Modeling and Estimating Preferences Over Treatment Programs for Depression

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

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

Choice question data and discrete-choice random-utility models are used to estimate preferences over the characteristics of treatment programs for depression. Preferences are allowed to vary across individuals as a function of their observable characteristics. The data comes from a survey of 107 patients diagnosed with Major Depressive Disorder (MDD) at a HMO mental-health facility. The data is analyzed using maximum likelihood estimation.

The findings include: (1) The value of consuming market goods is less when one is depressed. This is a type of income effect and drives a wedge between willingness-to-pay to eliminate one’s depression and willingness-to-accept it. Traditional income effects are also important. (2) The probability of choosing no treatment can be high and varies across individuals as a function of income, age, gender, and other observable individual characteristics. (3) Willingness-to-pay to avoid sexual and weight gain side effects can be high but also varies extensively across individuals.
In the United States, Major Depressive Disorder (MDD) is a widespread and chronic 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 depression also experience a second [1].

Depressed individuals are less productive at work than non-depressed individuals [2]. Experts predict that over the next decade depression will become the second leading cause of disability [3]. In 1990 the direct costs of treating depression (MDD, bipolar disorder, and dysthymia), such as medical services, medication, and therapy, totaled approximately $12.4 billion, accounting for more than two percent of all direct expenditures on health. Indirect costs associated with MDD and bipolar disorder from lost labor productivity and mortality were even larger at $22.3 billion, approximately 0.5% of GDP. These costs are similar to the costs associated with cancer, AIDS, and coronary heart disease [4]. But, most importantly, living with clinical depression greatly reduces one’s quality of life. Up to 15% of those suffering from MDD commit suicide [1].
Somewhat surprisingly, a significant share of individuals with MDD discontinue treatment prematurely [5, 6, 7]. For example, Lin et al. [8] found that 28% of primary care patients stopped taking anti-depressants within one month of beginning treatment; 44% had stopped within three months. One possible explanation is that the treatment method, often chosen by the health-care provider, does not match patient preferences. Another possibility is that how individuals feel about the side effects and costs changes as the level of depression wanes.

This study examines the treatment preferences of patients with MDD. We use a discrete-choice random-utility framework to model and estimate preferences over treatment attributes as a function of patient characteristics. Treatment attributes include effectiveness, money and time costs, type of treatment, and sexual and weight gain side effects. 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 easier to treat. We model how depressed individuals trade off treatment attributes as a function of depression severity, income, age, gender, and previous experience with side effects. We estimate: (1) the extent that perceived depression level affects the value of market goods; (2) other income effects; (3) the
probability of choosing no treatment; (4) willingness-to-pay to eliminate or reduce depression versus willingness-to-accept it; and (5) willingness-to-pay to avoid side effects.

The data come from a choice question survey administered to patients diagnosed with MDD at a HMO mental-health facility. The terms choice questions, choice experiments, and conjoint analysis are used interchangeably in the literature. There is an extensive literature on the theory and application of choice questions in marketing, transportation, and economics. For survey articles see: Louviere [9], Louviere [10], Wittink and Cattin [11], Green and Srinivasan [12], Batsell and Louviere [13], Adamowicz et al. [14]. To name a few examples, choice experiments have been used to examine patient treatment preferences over: asthma symptoms [15]; miscarriage management [16]; the diagnosis and treatment of severe knee injuries [17, 18]; health states involving respiratory and cardiovascular illnesses [19]; wait time for treatment [20]; cervical cancer screening [21]; health state preferences [22]; the location of surgery facilities [23]; rheumatology care [24]; and treatment of menorrhagia [25].

For each choice question, respondents chose their preferred treatment from two alternative depression treatment programs. Figure 1 shows an
example choice question from the survey. One reason to use a choice ques-
tion 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. 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.

Our results show that preferences over the side effects vary significantly
as a function of patient characteristics such as age and gender. This has
important implications for tailoring the treatment to the patient. In addi-
tion, the results indicate significant willingness-to-pay (WTP) to eliminate
or reduce MDD.

