Patient Preferences for Depression Treatment Programs and Willingness To Pay for Treatment:
Heterogeneity and Anhedonia

Short title: Patient Preferences for Depression Treatment Programs

Edward Morey *
Department of Economics, University of Colorado-Boulder

Jennifer Thacher †
Department of Economics, University of New Mexico

W. Edward Craighead
Department of Psychology, University of Colorado-Boulder

July 9, 2006

*Edward Morey and Jennifer Thacher are equal authors and rotate authorship position across articles. We thank Kaiser Permanente for allowing us to conduct the study and Arne Beck, Cathy Bartsch, and Carolee Nimmer for sponsoring the project. Special thanks to the patients who participated in the study and the clinicians who recruited them. Thanks to Nick Flores, Luke Rodgers, and Don Waldman for valuable comments and suggestions.

†Correspondent. 505-277-1965; Fax: 505-277-9445; jthacher@unm.edu; MSC305 3060, University of New Mexico, Albuquerque NM 87108
Abstract

Background: Current estimates of the societal costs of depression do not include estimates of how much individuals diagnosed with Major Depressive Disorder (MDD) would pay to eliminate their depression. Choice experiment data and discrete-choice random-utility models provide a useful method for valuing changes in mental health and mental-health treatment programs.

Aims of the study: (1) To demonstrate how choice experiments and discrete-choice random-utility models can be used to estimate preferences over treatment programs for depression and willingness-to-pay (WTP) to eliminate depression. (2) To model and estimate the magnitude of the anhedonia impact of depression: consumption provides less utility when one is depressed. (3) To model heterogeneity in preferences for treatment programs for depression. (4) To derive preliminary estimates of WTP and willingness-to-accept (WTA) for eliminating and reducing depression, both with, and without side effects.

Methods: The data are from a choice experiment survey of 104 individuals diagnosed with a new episode of MDD. Individuals indicated their preferred treatment from options that varied in effectiveness, hours of psychotherapy per month, use of anti-depressants, money costs, and side effects (weight gain, little or no interest in sex, inability to orgasm). Choices over treatment alternatives, including no treatment, were modeled using a discrete-choice random-utility model. Preference parameters were estimated using maximum likelihood estimation.

Results and Discussion: Estimated WTP to eliminate MDD is large but side effects can substantially reduce WTP. Preferences over treatment programs, and WTP, vary as a function of the individual’s age, gender, income category, body-mass-index, and family composition. Some depressed individuals seeking treatment have a high estimated probability of choosing no treatment. Depression has both a direct and indirect effect on utility. The indirect effect on utility, where the utility from consumption varies with emotional state, causes a divergence between WTP and WTA. This study should be replicated with a larger sample.

Implications: The WTP estimates suggest that depression imposes a high cost on society beyond the cost of treatment and the cost of lost output.
These costs should be included in any benefit-cost analysis of whether additional societal resources should be allocated to the treatment of depression. Side effects from anti-depressants also impose a large cost on society. Estimates such as the ones obtained in the paper could provide a mechanism for better matching treatment programs to the patient and thus potentially minimizing non-adherence. The WTP estimates suggest that the pharmaceutical industry could earn significant revenues by making anti-depressants more effective, reducing their side effects, or both.

**Key words:** Choice questions, discrete-choice random-utility models, depression, treatment preferences, WTP, WTA, income effects, anhedonia

**JEL classification:** I190, Q510

## 1 Background

Major Depressive Disorder (MDD) and its effective treatment are a widespread, chronic, and expensive problem. Over their lifetime, 10 to 25% of women and 5 to 12% of men will suffer from MDD. More than half of individuals who experience one episode of MDD also experience a second [1]. Over the next decade experts predict that depression will become the second leading cause of disability [2].

There are numerous studies assessing the cost of depression in terms of treatment costs and lost productivity. For example, in 1990 the direct costs of treating depression (MDD, bipolar disorder, and dysthymia) in the United States totaled approximately $12.4 billion while the indirect costs associated with MDD and bipolar disorder were even larger at $22.3 billion [3]. The total annual cost of depression in Europe was estimated at €118 billion in 2004 [4].

These types of estimates exclude the “cost” of reduced enjoyment of life. Efficient allocation of limited resources requires knowing the value that individuals place on eliminating their depression. Policymakers can use this information to make decisions about how much public money to invest in depression treatment and research. Pharmaceutical firms can use it to decide how much to invest in research and development of anti-depressants.

---

1 See also [5].
One would expect $WTP$ to eliminate MDD to be high: living with clinical depression greatly reduces one’s quality of life. Studies have found that individuals reliably rank MDD as worse than other chronic diseases (such as asthma, diabetes, hypertension, arthritis, neurologic disease, heart disease, back problems) [6], impairments to physical health [7], and in some cases view severe MDD as equivalently bad as or worse than death [8].

This study has multiple aims. One is to show how choice experiments and discrete-choice random-utility models can be used to estimate preferences over treatment programs for depression and $WTP$ to eliminate depression. Choice experiment data and discrete-choice random-utility models are standard tools for valuing commodities and policies, and are used in many fields to estimate preferences and $WTP$. But, to our knowledge, there are no applications to treatment programs for mental illness or mental-health states. Because of difficulties separating out patient preferences from those of the health care-provider, estimates of $WTP$ are difficult to obtain from revealed preference data, which looks at actual treatment choices.

A second goal is to model and estimate the magnitude of the anhedonia impact of depression. Anhedonia, the diminished interest or pleasure in almost all activities, is a hallmark of depression. In economic terms, anhedonia could be viewed as reduced utility from consumption. In this paper, we test whether, as expected, depression level reduces the utility received from consuming other goods and quantify this impact. One interesting implication of the anhedonia effect is that it makes an individual willing to pay more to end her depression than she would have to paid to

---

2There is an extensive literature on the theory and application of choice experiments in marketing, transportation, and economics [9]. For a discussion of this and other methods in this journal, see [10]. These types of questions are also commonly called conjoint analysis, choice questions, and discrete-choice experiments.

