup>13</sup>

#### 3.1 Model 1: No Heterogeneity

Consider first a model with no preference heterogeneity. That is, a model where all individuals are assumed to have the same preferences and preferences are assumed to be solely a function of the choice question attributes.

In the choice questions, use of anti-depressants and/or therapy improves one's emotional state from depressed to either not depressed or some depressive symptoms.<sup>14</sup> Both treatments have monetary costs. In addition, therapy has a time cost and anti-depressants can have side effects. Specifically assume the utility that individual i associates with choosing alternative k is<sup>15</sup>

$$U_{ik} = \alpha_m (Y_i - Cost_k) + \alpha_t [T_i - H_k]$$

$$+ \beta_{ndth} NDth_k + \beta_{dsth} DSth_k$$

$$+ \beta_{ad} Ad_k + \beta_{bt} Bt_k$$
(2)

 $<sup>^{13}\</sup>mathrm{All}$  observations with missing income were eliminated.

<sup>&</sup>lt;sup>14</sup>There is no intent to value unsuccessful treatment.

 $<sup>^{15}\</sup>mathrm{The}~j$  subscript is suppressed.

$$+(\beta_{no}NO_k + \beta_{ns}NS_k + \beta_{wg}WG_k)$$
$$+\varepsilon_{ik}$$

where

 $Y_i$  = individual *i*'s monthly household income (in thousands of dollars)

 $Cost_k$  = Monthly cost of treatment (in thousands of dollars)

 $T_i$  = Hours of free time per month

 $H_k$  = Therapy hours per month

 $NDth_k$  = Not Depressed from therapy only (1=Yes, 0=No)

 $DSth_k$  = Some Depressive Symptoms from therapy only (1=Yes, 0=No)

- $Ad_k$  = Improved emotional state from anti-depressants only (1=Yes, 0=No)
- $Bt_k$  = Improved emotional state from anti-depressants and therapy (1=Yes, 0=No)

$$NO_k$$
 = Experiences inability to have an orgasm side effect(1=Yes, 0=No)

$$NS_i$$
 = Experiences reduced sex drive side effect (1=Yes, 0=No)

$$WG_k$$
 = Experiences weight gain side effect (1=Yes, 0=No)

 $(Y_i - Cost_k)$  is the amount of money left after treatment costs to spend on the numeraire, market goods, and  $[T_i - H_k]$  is the amount of time left after therapy. Equation 2 assumes no-income effects and no-time effects. That is, the marginal utility of money,  $\alpha_m$ , and the marginal utility of time,  $\alpha_t$ , are assumed to be constants, which causes income levels and free time to drop out of the choice probabilities. The above specification allows individuals' feelings about emotional state to vary with treatment method and allows individuals to have different feelings about reducing or eliminating their depression in the case of treatment solely through therapy.<sup>16</sup> Holding constant money costs, time costs and side effects,  $\beta_{ndth}$  is the increase in utility associated with eliminating depression through the rapy treatment only. The same interpretation holds for  $\beta_{dsth}$  except it refers to the change in utility from reducing one's depression to Some Depressive Symptoms through the rapy alone.  $\beta_{ad}$  is the increase in utility associated with eliminating or reducing depression through anti-depressants alone.  $\beta_{bt}$  is the increase in utility associated with eliminating or reducing depression through both anti-depressants and therapy. The term  $(\beta_{no}NO_k + \beta_{ns}NS_k + \beta_{wq}WG_k)$  shifts utility if the treatment involves anti-depressants and there are one or more side effects associated with their use. Equation 2 assumes that an individual feels the same way about side effects, regardless of whether the anti-depressants reduce or eliminate the depression, and regardless of whether the treatment involves therapy. The utility associated with no treatment (depressed, no treatment) is  $U_{ik} = \alpha_m Y_i + \alpha_h T_i + \varepsilon_{ik}$ .

The probability of individual i choosing alternative k from the jth choice pair is the standard logit

<sup>&</sup>lt;sup>16</sup>Tests showed that individuals did not perceive a significant difference between not depressed and depressive symptoms when treatment was through anti-depressants alone or anti-depressants and therapy. We also examined a scale factor, where how individuals felt about each treatment method if it eliminated their depression was x% larger than if it reduced their depression. This specification proved to be inferior to the specification shown.

probability

$$P_{ijk} = \frac{e^{V_{ijk}}}{e^{V_{ijA}} + e^{V_{ijB}}} \quad k = A, B \tag{3}$$

The probability that individual i chooses no treatment, NT, over the preferred treatment alternative in the *j*th choice pair is<sup>17</sup>

$$P_{ijNT} = \frac{e^{V_{ijNT}}}{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}$$
(4)

Thus, the likelihood function takes the following form

$$L = \prod_{i=1}^{I} \prod_{j=1}^{J} (P_{ijA})^{y_{ijA}} (P_{ijB})^{y_{ijB}} (P_{ijNT})^{y_{ijNT}} (P_{ijT})^{1-y_{ijNT}}$$
(5)

where  $y_{ijA}$  is a dummy variable that indicates when alternative A is chosen.  $y_{ijB}$  and  $y_{ijNT}$  are defined similarly.