To our knowledge, this is the first study that estimates how the value
of market goods varies with one’s level of depression. Our empirical results
suggest that depressed individuals place less value on market goods/money
than individuals who are not depressed. This reflects that depressed individ-
uals have diminished ability to enjoy the things that money can buy. While
we are not the first to use choice questions to estimate treatment preferences
for illnesses, we are the first to use choice question data to value in dollars,
treatment programs for MDD.

Previous studies have used standard gamble [26], open-ended contingent valuation questions [27], and a limited choice format [28] to learn about preferences over MDD treatment programs. In the study by Dwight-Johnson et al. [28], patients chose over treatment programs that varied by cost, number of months spent in treatment, probability of cure, type of treatment, and presence of nausea or headache. The study by Dwight-Johnson et al. [28] was not based on a random utility model and did not estimate the preference weights on each of the attributes. The outpatient populations in each of these studies were primary-care patients who were screened with depression and patients currently being treated for depression.

Results vary across the three studies. Revicki and Wood [26] found that treatment preferences varied with current depression severity but not with demographic characteristics. Severe depression was ranked as the worst of all possible depression and remission states, with 25% of the sample considering severe depression as worse or equivalent to death. Imipramine was typically considered less preferred than the other medications studied, nefazodone and fluoxetine, because of the resultant side-effects.

Dwight-Johnson et al. [28] found that the majority of primary-care pa-
tients preferred active treatment of depression to a wait-and-see approach; patients were fairly evenly divided on the preferred treatment method (anti-depressants, individual counseling, group counseling). Treatment preferences varied by ethnicity, gender, income, and knowledge about treatment options. For example, wealthier individuals or those with more knowledge about anti-depressants were more likely to prefer active treatment.

While O’Brien et al. [27] 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. Average WTP to avoid each side effect are significantly different from each other at the 6% level. O’Brien et al. [27] find the most significant differences in WTP to avoid blurred vision (WTP=$Can22 per month) and dry mouth (WTP=$Can11 per month). The side-effects, specific to the anti-depressants studied, included blurred vision, tremor, sleepiness, dizziness, constipation, sweating, and dry mouth.
1 Survey and Sample

The population of interest is depressed adults seeking treatment for a new episode of MDD at an outpatient HMO mental health facility. Since many individuals with MDD do not seek treatment or do not go to this type of facility, the population studied, while large, is not necessarily reflective of the general depressed population.

The sample includes both individuals seeking treatment for the first time and those with previous treatment experience who are seeking treatment for a new episode of depression. The study was conducted for 11 months at a Kaiser Permanente mental health facility in Colorado. The clinicians at Kaiser Permanente actively participated in survey design.

The sample includes individuals age 22 and older. Patients as young as 18 were asked to participate if they were financially independent from their parents. Based on consultation with the clinicians and doctors at Kaiser we excluded individuals who in addition to MDD had other mental disorders (bipolar disorder, schizophrenia, psychotic features, etc.) or who possessed substance abuse problems. We also excluded patients assessed as suicidal, those requiring inpatient care, and those deemed not mentally
capable of being interviewed. For patients older than 73, the clinicians used their own discretion as to the physical and mental capabilities of the patient to participate.

All intake patients, prior to meeting with a clinician, received a note informing them of the study. Before meeting with a clinician, all intake patients took the Shedler QuickPsychoDiagnostics (QPD) survey on a handheld device [29]. 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. Clinicians then conducted a semi-structured mental health evaluation with each intake patient. While a formal instrument was not used to diagnose depression, this semi-structured evaluation reflects current practice at this, and other, HMOs. Clinicians were asked to use their best judgement in determining mild, moderate, or severe MDD. Patients diagnosed with MDD were asked to participate in the study. If the patient was unable to participate because of time constraints, the clinician provided a take-home survey.

The number of intake patients eligible for our study was much smaller than we anticipated: co-morbidities with depression seemed to be the rule.
rather than the exception and many intakes were for other disorders. Whether treatment preferences for depression are influenced by co-morbidities such as anxiety disorders is a more important issue than we anticipated, but must be left for future research. It is our sense most individuals who were asked to participate in the study did and that the clinicians made serious efforts to recruit. That said, the clinicians were sometimes too time constrained to recruit and did not always inform us of these occasions. So, an accurate assessment of the size of the population of interest and the proportion of it that we interviewed is not possible. We have no reason to believe that those individuals who completed our survey are unrepresentative in terms of our population of interest.