3There is a small literature examining patient depression treatment preferences. These studies have used standard gamble [8], open-ended contingent valuation questions [11], and a limited choice format [12] to learn about preferences over MDD treatment programs. The focus of these studies has been on examining how patients felt about alternate treatment methods and demographic factors that explain these preferences, not quantifying $WTP$ to reduce depression. In one case, [11], $WTP$ to avoid certain side effects is estimated. None of these studies use data from choice experiments to estimate a discrete-choice random-utility model.
accept being depressed ($WTA > WTP$).

An additional goal is to model the heterogeneity in preferences for treatment programs for depression. The probability of choosing a specific treatment is modeled and estimated as a function of the treatment options available, and as a function of observable characteristics of the individual such as age, income, gender and family composition. Understanding systematic ways in which these preferences vary is helpful in attempts to increase patient adherence and to design new drugs.

Finally, initial estimates of $WTP$ and $WTA$ are reported for eliminating and reducing depression, both with, and without side effects. To our knowledge, there have been no previous attempts to quantify, in dollars, the cost of depression to those depressed.\(^4\) The intent is not to suggest that these are the "numbers" but to indicate possible magnitudes and the extent to which they vary across individuals in predictable ways. The intent is not to provide an estimate of average $WTP$ to eliminate depression for the entire population of individuals with MDD.

An emphasis is placed on examining the impacts of side effects on choice and $WTP$ for treatment. This is important because many studies find that patients stop taking anti-depressants soon after starting treatment (e.g. [14]). In addition, the demand for anti-depressants has been found to be positively affected by reduced side effects [15]. We consider the the possibility that if the side effects are sufficiently severe, some will prefer to remain depressed. The probability of choosing no treatment is estimated for those considering treatment.

\section{Methods}

\subsection{The population of interest and the sample}

The focus of the study was on adults who suffered solely from MDD, were considering treatment, and were eligible for out-patient treatment. Eligible patients were recruited from those adults seeking treatment for a new episode of MDD at a Kaiser

\(^4\)An article in this journal recently advocated using surveys to estimate $WTP$ for a family member’s treatment for mental illness [13].
Permanente (HMO) outpatient, mental-health facility in Colorado.\(^5\) Both individuals seeking treatment for the first time and those with previous treatment experience seeking treatment for a new episode of depression were eligible for the study.

We focus on this population for a number of reasons. A significant share of individuals with MDD seek treatment; for example, [16] finds that 57% of individuals with MDD sought treatment in the past year. The focus of our study is on learning more about the characteristics of treatment that are important to patients when considering treatment and quantifying the value patients place on ending their depression, rather than on examining barriers that prevent patients from seeking treatment. Kaiser Permanente is the nation’s largest HMO, with approximately 8.4 million members. Learning about the preferences of patients in a setting typical of how many HMO patients receive their treatment can provide insight and guidance about a significant segment of the depressed population. Limiting the sample to those without co-morbidities allows a cleaner analysis of depression treatment preferences.

All intake patients at the clinic, prior to meeting with a clinician, received a note informing them of the study. Clinicians conducted a semi-structured mental health evaluation with each intake patient. While a formal instrument was not used to diagnose depression, this form of evaluation reflects current practice at this, and other, HMOs. Clinicians were asked to use their best judgement in determining mild, moderate, or severe MDD. Clinicians were instructed by Kaiser to ask those with MDD to participate in the survey.

Surveys were administered in person to patients at the end of their intake appointment by the survey administrator (Jennifer Thacher), who was available to answer any questions. Kaiser Permanente provided the administrator with an office in the clinic.

\(^5\)Based on consultation with the clinicians and doctors at the clinic, we excluded from our population of interest individuals who had other mental disorders (bipolar disorder, schizophrenia, psychotic features, etc.), who possessed substance abuse problems, or who were suffering from a life-threatening physical illness. We also excluded patients assessed as suicidal, requiring inpatient care, or deemed not mentally capable of being interviewed.
104 individuals completed the survey and provided usable data. Although several factors such as uneven clinician participation made it difficult to assess the precise number of patients who fully met the recruitment criteria, it is our sense that most individuals who were asked to participate in the study did and that a number of clinicians made serious efforts to recruit. Because intakes are randomly assigned to clinicians, we have no reason to believe that those individuals who completed our survey are unrepresentative in terms of our population of interest.

2.2 The survey instrument

The survey consisted of 37 questions, took approximately 15 minutes to complete, and consisted of four sections.\textsuperscript{6} Section 1 provided background information about psychotherapy, anti-depressants, and side effects. It included questions on perceptions and attitudes about treatment. Section 2 consisted of five choice experiments and a question on the importance of each treatment characteristic in answering the choice experiments. Section 3 collected demographic information and elicited information about any previous depression treatment. Section 4 asked a series of questions about the patient’s experience at the clinic. The survey instrument underwent extensive testing and revisions and was pre-tested on populations at both the University of Colorado and Kaiser Permanente.

For each choice experiment, respondents chose their preferred treatment from two alternative depression treatment programs. Figure 1 (page 23) shows an example choice experiment from the survey. Each question describes treatment by its effectiveness, cost, hours of psychotherapy, use of anti-depressants, and possible side effects. We allowed for three side effects: loss of sex drive, becoming non-orgasmic, and extent of weight gain.\textsuperscript{7} For example, the question in Figure 1 asks the respondent to choose between a treatment that eliminates her depression but causes a 15% increase in weight gain.