Parameter		Estimate	Est./s.e.	Prob.
MU of Income= - (money cost parameter)	αm	1.98	2.4180	0.0078
MU of Time= - (time cost parameter)	α <sub>t</sub>	0.02	0.4270	0.3348
MU: Eliminate Depression with Therapy Only	$\beta_{ndfb}$	2.91	7.7620	0.0000
MU: Reduce Depression with Therapy Only	$\beta_{deth}$	1.60	4.6540	0.0000
MU: Eliminate/Reduce Depression with Anti-				
Depressants Only	$\beta_{ad}$	2.29	6.6070	0.0000
MU: Eliminate/Reduce Depression with Both	$\beta_{bt}$	2.67	6.6010	0.0000
MU: Experience No Orgasm Side Effect	$\beta_{\mathbf{no}}$	-0.58	-3.2610	0.0006
MU: Experience No Sex Drive Side Effect	$\beta_{ns}$	-0.27	-1.7400	0.0409
MU: Experience Weight Gain Side Effect	$\beta_{wz}$	-1.08	-7.1800	0.0000

Table 4: Model 1 Maximum Likelihood Parameter Estimates

The mean log likelihood is -0.92. This model correctly predicts 70% of the AB choices, 88% of the follow-up choices, and 63% of both choices. A likelihood ratio test confirms that Model 1 is superior to a random allocation model, where Alternative A and Alternative B are each chosen with probability 0.5 in the initial choice and the choice of treatment versus no treatment were each also chosen with probability of 0.5.

Holding outcome constant, individuals prefer treatments that require less money and less time. The money cost parameter is significant while the time cost parameter is not.

Ignoring the insignificant time costs associated with therapy, individuals prefer to eliminate their depression through therapy rather than anti-depressants alone even if the anti-depressants have no side effects. A similar result was found by Dwight-Johnson et al (2000). Interestingly, to reduce their depression, individuals prefer anti-depressants to therapy. Not surprisingly, eliminating depression through therapy alone is seen as significantly preferable to reducing it. The result that individuals view some depressive symptoms as an improvement over their current level of depression is consistent with the finding by Revicki and Wood (1998) that individuals were able to distinguish between severe, moderate, and mild depression.

Ignoring the monetary costs, one's utility if treated solely with therapy is  $U_i = .02[T_i - H] + 2.91NDth + 1.60DSth + \varepsilon_i$  These estimates, along with the estimated marginal utility of money, 1.98,

 $<sup>^{17}\</sup>mathrm{The}$  derivation is in Appendix 1.

imply an estimated maximum willingness-to-pay, WTP, of \$1471 per month to eliminate depression by therapy alone and \$810 to reduce depression through the same method, a ratio of almost two to one.<sup>18</sup> In interpreting these results, it should be recalled that these estimates do not allow for any individual heterogeneity in preferences. These estimates are an average over all income levels. Furthermore, these amounts would be paid a limited amount of time, while the costs of not treating depression can increase proportionately over time.

Ignoring monetary costs, one's utility if treated solely with anti-depressants is

$$U_i = 2.29Ad + (-.58NO - .27NS - 1.08WG) + \varepsilon_i \tag{6}$$

On average, estimated WTP to eliminate depression through anti-depressants only is approximately \$300 less than the WTP to achieve the same outcome through therapy alone. If treatment combines both therapy and anti-depressants,

$$U_{ik} = .02[T_i - H_k] + 2.67Bt_k - (-.58NO_k - .27NS_k - 1.08WG_k) + \varepsilon_{ik}$$

The parameter estimate on  $Bt_k$  is not significantly different from the parameter estimate on NDth but it is significantly larger than the parameter estimate on DSth. Estimated WTP to eliminate depression with both therapy and anti-depressants is \$1350.

Similar to Revicki and Wood (1998) and O'Brien et al (1995), the results suggest that individuals view some side effects as being worse than others. By assumption, the impact of side effects from anti-depressants is the same independent of whether one receives therapy. Estimated WTP is \$548 per month to avoid weight gain<sup>19</sup>, \$295 to avoid the no-orgasm side effect, and \$138 to avoid the no sex-drive side effect. These estimates are of interest to drug companies. Taken out of context, these amounts could be applied to individuals not taking anti-depressants but who areoverweight, suffering from inability to have an orgasm, or experiencing no sex drive. For example, WTP to have a sex drive is estimated to be \$138 per month.

If the depression is eliminated with anti-depressants only and all three side-effects are experienced, WTP is \$179, but this amount is not significantly different from zero. One cannot reject the null hypothesis that the individual is indifferent between being depressed and not being depressed but experiencing the three side effects.

<sup>&</sup>lt;sup>18</sup>\$1279 (3.16/2.47) is the estimated compensating variation, CV, associated with the change from depressed to not depressed, holding constant the number of therapy hours. In this specification with no income effects, the CV equals the equivalent variation, EV and is equivalent to the marginal rate of substitution between emotional state and income. Since the welfare calculation is from one state to another and  $\varepsilon_i$  is assumed the same in both states of the world, the epsilons cancel and ones obtains the estimated CV rather than its expectation, estimated E[CV]. In the future, confidence intervals will be calculated for the estimated CV. To show that CV is equivalent to MRS in this case, you simply need to solve  $3.16 + 2.47(Y_i - CV_i) = 2.47Y_i$  where we have assumed no money costs and have ignored time costs because of their insignificance.

<sup>&</sup>lt;sup>19</sup>Degree of weight gain was not significant.