Surveys were administered in person to patients at the end of their intake appointment by a survey administrator (Jennifer Thacher) who explained the first choice question to all respondents and was available to answer questions. Kaiser Permanente provided the administrator with an office in the clinic and she spent five days a week at the site for the duration of the study. With the exception of the pretest, we did not pay participants, as this was not allowed by Kaiser Permanente. The take-home surveys included a thank-you note and a nominal gift of $2; previous research has shown that
nominal gifts increase the probability that the survey will be completed [30].
The survey instrument underwent extensive testing and revisions and was
pre-tested on populations at both the University of Colorado and Kaiser
Permanente.

The survey consisted of 37 questions and took approximately 15 minutes
to complete. The overall readability level was grade six, as assessed by the
Flesch-Kincaid Grade Level score. The survey had four sections. 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 the five pair-wise choice and follow-up
questions and a question on the importance of each treatment characteristic
in answering the choice questions. Respondents were told to assume that
each treatment plan would last one year and permanently eliminate or reduce
the depression. 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. An example
survey can be seen at www.unm.edu/~jthacher/DepressionSurvey.pdf.

Figure 1 shows an example choice question from the survey. Each ques-
tion 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. For example, this question asks the respondent to choose between eliminating her depression but experiencing a 15% weight gain and no interest in sex and reducing her depression but experiencing the no-orgasm side effect. An additional question followed each choice pair and asked the individual to choose between the previously chosen treatment plan and no treatment. Each survey contained five pairs of choice questions. In making these choices, individuals are choosing over three emotional states: their current level of depression, some depressive symptoms, and no depression. "Some Depressive Symptoms" was defined as a reduction in MDD where the individual still experiences some 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 experienced by non-depressed individuals. These states are associated with varying time and money costs and side effects.

[Figure 1 about here.]

The design for the choice questions was created by first generating a
factorial design that only included reasonable combinations of attributes [19]. For example, side effects only occurred in combination with taking anti-depressants. In addition, the design allowed for positive correlation between the cost and the number of hours spent in therapy. Then on the basis of D-optimality efficiency we selected 16 choice sets for the final design and divided it into four different survey versions. The choice sets were selected using the SAS \texttt{%choiceff} macro [31]. See Huber and Zwerina [32] and Zwerina et al. [33] for a discussion of this method. An additional simple first choice question was created by hand and added to each survey. We assigned choice pairs to survey versions so as to ensure that there were no implausible comparisons across choice pairs.

2 The Data

One hundred seven individuals took the survey. For estimation purposes, missing age and household income variables were mean filled; missing education data was median filled. Table 1 shows some of the sociodemographic characteristics of the sample. Women comprised 75% of the sample. Eighty-one percent of respondents were White, Non-Hispanic. The average age of
participants was 40 (s.d.=11); the youngest was 18 and the oldest was 74.
The most common response to highest completed level of education was
"some college". The average household income, based on the midpoint of
income ranges, was $53,738.

Table 2 shows the depression level and previous treatment experience
of patients at the time of the survey. All individuals in the study were
diagnosed as clinically depressed: of those whom the clinicians assigned a
score, 22% were diagnosed with mild MDD, 48% with moderate MDD, and
7% with severe 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 anti-depressants.

[Table 1 about here.]

When choosing between treatment programs, respondents chose the least-
cost alternative only 35% of the time. They chose not depressed over some
depressive symptoms only 61% of the time. In 89% of the follow-up choices,
respondents chose treatment.
Table 1: Sample Descriptive Statistics: Sociodemographics

<table>
<thead>
<tr>
<th>Level</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Education Level (N=106)</td>
<td>&lt; College Degree</td>
<td>129</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40</td>
<td>11</td>
<td>18</td>
<td>74</td>
<td>104</td>
</tr>
<tr>
<td>Household Income (Midpoint)</td>
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<td>$30,516</td>
<td>$5000</td>
<td>$150,000</td>
<td>103</td>
</tr>
<tr>
<td>Body Mass Index Score</td>
<td>28</td>
<td>7</td>
<td>16</td>
<td>55</td>
<td>107</td>
</tr>
</tbody>
</table>
3 Model