\textsuperscript{6}The survey instruments can be found at www.unm.edu/~jthacher/DepressionSurvey.pdf.
\textsuperscript{7}There are other possible side effects of taking anti-depressants such as dry mouth and diarrhea, but, unlike the weight gain and sexual side effects, they are typically treatable.
weight gain and a treatment that reduces her depression but causes both the loss of sex drive and no-orgasm side effects. An additional question followed each choice pair and asked the individual to choose between the previously chosen treatment plan and no treatment.

In making these choices, individuals are choosing over three health states: their current level of depression, some depressive symptoms, and no depression. Respondents were told to assume that each treatment plan would last one year and permanently eliminate or reduce the depression. “Some depressive symptoms” was defined as a reduction in MDD where the individual still experiences some symptoms of depression. Respondents were told that the symptoms were not as severe as full depression but were more intense than the normal feelings of sadness experienced by non-depressed individuals. These states are associated with varying time and money costs and side effects.

One reason to use a choice experiment survey is that the patient’s actual treatment program (the observed “choice”) does not necessarily reflect the patient’s preferences: the observed choice is the outcome of a dance between the patient, the clinician, and the insurance company. Thus, looking at actual treatment choices may not be informative about patient preferences. Choice questions are easily designed so that there is independent variation in each attribute of a treatment program and can include treatment options not currently available.

2.3 The Data

All individuals in the study were diagnosed by a clinician as having MDD: 22% were diagnosed with mild MDD, 48% with moderate MDD, and 7% with severe

---

8 Asking a follow-up question generates more information about preferences than simply including the no-treatment option in the original choice.

9 The design for the choice experiment was created by first generating a factorial design that only included reasonable combinations of attributes. For example, side effects could only occur when taking an anti-depressant and treatments with a higher number of hours of therapy were associated with higher costs. Using the SAS %choiceff macro, we selected 16 choice sets for the final design and divided it into four different survey versions.[17] [18]. An additional simple first choice experiment was created by hand and added to each survey.
MDD. Forty-five percent of the sample were receiving their first-ever treatment for depression. Of those who had previously received treatment, 76% had received antidepressants; of these, 56% experienced reduced sex drive, 42% experienced weight gain, and 36% experienced inability to orgasm.

Descriptive statistics for the variables used in the econometric models are presented in Table 1. Women comprised 75% of the sample. Eighty-one percent of respondents were White, Non-Hispanic. The average age of participants was 40. The most common response to highest completed level of education was “some college”. The average household income, based on the midpoint of income ranges in the survey, was $53,738. Looking at the choice attribute levels, the average weight gain among the three alternatives (A, B, and follow-up), was 2.8%.

When choosing between treatment programs, respondents chose the least-cost alternative 35% of the time. They chose not depressed over some depressive symptoms 61% of the time. In 89% of the follow-up choices, respondents chose treatment.

### 2.4 Data Analytic Procedures

#### 2.4.1 Choice modeling

A discrete-choice random-utility model is assumed with $K$ treatment alternatives, including no treatment. The individual is assumed to choose the preferred alternative given her current depression and her projection of what life would be like with either some depressive symptoms or no depression but additional costs and side effects. Each individual answered five sets of $A$, $B$ choice pairs with follow-up.

Denote the deterministic component of the random-utility model for individual $i$ choosing treatment $k$ as:

$$ V_{ik} = f(Y_i - P_k) + h(T_i - H_k) + g(X_k). $$

(1)

$Y_i$ is income, $P_k$ is the cost of alternative $k$, $T_i$ is free time, $H_k$ is the number of therapy hours, and $X_k$ is a vector of the characteristics of treatment $k$, including
effectiveness and side effects. Income not spent on treatment, \((Y_i - P_k)\), is spent on
the numeraire and time not spent on therapy, \((T_i - H_k)\), is spent in other activities.

Assuming that the error term follows an i.i.d. extreme value distribution, the
probability that individual \(i\) chooses alternative \(A\) from the \(j^{th}\) choice pair is:

\[
Pr_{ijA} = \frac{e^{V_{ijA}}}{e^{V_{ijA}} + e^{V_{ijB}}}.
\]

(2)

The probability that individual \(i\) chooses no treatment, \(NT\), over the preferred
treatment alternative in the \(j^{th}\) choice pair is:

\[
Pr_{ijNT} = \frac{e^{V_{ijNT}}}{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}.
\]

(3)

The likelihood function takes the following form:

\[
L = \prod_{i=1}^{107} \prod_{j=1}^{5} (Pr_{ijA})^{r_{ijA}} (1 - Pr_{ijA})^{1-r_{ijA}} (Pr_{ijNT})^{r_{ijNT}} (1 - Pr_{ijNT})^{1-r_{ijNT}}.
\]

(4)

\(r_{ijA}\) takes a value of 1 when alternative \(A\) is chosen and 0 otherwise. \(r_{ijNT}\) is defined
similarly. Maximum likelihood estimation is on the basis of 506 choices as not all
individuals answered the entire set of five choice experiments.

We present two specifications of Equation 1. In both specifications, utility from
treatment is modeled as a function of time and money cost, type of treatment
(whether it includes anti-depressants), effectiveness of treatment (whether it elimi-
nates depression or only reduces it), and presence of side effects. The attribute levels
in the choice experiments were chosen to test whether these attributes are significant
factors in treatment choice. The specifications vary in the inclusion of observable
preference heterogeneity.