#### 3.2 Model 2: Allowing the Value of Goods to Depend on Emotional state

Model 2 generalizes Model 1 by allowing the value of market goods to differ depending on one's emotional state. The conjecture is that individuals get greater pleasure from the consumption of goods when they are not depressed. Assume

$$U_{ik} = (\alpha_m + \alpha_{md}D_k + \alpha_{mds}DS_k)(Y_i - Cost_k) + \alpha_t[T_i - H_k]$$

$$+\beta_{ndth}NDth_k + \beta_{dsth}DSth_k$$

$$+\beta_{ad}Ad_k + \beta_{bt}Bt_k$$

$$+\beta_{no}NO_k + \beta_{ns}NS_k + \beta_{wg}WG_k$$

$$+\varepsilon_{ik}$$

$$(7)$$

where

$$D_k$$
 = Emotional state is depressed (1=Yes, 0=No)  
 $DS_k$  = Emotional state is some depressive symptoms (1=Yes, 0=No)

Equation 7 is identical to Equation 2 except  $\alpha_m$  is generalized to  $(\alpha_m + \alpha_{md}D_k + \alpha_{mds}DS_k)$ ; that is, this specification allows the marginal utility of money to differ as a function of the three emotional states. Assuming Equation 7, income does not drop out of the choice probabilities. Income effects are implied in the sense that the alternative chosen in the choice pairs affects one's emotional state, which in turn affects the value one places on market goods. Table 5 shows the parameter estimates for this model.

	Estimate	Est./s.e.	Prob.
α <sub>m</sub>	2.21	2.5500	0.0054
$\alpha_{\rm md}$	-0.36	-4.5300	0.0000
$\alpha_{\rm mb}$	-0.08	-1.9200	0.0274
α <sub>t</sub>	0.04	0.7580	0.2242
β <sub>ndfb</sub>	1.58	3.3380	0.0004
β <sub>deth</sub>	0.57	1.1850	0.1179
$\beta_{ad}$	1.02	2.2770	0.0114
βъt	1.60	3.1960	0.0007
$\beta_{\mathbf{n}o}$	-0.57	-3.1980	0.0007
$\beta_{ne}$	-0.34	-2.0750	0.0190
$\beta_{wz}$	-1.07	-7.0550	0.0000
	$\begin{array}{c} \mathcal{O}_{m} \\ \mathcal{O}_{md} \\ \mathcal{O}_{md} \\ \mathcal{O}_{q} \\ \beta_{ndt} \\ \beta_{deth} \\ \beta_{deth} \\ \beta_{be} \\ \beta_{m} \\ \beta_{m} \\ \beta_{wr} \end{array}$	Estimate           α <sub>ma</sub> 2.21           α <sub>ma</sub> -0.36           α <sub>ma</sub> -0.08           α <sub>ma</sub> -0.04           β <sub>ma</sub> 1.58           β <sub>ath</sub> 0.57           β <sub>ath</sub> 1.60           β <sub>bt</sub> 1.60           β <sub>ma</sub> -0.57           β <sub>ma</sub> -0.34	Estimate         Est./s.e. $\alpha_{m}$ 2.21         2.5500 $\alpha_{ml}$ -0.36         -4.5300 $\alpha_{md}$ -0.08         -1.9200 $\alpha_{q}$ 0.04         0.7580 $\beta_{ndt}$ 1.58         3.3380 $\beta_{sth}$ 0.57         1.1850 $\beta_{sth}$ 1.02         2.2770 $\beta_{kt}$ -0.57         -3.1980 $\beta_{ss}$ -0.57         -3.1980 $\beta_{ss}$ -0.34         -2.0750 $\beta_{ss}$ -0.34         -2.0750

Table 5: Model 2 Maximum Likelihood Parameter Estimates

The mean log likelihood is -0.89. Model 2 correctly predicts 70% of the AB choices, 89% of the follow-up choices, and 63% of both choices. A likelihood ratio test was performed to test the hypothesis that  $\alpha_{mds} = \alpha_{md} = 0$ . This hypothesis was rejected at the 1% level. Model 2 statistically dominates Model 1.

The conjecture is confirmed. The estimated marginal utility of money is 2.21 if the individual is not depressed, 2.13 (2.21 - .08) if the individual has some depressive symptoms and 1.84 if the individual is depressed. Consumption loses 17% of its value when an individual is depressed.

Given that Model 2 incorporates income effects, calculation of WTP is more complicated and WTPno longer equals WTA.<sup>20</sup> Consider an individual's WTP to eliminate her depression through the use of therapy alone. Ignoring the insignificant time costs associated with therapy and assuming zero cost for treatment, <sup>21</sup>

$$WTP = -\frac{\alpha_{md}}{\alpha_m} Y_i + \frac{\beta_{NDth}}{\alpha_m} \tag{8}$$

Equation 8 shows that eliminating depression has two effects on an individual's utility level. The first term is an income effect. Eliminating depression increases an individual's utility level because individuals value goods more when they are not depressed. The magnitude of this term increases with an individual's income level. The second term is the strict improvement in utility because the individual is no longer depressed. Calculating WTA for the same scenario,

$$WTA = -\left(\frac{\alpha_{md}}{\alpha_m + \alpha_{md}}\right)Y_i + \frac{\beta_{NDth}}{\alpha_m + \alpha_{md}} \tag{9}$$

A similar interpretation holds for this formula, except that now things are valued on the basis of marginal utility of income when depressed. The amount that must be paid to an individual in the depressed state to make her indifferent between being depressed or not depressed is greater than the amount that must be taken away from her in the non depressed state to make her indifferent between the two states. In other words, an individual must be paid more to remain depressed than she is willing to pay to become not depressed. This result is occurring simply because each dollar of income (or unit of numeraire good) is worth less to an individual when depressed. Thus, depressed individuals must have a larger income to get the same utility benefit from their income as an non depressed individual. In addition, because money has less value to them, individuals who are depressed must be paid significantly more to accept continuing depression. When in the non-depressed state, individuals value money more, and so are less willing to give up money in order to prevent depression. Table 6 shows the estimated WTP and WTAfor various income levels in the case when depression could be eliminated with therapy alone, ignoring insignificant time costs and assuming zero cost. For example, for an individual with annual household income of \$55,000, which is close to the sample average, the estimated WTP is \$1471 while the estimated WTA is \$1763. A depressed individual would have to be paid \$1763 per month to voluntarily remain depressed but would pay \$1471 per month to prevent the depression through therapy.