A discrete choice random-utility model is assumed with $K$ treatment alternatives, including no treatment; error terms are assumed to follow an extreme-value distribution. 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, each followed by a follow-up choice between the chosen alternative and no treatment ($NT$). Denote the utility to individual $i$ of choosing treatment $k$ from the $j^{th}$ choice set

$$U_{ijk} = V_{ijk} + \varepsilon_{ijk}, \ i = 1...107, \ j = 1,...,5, \ k \in [A,B,\text{and } NT]$$

where

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

$Y_i$ 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 $k$. 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. The probability that individual $i$ chooses alternative $A$ from the $j^{th}$ choice pair
is
\[ \text{Pr}_{ijA} = \frac{e^{V_{ijA}}}{e^{V_{ijA}} + e^{V_{ijB}}}. \] (3)

The probability that individual \( i \) chooses no treatment, \( NT \), over the preferred treatment alternative in the \( j^{th} \) choice pair is:
\[ \text{Pr}_{ijNT} = \frac{e^{V_{ijNT}}}{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}. \] (4)

The likelihood function takes the following form:
\[
L = \prod_{i=1}^{107} \prod_{j=1}^{5} (\text{Pr}_{ijA})^{r_{ijA}}(1 - \text{Pr}_{ijA})^{1-r_{ijA}}(\text{Pr}_{ijNT})^{r_{ijNT}}(1 - \text{Pr}_{ijNT})^{1-r_{ijNT}}. \] (5)

\( r_{ijA} \) 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 questions that they were presented.

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 eliminates depression or only reduces it), and presence of side-effects. Interviews and pre-tests indicated that these were the most important determinants of treatment choice. The attribute levels in the
choice questions were chosen to test whether in fact these attributes are significant factors in treatment choice.

The model is presented in two steps: first without preference heterogeneity (Model 1) and then with preference heterogeneity as a function of individual characteristics such as age and gender (Model 2). The probability of selecting no treatment and \( WTP \) estimates are presented for only Model 2.

3.1 Model 1: Allowing Emotional State to Affect Utility Indirectly through Consumption and Directly

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

\[
U_{ik} = (\alpha_y + \alpha_{yd}D_k + \alpha_{yds}DS_k)(Y_i - P_k) \\
+ \alpha_t (FreeTm_i - ThHrs_k) \\
+ \beta_d D_k + \beta_{ds} DS_k \\
+ [\beta_a + \beta_o O_k + \beta_{ax} SX_k + \beta_w W_k + \beta_{w.5} W_k^{0.5}] AD_k \\
+ \varepsilon_{ik}
\]
where,

\[ D_k = \text{Emotional state in treatment } k \text{ is continued MDD (1=Yes, 0=No)} \]

\[ DS_k = \text{Emotional state in treatment } k \text{ is Some Depressive Symptoms (1 = Yes, 0 = No)} \]

\[ Y_i = \text{Individual } i\text{'s monthly household income (in thousands of dollars)} \]

\[ P_k = \text{Monthly price of treatment } k \text{ (in thousands of dollars)} \]

\[ FreeTm_i = \text{Non-sleeping hours minus work hours} \]

\[ ThHrs_k = \text{Hours spent in therapy per month} \]

\[ AD_k = \text{Treatment involves use of anti-depressants (1=Yes, 0=No)} \]

\[ O_k = \text{Experiences the no-orgasm side effect (1=Yes, 0=No)} \]

\[ SX_k = \text{Experiences the reduced sex-drive side effect (1=Yes, 0=No)} \]

\[ W_k = \text{Weight gain (% increase)} \]

In Model 1 (Equation 6), emotional state affects utility both directly and indirectly. First, emotional state is allowed to have a direct and negative impact on utility, independent of consumption (the term \( \beta_d D_k + \beta_{ds} DS_k \)). This term equals zero if the treatment eliminates the individual’s depression: \( D_k \) takes a value of 1 if alternative \( k \) does not change their current depressed state and 0 otherwise; \( DS_k \) takes a value of 1 if alterna-
tive $k$ changes their emotional state to Some Depressive Symptoms and zero otherwise. Emotional state is also allowed to affect utility indirectly by affecting the utility one obtains from consuming the numeraire. This is shown by the term $(\alpha_y + \alpha_{yd} D_k + \alpha_{yds} DS_k) (Y_i - P_k)$, where $(Y_i - P_k)$ is income individual $i$ has left to spend on the numeraire after treatment $k$.