In specification 1, the utility individual \(i\) gets from treatment \(k\) is:

\[
U_{ik} = \beta_d D_k + \beta_{ds} DS_k + \alpha_y + \alpha_y D_k + \alpha_{ys} DS_k (Y_i - P_k)
+ \alpha_t (FreeTm_i - ThHrs_k) + [\beta_a + \beta_o O_k + \beta_{sx} SX_k + \beta_w W_k + \beta_{w,0.5} W_k^{0.5}] AD_k
+ \varepsilon_{ik}.
\]

10
In this specification 1, depression affects utility both directly and indirectly. The first line of Equation 5 allows depression state to have a direct (and presumably negative) impact on utility, independent of consumption. $D_k$ and $DS_k$ take a value of 1 if the health state in treatment $k$ is depression or depressive symptoms, respectively. These terms are zero if the chosen treatment eliminates depression. The second line in Equation 5, the anhedonia effect, allows depression to affect utility indirectly through the utility one obtains from consuming the numeraire. This specification allows us to test whether individuals feel the same way about market goods regardless of their depression level. Note that this specification restricts the marginal utility of income to be constant for a given health state (this restriction is dropped in specification 2), but allows the marginal utility of income to vary with health state. The third line of Equation 5 captures the time costs of treatment while the fourth line shows the impact of three side effects: no orgasm ($O_k$), reduced sex-drive ($SX_k$), and weight gain ($W_k$). The side effect terms are zero if the treatment has no antidepressant side effects. Specification 1 assumes everyone has the same preferences over treatment programs - obviously a highly restrictive and untenable assumption; the impact of side effects and costs on choice of treatment, or even whether to get treatment, is likely to vary greatly across individuals.

Specification 2 allows for preference heterogeneity and is shown in Equation 6.

$$U_{ik} = (\beta_d + \beta_{de} Ed_i) D_k + (\beta_{ds} + \beta_{dse} Ed_i) DS_k$$

$$+ (\alpha_y + \alpha_{yd} D_k + \alpha_{yds} DS_k + \alpha_{yl} L_i + \alpha_{ym} M_i) (Y_i - P_k)$$

$$+ (\alpha_t + \alpha_{tk} K_i) (FreeTm_i - ThHrs_k)$$

$$+ \left[ \begin{array}{c}
\beta_a + \beta_{apw} P_{v_i} + \\
(\beta_o + \beta_{oa} Age_i + \beta_{og} G_i + \beta_{os} S_{p_i}) O_k + \\
(\beta_{sx} + \beta_{sxy} G_i + \beta_{sxa} Age_i + \beta_{sxs} S_{p_i}) SX_k + \\
(\beta_w + \beta_{wy} G_i + \beta_{wb} BMI_i + \beta_{wa} Age_i) W_k + \beta_{w,5} W_k^{0.5}
\end{array} \right] AD_k$$

$$+ \varepsilon_{ik}$$

Specification 2 allows the direct effects of MDD and depressive symptoms on utility to vary with education level. Marginal utility of income varies with both health state and household income level (low, medium and high). Thus, there are
two types of income effects: the utility from consumption depends on the health state and the marginal utility of income depends on income category. The marginal utility of time varies as a function of whether the individual has children under five. And the disutility associated with side effects is allowed to vary as a function of age, previous experience with anti-depressants, gender, the presence of a live-in partner, and BMI. All were the factors that we thought might influence how individuals would feel about the sexual and weight-gain side effects of anti-depressants.

2.4.2 WTP and WTA

Income effects exist in both specifications 1 and 2 because the marginal utility of money is a function of health state.\(^\text{10}\) Thus, WTP does not equal WTA. Consider an individual’s WTP to go from a state with MDD to a state of non-depression under specification 1. An individual would be willing to pay an amount such that her utilities are the same in both states:

\[
g(X^0) + (\alpha_y + \alpha_{yd})Y_i + \epsilon_i0 = g(X^1) + \alpha_y (Y_i - WTP_i) + \epsilon_i1. \tag{7}
\]

Thus the deterministic portion of WTP is:

\[
WTP_i = \frac{g(X^0) - g(X^1)}{\alpha_y} - \frac{\alpha_{yd}}{\alpha_y}Y_i. \tag{8}
\]

The first term, \(\frac{g(X^0) - g(X^1)}{\alpha_y}\), is the direct effect on utility of a change in emotional state: it is the marginal rate of substitution between emotional state and income. The second term, \(-\frac{\alpha_{yd}}{\alpha_y}Y_i\), is the indirect effect on utility from a change in emotional state. WTP is based on the constant marginal utility of money that applies in the improved state, \(\alpha_y\). For the same scenario,

\[
WTA_i = \frac{g(X^0) - g(X^1)}{\alpha_y + \alpha_{yd}} - \frac{\alpha_{yd}}{\alpha_y + \alpha_{yd}}Y_i. \tag{9}
\]

A similar interpretation holds for this formula, except that now things are valued on the basis of marginal utility of income when depressed (\(\alpha_y + \alpha_{yd}\)).

Comparing Equations 8 and 9 shows that in absolute terms, WTA > WTP: you must pay an individual more to remain depressed than she is willing to pay

\(^{10}\)There are additional income effects in specification 2.
to eliminate her depression. Because individuals value dollars less when depressed, depressed individuals must be paid significantly more to accept continuing MDD. The formulas for \( WTP \) and \( WTA \) are similar in specification 2 but also include traditional income effects.

3 Results

3.1 Marginal values of treatment attributes

Table 2 reports the parameters estimates from specifications 1 and 2 (Equations 5 and 6). Most parameters are highly significant and of the expected sign across both specifications. Ceteris paribus, individuals prefer treatments that cost less. Emotional state affects utility both directly and indirectly. The presence of either MDD or depressive symptoms lowers utility directly; as would be expected the effect is stronger for MDD than for depressive symptoms. The direct effect of MDD on utility is greatest for those with a college degree while the parameter \( \beta_{dse} \) is insignificant, suggesting that education does not affect the disutility directly caused by depressive symptoms. The null hypothesis that current emotional state does not affect the marginal utility of money is rejected.\(^{11}\) As would be expected, specification 2 shows that for a given health state, marginal utility from consumption drops as household income increases. Therefore, eliminating MDD increases an individual’s utility level both because she prefers being not depressed and because an individual values goods more when she is not depressed.