 $2^{1}\alpha_{m}(Y_{i} - CV_{i}) + \alpha_{t}(T_{i} - H) + \beta_{ndth}NDth + \varepsilon = (\alpha_{m} + \alpha_{md})Y_{i} + \alpha_{t}(T_{i} - H) + \varepsilon$ 

<sup>&</sup>lt;sup>20</sup>For an improvement, depressed to either not depressed or depressive symptoms, WTP = CV and the CV is the amount that has to be subtracted from the individual's income in the improved state to make her indifferent between the new state with the subtraction and the depressed state. So, WTP is calculated using the marginal utility of money that applies when one is in the improved state. In contrast, willingness to accept the depressed rather than the improved state, WTA, is the equivalant variation, EV. The EV is the amount of money that has to be added to income in the depressed state to make the individual indifferent between remaining depressed and having this extra income and having an improved emotional state. So, WTA is calculated using the marginal utility of money that applies when the individual is depressed.

Income	WTP	WTA
\$30,000	\$1,128	\$1,351
\$55,000	\$1,471	\$1,763
\$90,000	\$1,953	\$2,351

 Table 6: Estimated WTP vs WTA by Income Level (when depression can be eliminated by therapy alone)

Table 9 shows the average WTP and WTA for individuals in the sample when depression could be eliminated using therapy .

	Average	Std Dev	Min	Max
WTP	\$1,458	\$422	\$783	\$2,780
WTA	\$1,747	\$506	\$939	\$3.330

Table 7: Sample WTP vs WTA (when depression can be eliminated with therapy alone)

Assuming no side effects, the estimated average WTP to eliminate depression with only antidepressants is \$1206 per month; estimated WTA is \$1444. Generalizing the model to allow the value of goods to depend on one's emotional state increases the WTP and WTA associated with successful treatment of depression. Model 1 was underestimating WTP for these scenarios.

In Model 2, estimated WTP to avoid side effects and WTA side effects depends on the reference point (depressed, some depressive symptoms and not depressed). For example one could ask how much an individual on anti-depressants who is currently experiencing side effects but no depression would pay per month to eliminate those side effects. This amount is calculated using the individual's marginal utility of money when she is not depressed. For this scenario, estimated WTP to avoid weight gain is \$484 per month. It is \$258 to avoid the no-orgasm side effect and \$156 to avoid the no sex-drive side effect. WTA = WTP, as we are assuming the same emotional state in both scenarios.

Alternatively, one could use the model to estimate what a depressed individual would pay per month to not gain weight. To value that scenario, one would use the marginal utility of money that applies when the individual is depressed. For the weight gain, this estimated WTP is \$580; the individual is willing to pay more when depressed because money is worth less when one is depressed.

Using anti-depressants alone or in combination with therapy to eliminate depression when it results in all three side effects has a negative but not significant impact on utility. The combined impact of the side effects cancels out the gain from eliminating the depression.

Summarizing, Model 1 and 2 give different results and Model 2 is statistically preferred. Both Model 1 and Model 2 are highly restrictive in that, conditional on emotional state, both assume everyone has the same preferences over depression treatment programs. Model 2 suggests that with side effects, treatment with anti-depressants will be an improvement for some and a (non-significant) deterioration for others. Previous studies have found a similar result: severe depression is considered worse than an improved emotional state combined with medication side effects (Revicki and Wood, 1998). Model 3 generalizes Model 2 by allowing preferences for treatment to vary as a function of observable characteristics of the individual. In this case, when certain personal characteristics are accounted for, some individuals do not rank the elimination of their depression as an improvement and in certain extreme cases view the treatment and improved emotional state as worse than their current depression.

#### 3.3 Model 3: Preference Heterogeneity

Model 3 generalizes Model 2 by making parameters a function of characteristics of the individual. We investigated the impact of the following individual characteristics: household income, gender, education level, the individual's current level of depression as rated by the clinician, race/ethnicity, age, previous experience with the side effect, and Body Mass Index (BMI).

Model 3 is a work in progress. In its current form,

- The marginal utility of income is a function of whether one's household income is  $\leq 10K$ , between 10K and 20K, or  $\geq \$80K$  per year.
- The marginal utility of reducing or eliminating depression is a function one's education level and the severity of one's depression
- The impact of the no orgasm side-effect is a function of age.
- The impact of the weight-gain side-effect is a function of gender, previous experience with this side effect, and whether one is underweight.

The current version of Model 3 is

$$U_{ik} = (\alpha_m + \alpha_{md}D_k + \alpha_{mds}DS_k + \alpha_{mr}IR_i + \alpha_{mp}IP_i)(Y_i - Cost_k) + \alpha_t[T_i - H_k] + \beta_{ndth}NDth_k + + \beta_{dsth}DSth_k + \beta_{ad}Ad_k + \beta_{bt}Bt_k$$
(10)  
+  $(\beta_{ndsc}SC_i + \beta_{ndsv}Sv_i + \beta_{ndmd}Md_i)ND_k + (\beta_{no} + \beta_{noyg}Yg_i)NO_k + (\beta_{ns} + \beta_{nsf}F_i)NS_k + (\beta_{wg} + \beta_{wgf}F_i + \beta_{wgpv}Pv_i + \beta_{wsk}Sk_i)WG_k + \varepsilon_{ik}$ 

where

- $IR_i$  = Income of 80K or greater (1=Yes, 0=No)
- $IP_i$  = Income of 10K or less (1=Yes, 0=No)
- $F_i$  = Female (1=Yes, 0=No)
- $SC_i$  = Education level (1=if less than a college degree, 0=otherwise)
- $Sv_i$  = Current depression rated as severe by clinician (1=Yes, 0=No)
- $Md_i$  = Current depression rated as moderate by clinician (1=Yes, 0=No)
- $Yg_i = 1$  if the individual is less than 41 years of age, and 0 otherwise
- $Pv_i$  = Previously experienced wt gain side effect (1=Yes, 0=No)
- $Sk_i$  = Underweight according to BMI score (1=Yes, 0=No)