This specification allows one to test whether individuals feel the same way about market goods regardless of their depression level. Note that the term $(\alpha_y + \alpha_{yd} D_k + \alpha_{yds} DS_k) (Y_i - P_k)$ restricts the marginal utility of income to be constant for a given emotional state, but allows the marginal utility of income to vary with emotional state.

The three side effects considered are no orgasm ($O$), reduced sex-drive ($SX$), and weight gain ($W$). These affect utility through the term,

$$\left[\beta_a + \beta_o O_k + \beta_{sx} SX_k + \beta_w W_k + \beta_{w.5} W_k^{0.5}\right] AD_k,$$

which is zero if treatment has no anti-depressant side effects. The variables $O$ and $SX$ take a value of 1 if alternative $k$ has this side effect and 0 otherwise; $W$ is a continuous variable equal to the percentage gain in weight.

The term $\alpha_t (FreeTm_i - ThHrs_k)$ captures the time costs of treatment. $FreeTm_i$ is hours not asleep and not at work and $ThHrs_k$ is the number of
therapy hours associated with treatment $k$.

Model 1 correctly predicts 67% of the AB choices, 87% of the follow-up choices, and 59% of both choices. Table 3 reports the parameter estimates for Model 1. Most parameters are highly significant and of the expected sign. Ceteris paribus, individuals prefer treatments that cost less. Depression lowers utility directly. A likelihood ratio test rejects the hypothesis that $\alpha_{ys} = \alpha_{yd} = 0$ ($LRT = 25.44 > \chi^2_{2}(.05) = 5.99$). Thus we can reject the hypothesis that current emotional state does not affect the marginal utility of money: both the current level of MDD and depressive symptoms reduce the utility from consumption. 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.

In this simple model with no preference heterogeneity, the marginal value of free time is not significantly different from zero.

The insignificance of the $\beta_a$ parameter indicates that if anti-depressants have no side effects, individuals are indifferent whether treatments include anti-depressants. Side effects decrease the utility from treatment.

[Table 2 about here.]
Income effects exist in this model because the marginal utility of money is a function of the alternative chosen. Thus, \( WTP \) does not equal \( WTA \).

Consider an individual’s \( WTP \) to go from a state with MDD to a state of non-depression. An individual would be willing to pay an amount such that her utilities are the same in both states:

\[
g (X^0) + (\alpha_y + \alpha_{yd})Y_i + \varepsilon^0 = g (X^1) + \alpha_y (Y_i - WTP_i) + \varepsilon^1
\]

The deterministic component of the \( WTP \) formula is:

\[
WTP_i = \frac{g (X^0) - g (X^1)}{\alpha_y} - \frac{\alpha_{yd} Y_i}{\alpha_y}
\] (7)

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, \( -\frac{\alpha_{yd} Y_i}{\alpha_y} \), 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. For the same scenario, the deterministic component of willingness to accept is:

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

A similar interpretation holds for this formula, except that now things are valued on the basis of marginal utility of income when depressed (\( \alpha_y + \alpha_{yd} \)).
In absolute terms, $WTA > WTP$. You must pay an individual more to remain depressed than she is willing to pay to eliminate her depression: individuals value dollars less when depressed, so depressed individuals must be paid significantly more to accept continuing MDD. $WTA$ and $WTP$ estimates are presented below for Model 2, the model with heterogeneity.

3.2 Model 2: Modifying Model 1 to allow for preference heterogeneity

Model 1 demonstrates how marginal utility of income varies with emotional state, creating a wedge between $WTA$ and $WTP$ for a change in emotional state, but does not investigate whether treatment preferences vary as a function of observable characteristics on the individual. How and if they do would be useful information for clinicians. With this in mind, Model 2 (Equation 9) generalizes Model 1 in a number of ways.