[Table 2 here]

The marginal utility of time is significant and positive for individuals with small children, making those individuals, ceteris paribus, less likely to choose therapy. For everyone else, and like in specification 1, one cannot reject the null that the marginal utility of time is zero. The fact that \( \beta_a \) is insignificant while \( \beta_{apv} \) is significant suggests that most patients don’t care whether treatment includes anti-depressants.

\(^{11}\)A likelihood ratio test rejects the hypothesis that \( \alpha_{yds} = \alpha_{ydt} = 0 \) (\( LRT = 25.44 > \chi^2_2 (.05) = 5.99 \)).
as long as treatment has have no side effects; however, those with previous experience with anti-depressants prefer treatment programs that include them.

On average, side effects decrease the utility from treatment. However, when individual characteristics are accounted for, the impacts of the side effects on utility are mixed. Not being able to orgasm is a negative whose magnitude is unaffected by gender, but its negative impact declines significantly with age. Males care about loss of sex drive but one cannot reject the null hypotheses that females do not care about this side effect. Whether one has a live-in partner does not affect how one feels about the sexual side effects and age was not found to affect how one feels about loss of sex drive. Gaining weight from taking anti-depressants makes all individuals worse off; utility decreases at an increasing rate as the percent of weight gain increases. Females are impacted more than males. The negative impact increases with an individual’s body-mass-index score.

Specification 2, on the basis of a likelihood ratio test, explains the answers to the choice experiments significantly better than does specification 1 and correctly predicts more of the choices made: 72% (67% in specification 1) of the AB choices, 87% (87%) of the follow-up choices, and 63% (59%) of both choices. Thus, although both models give consistent results, we not surprisingly conclude that individual characteristics matter: there is no ”one size fits all” treatment for depression. Preferences for depression treatment varies in predictable and observable ways. All results in the following section are based on specification 2 results.

3.2 Predicting treatment choice

The above results can be used to investigate who is more or less likely to choose different types of treatments, including no treatment. As noted earlier, many depressed individuals prematurely stop treatment and many depressed individuals never seek treatment. Table 3 shows how for a representative individual, the probability of choosing no treatment varies as a function of income level for six different costless treatment options.\textsuperscript{12} For example, if the treatment options were two hours of ther-

\textsuperscript{12}The representative individual was identified based on the most common characteristics of individuals in our sample.
apy a month at zero cost, or no treatment, only 4% of individuals from high-income households are predicted to choose no treatment but 18% of low-income households are predicted to choose no treatment. These numbers rise to 11% and 37% respectively if the individual has small children (not shown in table).

Table 3 also shows the extent to which side effects from anti-depressants increase the probability of choosing no treatment. For example, if the choice is between no treatment or treatment with anti-depressants with all three side effects, specification 2 predicts that 50% of low-income individuals will choose no treatment. Only 18% will choose no treatment if the anti-depressants are side effect free, an almost three-fold increase.

[Table 3 here]

Using the sample population, we calculated for each individual the probability of choosing a variety of possible treatment and then averaged over the sample. These sample averages are then reported in Table 4 for each treatment option. Treatment $B$, anti-depressants with the sexual side effects and a cost of $50, has the highest probability of being chosen. The model predicts that on average, there is a 31% chance that an individual in our sample would choose this treatment plan while there is a 19% probability that she would choose no treatment. Treatment $D$, anti-depressants with no side effects and a cost of $350 has the next highest probability of being chosen (24%).

[Table 4 here]

As would be expected given the superior fit of specification 2 over specification 1, individuals deviate greatly from the average as a function of their observable characteristics. Columns two and three of Table 4 report the minimum and maximum estimated choice probabilities for each of the five alternatives. Consider Treatment $B$, anti-depressants with the sexual side effects and a cost of $50. The patient in the sample least likely to choose this treatment (7%) is 18 years old, male, does not have a college degree or kids, earns less than $30,000, and has not had previous treatment with anti-depressants. In contrast, the patient most likely to choose this treatment
is a 66 year old female with a college degree who possesses more free time than the young male patient but who is similar in other ways; she has a 54% probability of choosing this option.

Table 3 clearly shows that for all types of treatment, those from lower income categories are much more likely to choose not to treat their depression. This results from two effects: (1) eliminating MDD benefits lower-income individuals less because they consume less, and (2) for a given benefit, they are willing to pay less to achieve the benefit.

3.3 \textit{WTA} and \textit{WTP} estimates

Table 5 presents \textit{WTA} and \textit{WTP} estimates for specification 2. The estimated expected \textit{WTP} to eliminate depression is high for many individuals. As discussed later, this is consistent with other results on how individuals rank depression compared to other medical conditions.

[Table 5 here]

The survey indicated that the treatment plans would last for one year and permanently eliminate or reduce the depression, so the amounts reported are \textit{WTP} per month for 12 months to permanently eliminate or reduce their depression. Table 5 reports \textit{WTP} and \textit{WTA} for a number of different treatment scenarios; in each case, it shows the expected value for a representative individual as well as the minimum and maximum values that could be obtained.

There are several important points to note about Table 5. For our representative individual, estimated expected \textit{WTP} is highest for a “magic-pill” cure (no side effects and no cost): $686 per month. But the estimated amount varies across the individuals from $305 to $1700. An individual with less than a college degree, earning an annual income of less than $10,000, and with no previous experience with anti-depressants is \textit{WTP} $305. An individual with a college degree earning an annual income of $150,000 or more who has previous experience with anti-depressants is \textit{WTP} $1700.
$WTP$, in terms of money, for the elimination of depression drops substantially when the cure requires one to endure side effects - non-monetary costs. For the representative individual, adding a 5% weight gain to the cure caused expected $WTP$ to drop from $686 to $406; adding both sexual side effects reduces her $WTP$ in terms of money to $225 - a three-fold drop.