For example, the impact of weight gain side-effect,  $(\beta_{wg} + \beta_{wgf}F_i + \beta_{wgpv}Pv_i + \beta_{wsk}Sk_i)$  is a function of gender, previous experience with this side effect, and whether one is underweight according to the an individual's Body Mass Index score. In contrast, the impact of the no orgasm side effect,  $(\beta_{no} + \beta_{noyg}Yg_i)$  is only a function of whether one is young, and the no sex-drive side effect is only a function of gender.

Parameter		Estimate	Est./s.e.	Prob.
MU of Income= - (money cost parameter)	۵m	2.41	2.4510	0.0071
Reduction in MU of Income if Depressed	0. mi	-0.24	-2.6330	0.0042
Reduction in MU of Income if Depressive Symptoms	Cl.mds	-0.10	-1.9480	0.0257
Change in MU of income if income >=80K	0. <sub>mr</sub>	-1.85	-1.0880	0.1383
Change in MU of income if income <=10K	۵. ۲	6.50	2.2450	0.0124
MU of Time= - (time cost parameter)	α,	0.04	-0.7260	0.2339
MU: Eliminate Depression with Therapy Only	β <sub>nith</sub>	2.43	4.5170	0.0000
MU: Reduce Depression with Therapy Only	$\beta_{deth}$	1.23	2.3500	0.0094
MU: Eliminate/Reduce Depression with Anti-Depressants Only	$\beta_{ad}$	1.72	3.3510	0.0004
MU: Eliminate/Reduce Depression with Both	$\beta_{bt}$	2.31	4.1810	0.0000
Change in MU: Eliminate Depression with < College Degree	β <sub>nde a</sub>	-1.06	-3.6600	0.0001
Change in MU: Eliminate Depression if Severely Depressed	$\beta_{nkv}$	1.10	1.7910	0.0367
Change in MU: Eliminate Depression if Moderately Depressed	$\beta_{ndmd}$	0.95	3.2360	0.0006
MU: Experience No Orgasm Side Effect	$\beta_{10}$	-0.26	-1.0370	0.1498
Change in MU: No Orgasm Side Effect if Young	$\beta_{myg}$	-0.76	-2.4470	0.0072
MU: Experience No Sex Drive Side Effect	β	-0.79	-2.6640	0.0039
Change in MU: No Sex Drive Side Effect if Female	$\beta_{\rm inf}$	0.66	2.0020	0.0226
MU: Experience Weight Gain Side Effect	$\beta_{w_{\overline{e}}}$	-0.46	-1.7850	0.0371
Change in MU: Weight Gain Side Effect if Female	$\beta_{wef}$	-1.22	-4.2970	0.0000
Change in MU: Weight Gain Side Effect if Previously	·			
Experienced	$\beta_{wgpv}$	0.83	2.6450	0.0041
Change in MU: Weight Gain Side Effect if Underweight	β <sub>wa</sub> h	1.42	2,5760	0.0050

Table 8: Model 3 Maximum Likelihood Parameter Estimates

The mean log likelihood is -0.83. On the basis of a likelihood ratio test, Model 3 explains the choices significantly better than Model 2. Model 3 correctly predicts 73% of the AB choices, 88% of the follow-up choices, and 65% of both choices. Given the exploratory nature of the analysis, parameters were retained if they were significant at the 15% level.

The impact of eliminating one's depression is now shifted by the amount  $(-1.06SC_i + 1.10Sv_i + 0.95Md_i)$ . The improvement in emotional state is valued less if one has less than a college degree. This result has potentially important implications for the role of the health care provider in terms of recommending appropriate treatment. Our estimates show that moderately and severely depressed individuals value an elimination of their depression more than a mildly depressed individual does. However, there is not a significant difference between how a moderately and severely depressed individual values an elimination of their depression. Revicki and Wood (1998) found statistically significant differences between utility scores based on current depression severity.

Ceteris paribus, the marginal utility of money is lowest for households with incomes less than or equal to \$10,000, followed by middle income households, with individuals from households with incomes greater than \$80,000 per year having the highest marginal utility of income (8.91 vs. 2.41 vs 0.55). That is, individuals with more income have a higher WTP to eliminate depression and side effects. Simply because of differences in how they value an extra dollar of income, all else equal, those with household income greater than \$80,000 will have approximately four times the WTP to eliminate depression as those with household incomes between 10K - 80K and 16 times the WTP of the very poorest. Table 7 shows WTP and WTA for both mildly and severely depressed individuals without a college degree as a function of income level.<sup>22</sup> For example, consider two severely depressed individuals without a college degree. As shown in Table 9, estimated WTP to eliminate the depression with therapy alone is \$420 if household income is \$10,000, \$2152 if household income is \$55,000, and \$9676 if income is \$90,000. These estimates are consistent with other studies on the topic which have found that individuals consistently rank depression as worse than other chronic diseases (Wells et al, 1999; Revicki and Wood, 1996) and in some cases view severe depression as equivalently bad as or worse than death (Revicki and Wood, 1996).

	Mild Depression		Severe D	epression
Income	WTP	WTA	WTP	WTA
\$10,000	\$295	304	\$420	\$431
\$30,000	\$1,265	\$1,407	\$1,723	\$1,917
\$55,000	\$1,476	\$1,642	\$1,934	\$2,152
\$90,000	\$7,686	\$13,720	\$9,676	\$17,272

Table 9: Estimated WTP vs WTA by Income Level (when depression can be eliminated by therapy alone and individual has less than a college degree)

As in Model 2, the value of consuming goods increases as one's level of depression decreases, so WTP to eliminate the depression does not equal WTA it.

Table 10 shows the sample average WTP and WTA to eliminate depression through therapy. These numbers are averaged over values that vary as a function of current depression level, income, and education level.

	Average	Std Dev	Min	Max
WTP	\$3,314	\$3,075	\$166	\$10,691
WTA	\$5,387	\$5,841	\$170	\$19,084

Table 10: Sample WTP vs WTA (when depression can be eliminated with therapy alone and individual has less than a college degree)

The impact of the non-orgasm side effect,  $(-.26 - .76Yg_i)$ , is almost four times as bad if one is under 41 years of age. For individuals age 41 or older, the presence of the no orgasm side effect will not affect treatment decisions. Feelings about the no orgasm side effect do not depend on one's gender. The impact of the no sex-drive side effect,  $(-.79 + .66F_i)$  is negative and significant for males. The side effect is not significant for females. If currently being treated with anti-depressants but experiencing the sexual side effects, estimated WTP for an anti-depressant that eliminates the sex drive side effect

 $<sup>^{22}</sup>$ Consider the case of an individual who eliminates her depression solely with therapy. Assuming no cost and ignoring the insignificant time parameter and scale factor, we calculate WTP as

 $<sup>(\</sup>alpha_m + \alpha_{mr}IR_i + \alpha_{mp}IP_i)(Y_i - CV_i) + \beta_{ndth} + \beta_{ndsc}SC_i + \beta_{ndsv}SV_i + \beta_{ndmd}MD_i = (\alpha_m + \alpha_{md} + \alpha_{mr}IR_i + \alpha_{mp}IP_i)Y_i$  and WTA as

 $<sup>(\</sup>alpha_m + \alpha_{mr}IR_i + \alpha_{mp}IP_i)Y_i + \beta_{ndth} + \beta_{ndsc}SC_i + \beta_{ndsv}Sv_i + \beta_{ndmd}Md_i = (a_m + \alpha_{md} + \alpha_{mr}IR_i + \alpha_{mp}IP_i)(Y_i + EV_i)$ 

is \$327 per month for a male whose household income is between \$10,001 and \$80,000 per year, and \$1420 if his household income is greater than \$80,000 per year. For a female the comparable amounts are \$53 and \$229, which are not significantly different from zero.

The impact of the weight gain side effect,  $(-.46 + -1.22F_i + .83Pv_i + 1.42Sk_i)$ , is negative for most individuals. Women are more negatively impacted than men by this side effect. Underweight individuals or individuals with previous experience with the side effect are less negatively impacted than other individuals. The weight gain side effect is actually viewed as a positive benefit by underweight males. All women except those who are underweight, view the side effect negatively. For underweight women, regardless of their previous experience with this side effect, the side effect does not significantly affect them.

Females who are not underweight and who have no previous experience with this side effect would be willing to pay an estimated extra \$3035 per month for an anti-depressant without this side effect if their household income is greater than \$80K per year, \$698 if it is less than \$80K but greater than \$10K, and \$188 if their household income is less than \$10K.

Note that the ranking of the side effects varies across individuals as a function of their characteristics. For example, consider two young people who are not underweight and have no previous experience with the weight-gain side effect. The female ranks them, from worst to least bothersome as, weight gain, no orgasm, no sex drive. The male views the no orgasm and no sex drive side effects as equivalently bad and marginally worse than the weight gain.

Eliminating or reducing depression with therapy alone at zero costs makes everyone better off. The same is true for costless treatments that include anti-depressant but no side effects, although the improvement is not significant for individuals without a college degree. Therapies that include multiple side effects can cancel the impact of reducing one's level of depression. For some individuals, Model 3 suggests that the individual would prefer to remain depressed rather than experience multiple side effects.

In explanation, if depression is eliminated using anti-depressants only, and money costs are ignored

$$U_{i} = (1.72 - 1.06SC_{i} + 1.10Sv_{i} + 0.95Md_{i}) + (-.26 - .76Yg_{i})NO + (-.79 + .66F_{i})NS + (-.46 + -1.22F_{i} + .83Pv_{i} + 1.42Sk_{i})WG + \varepsilon_{i}$$

The first term is always positive, the second and third terms always negative, and the fourth term varies in sign. Consider, for example, a young male without a college degree, who is only mildly depressed, and has no previous experience with the weight-gain side effect. For this individual,  $U_i = 0.66 - 1.02NO - .79NS - .46WG + \varepsilon_i$  is negative (worse than remaining depressed) if both sexual side effects occur. Also consider a young female without a college degree who is only mildly depressed and has not previous experience with the weight-gain side effect. For this individual,  $U_i = 0.66 + 1.02NO - .79NS$ 

 $.13NS - 1.68WG + \varepsilon_i$ . She would rather remain depressed than experience the weight-gain side effect, and is close to indifferent between remaining depressed and not being depressed but experiencing the no orgasm side effect. She is affected little by the no sex drive side effect. Alternatively, if the same female was moderately depressed,  $U_i = 1.62 - 1.02NO - .13NS - 1.68WG + \varepsilon_i$ , she is indifferent being not depressed with the weight gain or remaining depressed, but she would not accept both the weight gain and no orgasm side effects. In the case of severe depression, she is indifferent between all three side effects and eliminating her depression. The result that WTP to avoid side effects varies with income level and demographic characteristics is different from O'Brien et al (1995).