$WTP$ for eliminating depression takes the largest number of different estimated values when the treatment includes all three side effects. As can be seen from Table 5 some individuals would actually have a negative estimated $WTP$, where the negative amount indicates that the treatment makes the individual worse off, even though it eliminates their depression. A young overweight man without a college degree, without previous experience with anti-depressants, and in the lowest income category has the lowest overall $WTP$.

4 Discussion

We find that preferences for treating MDD vary significantly as a function of observable characteristics of the individual. As a result, there is strong variation in $WTP$ and the probability of choosing competing treatments. [11] also found significant variation in WTP among patients.

Our finding that demographic characteristics are a significant factor in explaining treatment preferences is shared by [12] but not by [8]. While (author?) [11] found significant variation in WTP among patients, they did not find significant differences by income, gender, age, or education groups, in stated WTP to avoid certain side effects.

We find empirical evidence that depression has both a direct and indirect effect on utility. The indirect effect on utility, where the utility from consumption varies with depression level, causes a divergence between $WTP$ and $WTA$. This might be deemed the anhedonia effect: money is worth less when one is depressed. We seem to be the first to quantify this effect.

Our finding that more severe levels of depression affect one more negatively is certainly not unexpected: [8] find a similar result, although their study was not able
to quantify this effect.

The results also indicate substantial WTP to eliminate depression. This is not surprising given that individuals often view depression as comparable to life-threatening diseases such as cancer, and some view severe MDD as equivalently bad or worse that death. Thus, although at first glance some of our WTP estimates seem large, we find them plausible. $3660 ($305 x 12 months) is a lot for someone with a yearly income of less than $10,000 to pay for a permanent cure free of side effects, but not that great when one considers what people pay and do to treat diseases such as cancer - borrowing would be required.

Care must be taken in drawing broad inferences from our small sample. In addition to its small size, we don’t know how representative it is of the population of depressed individuals, without other co-morbidities, who seek treatment for MDD. That said, these caveats do not negate our results that those in the sample have significant estimated WTP in terms of money and side effects to change their emotional state and that a significant amount of that variation can be explained in terms of observable characteristic of the individual.

Our results are suggestive and indicate the desirability of conducting a similar study with a larger and more representative sample.

5 Implications for policy and treatment

5.1 For allocating resources to the treatment of depression

The WTP estimates suggest that depression imposes a high cost on society that is above and beyond the cost of treatment and the cost of lost output: many depressed individuals would pay dearly not to be depressed and would pay even more to not be depressed and not experience side effects. The costs in terms of reduced utility from depression should be included in any benefit-cost analysis designed to determine whether additional societal resources should be allocated to the treatment of depression.

In addition, the estimated large differences between WTP for reducing depression
with and without side effects, suggests that side effects from anti-depressants also impose a large cost on society. The magnitude of these differences make it less easy to dismiss the affect of sexual and weight-gain side effects on peoples’ lives.

5.2 For treating the individual

Our finding that one treatment does not fit all is not new. That said, our estimates suggest a mechanism for better matching treatment programs to the patient in a world of assembly-line medicine. Before any treatment plan is discussed with the patient, the treatment provider could have an estimate of the probability of a patient choosing each treatment option available as a function of the monetary costs to the individual (what their insurance would pay for each option) and easily observable characteristics of the individual (age, gender, income, etc.). This information can provide a starting point for discussion given the limited time of the care provider. It could help the care provider better direct the discussion and to investigate further if the patient expresses a preference drastically different than what their demographics would suggest.

The types of estimates presented could also be used to prevent non-adherence. Many people do not adhere to an anti-depressant regime because of side effects. A clinic could schedule follow-ups for those most likely, in terms of their characteristics, to choose no treatment in the presence of side effects.

5.3 For the pharmaceutical industry

Currently, anti-depressants do not eliminate, or even reduce, depression in everyone who diligently takes them. In addition, many who take them experience sexual and weight gain side effects. Our WTP estimates suggest the magnitude of revenues that the pharmaceutical industry could earn by making the drugs more effective and reducing the side effects associated with the drugs.
5.4 For economic theory

Economists, for the most part, ignore the impact of emotional health states on preferences, utility, and choice, and can overlook emotional state shifts as a reason for \( WTP \) and \( WTA \) divergence. This research provides estimates of how much the two can diverge because of depression.

5.5 For future research

In many senses, our study is a pilot study. The study should be done more generally with a larger sample and more protocols in place to assess response rates and representativeness. Doing so would provide more definitive estimates of \( WTP \) for the depressed population. To make our results more policy relevant, co-morbidities of depression need to be modeled, along with the depression.

Since the patients in our study were depressed, answering the choice experiments required that they consider what it would be like to experience a different emotional state. Recent research shows that individuals tend to mis-predict how much changes will affect their long-run utility [19]. This raises the question of whether the depressed mispredict what it would be like to be not depressed. To address this issue one could redo our study but follow the patients over time, recording treatment adherence, assessing their level of depression over time, and asking additional choice experiments as their level of depression does or does not abate. Future research needs to monitor compliance and collect data from those who do and do not continue treatment. More data is needed on how individuals’ trade-offs between effectiveness and costs might or might not change as treatment progresses.