### 4 Extensions

As noted earlier, this paper remains a work in progress. The primary work to be done deals with exploring additional types of preference heterogeneity. Model 3 will be expanded to deal with other potential sources of preference heterogeneity. Additional examination of how individuals answered attitudinal questions will be used to help identify and model this heterogeneity. In addition, this paper will explore how latent class models and cluster analysis can be used to model heterogeneity.

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## 5 Appendix 1

In this appendix, the probability functions for the follow-up question for a logistic model are derived.

In this model, the individual makes two choices. She is first presented two possible depression treatment alternatives and asked to choose which treatment plan she prefers, A or B. The individual is then asked a follow-up question. She is asked whether she would prefer the alternative she just choose (Alternative T) or no treatment (Alternative NT). Thus, in the follow-up she chooses conditional on her first choice.

The likelihood function for this problem will be

$$L = \prod_{i=1}^{I} \prod_{j=1}^{J} (P_{ijA})^{y_{ijA}} (P_{ijB})^{y_{ijB}} (P_{ijNT})^{y_{ijC}} (P_{ijT})^{1-y_{ijC}}$$
(11)

where

$$P_{ijNT} = P_{ijNT|A}P_{ijA} + P_{ijNT|B}P_{ijB} = P_{ijA\cap NT} + P_{ijB\cap NT}$$

and

$$P_{ijT} = P_{ijA|A}P_{ijA} + P_{ijB|B}P_{ijB} = P_{ijA\cap A} + P_{ijB\cap B}$$

In the case of a logistic model, it is well-known that

$$P_{ijA} = \frac{e^{V_{ijA}}}{e^{V_{ijA}} + e^{V_{ijB}}}$$

 $P_{ijB}$  follows a similar form.

It is necessary to derive the form of  $P_{ijT}$  and  $P_{ijNT}$  in the case of a logistic model. Suppose the respondent chooses Alternative A in the first choice and chooses treatment over no treatment in the follow-up. In the first case, if the individual i chose alternative A over alternative B, then it must be the case that the utility from choosing alternative A was greater than the utility from choosing alternative B. Similarly, if the respondent chooses Alternative A over no treatment, it must be the case that she prefers Alternative A to her current state of depression where she is receiving no treatment. Therefore, the probability of choosing Alternative A both times is the probability that:

• the utility from alternative A is greater than the utility from Alternative B

#### AND

• the utility from alternative A is greater than the utility from no treatment. Then

$$\begin{aligned} P_{ijA\cap A} &= P(U_{ijA} \ge U_{ijB} \land U_{ijA} \ge U_{ijNT}) \\ &= P\left[ (V_{ijA} + \varepsilon_{ijA} \geqslant V_{ijB} + \varepsilon_{ijB}) \land (V_{ijA} + \varepsilon_{ijA} \geqslant V_{ijNT} + \varepsilon_{ijNT}) \right] \\ &= P\left[ (\varepsilon_{ijB} \le V_{ijA} - V_{ijB} + \varepsilon_{ijA}) \land (\varepsilon_{ijNT} \le V_{ijA} - V_{ijNT} + \varepsilon_{ijA}) \right] \end{aligned}$$

By assumption, the error terms  $\varepsilon_{ijA}, \varepsilon_{ijB}, \varepsilon_{ijNT}$ , are independent draws from the extreme value distribution. Given this asumption, we can rewrite the above as

$$P_{ijA\cap A} = \int_{-\infty}^{\infty} \left[ \int_{-\infty}^{V_{ijA} - V_{ijB} + \varepsilon_{ijA}} f(\varepsilon_{ijB}) d\varepsilon_{ijB} \right] \left[ \int_{-\infty}^{V_{ijA} - V_{ijNT} + \varepsilon_{ijA}} f(\varepsilon_{ijNT}) d\varepsilon_{ijNT} \right] f(\varepsilon_{ijA}) d\varepsilon_{ijA}$$
$$= \int_{-\infty}^{\infty} \left[ F\left(\varepsilon_{ijB}\right) \right] \Big|_{-\infty}^{V_{ijA} - V_{ijB} + \varepsilon_{ijA}} \left[ F\left(\varepsilon_{ijNT}\right) \right] \Big|_{-\infty}^{V_{ijA} - V_{ijNT} + \varepsilon_{ijA}} f(\varepsilon_{ijA}) d\varepsilon_{ijA}$$