There are many ways to model heterogeneity in choice other than assuming the heterogeneity is completely and deterministically generated by variations in observable characteristics of the individual. One could for example investigate probabilistic heterogeneity using a random-parameters framework or a latent-class model. Or, one could estimate models that allow for both explained and unexplained heterogeneity.
References


Figure 1: Example choice experiment

<table>
<thead>
<tr>
<th></th>
<th>Alternative A</th>
<th>Alternative B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>Not Depressed</td>
<td>Some Depressive Symptoms</td>
</tr>
<tr>
<td>Hours of psychotherapy per month</td>
<td>6 hours</td>
<td>6 hours</td>
</tr>
<tr>
<td>Use of anti-depressants</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Your monthly cost for treatment</td>
<td>$350</td>
<td>$350</td>
</tr>
<tr>
<td>Weight gain from treatment</td>
<td>15% weight gain</td>
<td>None</td>
</tr>
<tr>
<td>Little or no interest in sex</td>
<td>Side effect occurs</td>
<td>No side effect</td>
</tr>
<tr>
<td>Inability to achieve an orgasm</td>
<td>No side effect</td>
<td>Side effect occurs</td>
</tr>
</tbody>
</table>

Check the box of the alternative you prefer

- [ ] I prefer Alternative A
- [ ] I prefer Alternative B

If you had to choose, would you prefer the alternative you chose in question 10 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 10, 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
Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Std Dev</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio-demographic variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Ed_i$</td>
<td>Individual $i$ has less than a college degree (1=No college degree, 0=College degree)</td>
<td>0.74</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>$Li$</td>
<td>Individual $i$ has annual household income less than $30,000(1=Yes, 0=No)</td>
<td>0.23</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>$Mi$</td>
<td>Individual $i$ has annual household income less than $80,000(1=Yes, 0=No)</td>
<td>0.43</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>$Y_i$</td>
<td>Monthly household income</td>
<td>4519</td>
<td>2496</td>
<td>104</td>
</tr>
<tr>
<td>$FreeTm_i$</td>
<td>Average monthly free time</td>
<td>317</td>
<td>85</td>
<td>104</td>
</tr>
<tr>
<td>$Pv_i$</td>
<td>Previously received treatment with anti-depressants (1=Yes, 0=No)</td>
<td>0.42</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>$Age_i$</td>
<td>Age</td>
<td>40</td>
<td>11</td>
<td>101a</td>
</tr>
<tr>
<td>$Gi$</td>
<td>Gender (1=Female, 0=Male)</td>
<td>0.74</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>$Sp_i$</td>
<td>Has live-in partner (1=Yes, 0=No)</td>
<td>0.67</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td>$BMI_i$</td>
<td>Body Mass Index score</td>
<td>28</td>
<td>7</td>
<td>104</td>
</tr>
<tr>
<td><strong>Choice experiment attributes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$D_k$</td>
<td>Emotional state in treatment $k$ is continued MDD (1=Yes, 0=No)</td>
<td>0.33</td>
<td></td>
<td>1518</td>
</tr>
<tr>
<td>$DS_k$</td>
<td>Emotional state in treatment $k$ is Some Depressive Symptoms (1=Yes, 0=No)</td>
<td>0.24</td>
<td></td>
<td>1518</td>
</tr>
<tr>
<td>$P_k$</td>
<td>Average monthly price of treatment</td>
<td>102</td>
<td>121</td>
<td>1518</td>
</tr>
<tr>
<td>$ThHrs_k$</td>
<td>Average monthly therapy hours</td>
<td>2.6</td>
<td>2.7</td>
<td>1518</td>
</tr>
<tr>
<td>$AD_k$</td>
<td>Treatment involves use of anti-depressants (1=Yes, 0=No)</td>
<td>0.66</td>
<td></td>
<td>1518</td>
</tr>
<tr>
<td>$O_k$</td>
<td>Experiences the no-orgasm side effect (1=Yes, 0=No)</td>
<td>0.16</td>
<td></td>
<td>1518</td>
</tr>
<tr>
<td>$SX_k$</td>
<td>Experiences the reduced sex-drive side effect (1=Yes, 0=No)</td>
<td>0.22</td>
<td></td>
<td>1518</td>
</tr>
<tr>
<td>$W_k$</td>
<td>Weight gain (% increase )</td>
<td>2.8%</td>
<td>4.7%</td>
<td>1518</td>
</tr>
</tbody>
</table>

---

a Missing observations were mean filled for estimation purposes

b N here reflects attribute levels over all alternatives and choice sets
Table 2: Maximum Likelihood Parameter Estimates: 506

Choices

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification 1</th>
<th>Specification 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est</td>
<td>S.E.</td>
</tr>
<tr>
<td><strong>Marginal values: direct effects of depression</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_d$</td>
<td>−1.26</td>
<td>0.44</td>
</tr>
<tr>
<td>$\beta_{de}$</td>
<td>1.33</td>
<td>0.47</td>
</tr>
<tr>
<td>$\beta_{ds}$</td>
<td>−0.08</td>
<td>0.28</td>
</tr>
<tr>
<td>$\beta_{dse}$</td>
<td>0*</td>
<td>−</td>
</tr>
<tr>
<td><strong>Marginal values: indirect effects of depression</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha_y$</td>
<td>3.08</td>
<td>0.81</td>
</tr>
<tr>
<td>$\alpha_{yd}$</td>
<td>−0.36</td>
<td>0.08</td>
</tr>
<tr>
<td>$\alpha_{yds}$</td>
<td>−0.13</td>
<td>0.06</td>
</tr>
<tr>
<td>$\alpha_{yl}$</td>
<td>0.87</td>
<td>0.25</td>
</tr>
<tr>
<td>$\alpha_{ym}$</td>
<td>0.29</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Marginal values: time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha_t$</td>
<td>0.68</td>
<td>1.45</td>
</tr>
<tr>
<td>$\alpha_{tk}$</td>
<td>5.04</td>
<td>2.13</td>
</tr>
<tr>
<td><strong>Marginal values: treatment effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_a$</td>
<td>0.12</td>
<td>0.18</td>
</tr>
<tr>
<td>$\beta_{apv}$</td>
<td>0.42</td>
<td>0.28</td>
</tr>
<tr>
<td><strong>Marginal values: orgasm side effect</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_o$</td>
<td>−0.65</td>
<td>0.16</td>
</tr>
<tr>
<td>$\beta_{oa}$</td>
<td>0.24</td>
<td>0.13</td>
</tr>
<tr>
<td>$\beta_{og}$</td>
<td>0*</td>
<td>−</td>
</tr>
<tr>
<td>$\beta_{os}$</td>
<td>0*</td>
<td>−</td>
</tr>
<tr>
<td><strong>Marginal values: sex drive side effect</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{sx}$</td>
<td>−0.25</td>
<td>0.16</td>
</tr>
<tr>
<td>$\beta_{sxg}$</td>
<td>1.12</td>
<td>0.32</td>
</tr>
<tr>
<td>$\beta_{sxa}$</td>
<td>0*</td>
<td>−</td>
</tr>
</tbody>
</table>
### Table 2: (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification 1</th>
<th>Specification 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est</td>
<td>S.E.</td>
</tr>
<tr>
<td>( \beta_{sx} )</td>
<td>0*</td>
<td>-</td>
</tr>
<tr>
<td><strong>Marginal values: weight-gain side effect</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \beta_w )</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>( \beta_{wg} )</td>
<td>-0.12</td>
<td>0.03</td>
</tr>
<tr>
<td>( \beta_{wb} )</td>
<td>-3.99</td>
<td>1.97</td>
</tr>
<tr>
<td>( \beta_{wa} )</td>
<td>0*</td>
<td>-</td>
</tr>
<tr>
<td>( \beta_{w,t} )</td>
<td>-0.43</td>
<td>0.17</td>
</tr>
</tbody>
</table>

| LnL      | -465.57|       | -432.306          |

<sup>a</sup> Not significant - fixed at 0

<sup>a</sup> Calculated from t statistic with one degree of freedom

Income in thousands of dollars. Age in 10’s. BMI in 1000’s.
Table 3: Probability Representative Individual Chooses No Treatment as a Function of Income and Treatment Characteristics

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Income = 20K</th>
<th>Income = 55K</th>
<th>Income = 90K</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Hours of Therapy</td>
<td>18%</td>
<td>9%</td>
<td>4%</td>
</tr>
<tr>
<td>Anti-depressants: No Side Effects</td>
<td>18%</td>
<td>9%</td>
<td>4%</td>
</tr>
<tr>
<td>No Orgasm Side Effect</td>
<td>30%</td>
<td>16%</td>
<td>8%</td>
</tr>
<tr>
<td>No Sex Drive</td>
<td>16%</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>5% Weight Gain</td>
<td>35%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>All 3 Side Effects</td>
<td>50%</td>
<td>31%</td>
<td>17%</td>
</tr>
</tbody>
</table>

Calculated for sample representative individual from specification 2 estimates:

\[ FreeTm = 7.944, K = 0, Ed = 1, Pv = 0, G = 1, BMI = 0.027 \]

Table 4: Heterogeneity Causes Differences in Preferred Treatment

<table>
<thead>
<tr>
<th>Treatment Option</th>
<th>Probability Choose Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Therapy Only (4 hours per month; $400)</td>
<td>13% 2% 25%</td>
</tr>
<tr>
<td>B: Anti-depressants Only (Sexual side effects $50)</td>
<td>31% 7% 54%</td>
</tr>
<tr>
<td>C: Anti-depressants &amp; Therapy (2 hours; 5% Weight gain; $250)</td>
<td>13% 4% 30%</td>
</tr>
<tr>
<td>D: Anti-depressants Only (No side effect; $350)</td>
<td>24% 16% 37%</td>
</tr>
<tr>
<td>E: No Treatment</td>
<td>19% 4% 42%</td>
</tr>
</tbody>
</table>
Table 5: Monthly Estimated WTP and WTA for Example Treatments to Eliminate MDD: Representative Individual (R.I.) and Possible Range

<table>
<thead>
<tr>
<th>Treatment</th>
<th>WTP</th>
<th></th>
<th>WTA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.I.$^a$</td>
<td>Min</td>
<td>Max</td>
<td>R.I.$^a$</td>
</tr>
<tr>
<td>AD: No Side Effects</td>
<td>$686$</td>
<td>$305$</td>
<td>$1700$</td>
<td>$747$</td>
</tr>
<tr>
<td>AD: Therapy - 2 hours</td>
<td>$686$</td>
<td>$305$</td>
<td>$1769$</td>
<td>$747$</td>
</tr>
<tr>
<td>AD: No-Orgasm</td>
<td>$479$</td>
<td>$-1$</td>
<td>$1480$</td>
<td>$521$</td>
</tr>
<tr>
<td>AD: Reduced Sex Drive</td>
<td>$713$</td>
<td>$-4$</td>
<td>$1483$</td>
<td>$776$</td>
</tr>
<tr>
<td>AD: 5% Weight Gain</td>
<td>$406$</td>
<td>$-11$</td>
<td>$1547$</td>
<td>$441$</td>
</tr>
<tr>
<td>AD: Sexual Side Effects &amp; 5% Weight Gain</td>
<td>$225$</td>
<td>$-252$</td>
<td>$1020$</td>
<td>$245$</td>
</tr>
</tbody>
</table>

R.I. based on specification 2 estimates: $FreeTm = 7.944$, $K = 0$, $Ed = 1$, $Pv = 0$, $G = 1$, $BMI = .027$, $Y = 4.499$, $L = 0$, $M = 1$, $Age = 4.0$