For the extreme value distribution,  $f(\varepsilon) = \exp(-\varepsilon - e^{-\varepsilon})$  and  $F(\varepsilon) = \exp(-e^{-\varepsilon})$ . Substituting,

$$P_{ijA\cap A} = \int_{-\infty}^{\infty} \left[ \exp(-e^{\varepsilon_{ijB}}) \right] \Big|_{-\infty}^{V_{ijA} - V_{ijB} + \varepsilon_{ijA}} \left[ \exp(-e^{\varepsilon_{ijNT}}) \right] \Big|_{-\infty}^{V_{ijA} - V_{ijNT} + \varepsilon_{ijA}} \exp(-\varepsilon_{ijA} - e^{-\varepsilon_{ijA}}) d\varepsilon_{ijA}$$

$$= \int_{-\infty}^{\infty} \left[ \exp(-e^{V_{ijB} - V_{ijA} - \varepsilon_{ijA}}) \right] \left[ \exp(-e^{V_{ijNT} - V_{ijA} - \varepsilon_{ijA}}) \right] \exp(-\varepsilon_{ijA} - e^{-\varepsilon_{ijA}}) d\varepsilon_{ijA}$$

$$= \int_{-\infty}^{\infty} \exp\left[ -e^{V_{ijB} - V_{ijA} - \varepsilon_{ijA}} - e^{V_{ijNT} - V_{ijA} - \varepsilon_{ijA}} - \varepsilon_{ijA} - e^{-\varepsilon_{ijA}} \right] d\varepsilon_{ijA}$$

$$= \int_{-\infty}^{\infty} \exp\left[ -e^{-\varepsilon_{ijA}} \left( 1 + e^{V_{ijB} - V_{ijA}} + e^{V_{ijNT} - V_{ijA}} \right) - \varepsilon_{ijA} \right] d\varepsilon_{ijA}$$

Let  $\lambda_i = \log \left(1 + e^{V_{ijB} - V_{ijA}} + e^{V_{ijNT} - V_{ijA}}\right)$ . Then  $1 + e^{V_{ijB} - V_{ijA}} + e^{V_{ijNT} - V_{ijA}} = e^{\lambda_i}$ . Substituting,

$$P_{ijA\cap A} = \int_{-\infty}^{\infty} \exp\left[-e^{-\varepsilon_{ijA}}e^{\lambda_i} - \varepsilon_{ijA}\right] d\varepsilon_{ijA}$$
$$= \int_{-\infty}^{\infty} \exp\left[-e^{-(\varepsilon_{ijA} - \lambda_i)} - \varepsilon_{ijA}\right] d\varepsilon_{ijA}$$

Let  $\varepsilon = \varepsilon_{ijA} - \lambda_i$ 

$$P_{ijA\cap A} = \int_{-\infty}^{\infty} \exp\left[e^{-\varepsilon} - \varepsilon - \lambda_i\right] d\varepsilon$$
$$= \int_{-\infty}^{\infty} e^{-e^{-\varepsilon} - \varepsilon} e^{-\lambda_i} d\varepsilon$$
$$= e^{-\lambda_i} \int_{-\infty}^{\infty} e^{-e^{-\varepsilon} - \varepsilon} d\varepsilon$$
$$= e^{-\lambda_i} \int_{-\infty}^{\infty} f(\varepsilon) d\varepsilon$$
$$= e^{-\lambda_i} (1)$$
$$= \frac{1}{1 + e^{V_{ijB} - V_{ijA}} + e^{V_{ijNT} - V_{ijA}}}$$
$$= \frac{e^{V_{ijA}}}{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}$$

 $P_{ijB\cap B}$  can be calculated in a similar manner so that,

$$P_{ijT} = P_{ijA\cap A} + P_{ijB\cap B}$$
$$\frac{e^{V_{ijA}} + e^{V_{ijB}}}{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}$$

D _	$e^{V_{ijNT}}$
$I_{ijNT} -$	$\overline{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}$

# 6 Appendix 2

$\mathbf{E}$	ffectiver	ness Attribut	e				
Level				Frequency		Percent	
S	ome Depr	essive Sympton	ms	365		36%	
N	ot Depressed			641		64%	
	Thera	py Hours Att	trib	ute			
	Level	Frequency	Pe	ercent			
	0	212	21	%			
	2	150	15	%			
	4	117 1		12%			
	6	527	52%				
	Cost A	Attribute					
	Level	Frequency	Pe	ercent			
	10	10	1%	1%			
	15	151	15	%			
	20	10	1%	.%			
	90	181	18	%			
	100	153	15	5%			
	105	105         159         16           120         27         39		16% 3%			
	120						
	150	31	3%	3%			
	200	3	0.3% 11%				
	300	112					
	350	169	17	17%			
	Anti-I	Depressant U	se /	Attribu	te		
	Level	Level Frequency		Percent			
	No	241	24	%			
	Yes	765 76'		%			
	Orgası	m Side Effect	tribute	<u> </u>			
	Level					Freque	
	No Orgasm Side Effect D			oes Not	Occur	776	
	No Org	asm Side Effec	t O	ccurs		230	
No Orgasin Side Effect (							

Sex Drive Side Effect Attribute						
Level	Frequency	Percent				
No Sex Drive Side Effect Does Not Occur	680	68%				
No Sex Drive Side Effect Occurs	326	32%				

Weight Gain Side Effect AttributeLevelFrequencyPercentNo Weight Gain52152%

5% Weight Gain	244	24%
10% Weight Gain	130	13%
15% Weight Gain	111	11%

	Not	Therapy		Anti-	No	No Sex	Weight
	Depressed	Hours	Cost	Depressants	Orgasm	Drive	Gain
Not Depressed	1.00	0.18	0.23	0.07	0.20	0.27	-0.09
Therapy Hours	0.18	1.00	-0.02	-0.09	-0.24	0.09	-0.44
Cost	0.23	-0.02	1.00	-0.12	-0.09	-0.35	-0.32
Anti-Depressants	0.07	-0.09	-0.12	1.00	0.05	0.30	0.14
No Orgasm	0.20	-0.24	-0.09	0.05	1.00	0.00	-0.11
No Sex Drive	0.27	0.09	-0.35	0.30	0.00	1.00	0.02
Weight Gain	-0.09	-0.44	-0.32	0.14	-0.11	0.02	1.00

Design Correlation between Attribute Differences