Model 2 allows the marginal utility of income to vary with both emotional state and household income level (low, medium and high). Model 2 thus has two types of income effects: the marginal utility of income depends on the alternative chosen and the marginal utility of income depends on
income category. This second type of income effect allows the marginal utility to drop, in steps, as household income increases: marginal utility of income for low-income households differs from high-income households by the parameter \( \alpha y_L \), and marginal utility of income for medium-income households differs from high-income households by the parameter \( \alpha y_M \). This step specification for income effects is discussed in detail in Morey et al. [34].

Model 2 also generalizes Model 1 by allowing the marginal utility of time to vary as a function of whether the individual has children under five: the marginal utility of time is \((\alpha_t + \alpha_{tk})\) for those with small children and \(\alpha_t\) for everyone else. How disutility from sexual and weight-gain side effects might vary across individuals is also investigated in Model 2. The disutility from a weight-gain side effect is allowed to vary as a function of age, gender, and Body Mass Index (BMI). The disutility for the sexual side effects are allowed to vary as a function of age, gender, and whether one has a live-in partner.

Model 2 generalizes Model 1 by allowing the direct affect on utility of a change in emotional state to depend on education level. Finally, Model 2 also allows the influence of treatment with anti-depressants to vary depending on whether the individual has previous experience with anti-depressants.
\[ U_{ik} = (\alpha_y + \alpha_{yd}D_k + \alpha_{yds}DS_k + \alpha_{yl}L_i + \alpha_{ym}M_i) (Y_i - P_k) \]

\[ + (\alpha_t + \alpha_{tk}Kid_i) (\text{FreeTm}_i - \text{ThHrs}_k) \]

\[ + (\beta_d + \beta_{de}Ed_i) D_k + (\beta_{ds} + \beta_{dse}Ed_i) DS_k \]

\[ \beta_a + \beta_{apv}Pv_i + \]

\[ (\beta_o + \beta_{oa}Age_i + \beta_{og}G_i + \beta_{oa}Sp_i) O_k + \]

\[ (\beta_{sx} + \beta_{sxa}Age_i + \beta_{sxs}Sp_i) SX_k + \]

\[ (\beta_w + \beta_{wg}G_i + \beta_{wb}BMI_i + \beta_{wa}Age_i) W_k + \beta_{w,5}W_k^{0.5} \]

\[ + \varepsilon_{ik} \]

(9)
where

\[ L_i = \text{Individual } i \text{ has annual household income less than } $30,000 (1=Yes, 0=No) \]

\[ M_i = \text{Individual } i \text{ has annual household income less than } $80,000 (1=Yes, 0=No) \]

\[ K_i = \text{Individual } i \text{ has at least one child less than 5 years of age (1=Yes, 0=No)} \]

\[ Ed_i = \text{Individual } i \text{ has less than a college degree (1=No college degree, 0=College degree)} \]

\[ P_{vi} = \text{Previously received treatment with anti-depressants (1=Yes, 0=No)} \]

\[ Age_i = \text{Age (in 10s)} \]

\[ G_i = \text{Gender (1=Female, 0=Male)} \]

\[ Sp_i = \text{Has live-in partner (1=Yes, 0=No)} \]

\[ BMI_i = \text{Body Mass Index score (in 1000s)} \]

The two important research questions are: (1) whether the finding in Model 1 that the marginal utility of income declines with depression was merely an artifact of the restrictive assumption that everyone has the same preferences, and (2) which observable characteristics of the individual significantly influence treatment choice.

Model 2 was estimated in two steps: first with all parameters in Equation 9, then with the insignificant parameters (based on p-values) fixed at
zero. A likelihood ratio test rejects the null hypothesis that including these insignificant parameters significantly increases the fit of the model ($LRT = 6.20 < \chi^2_{15.05} = 15.51$). Model 2 correctly predicts 72% of the AB choices, 87% of the follow-up choices, and 63% of both choices. The Model 2 parameter estimates are reported in Table 4.

[Table 3 about here.]

The effect of depression on the marginal utility of income remains the same as in Model 1: utility from consumption decreases as depression worsens. In addition, holding emotional state constant, the estimated marginal utility of income is highest for low-income households and lowest for high-income households.

The direct effect of MDD on utility remains negative for all, but is greatest, in absolute terms, for those with a college degree: those without a college degree value the elimination of MDD less than those with a college degree.

Model 1 assumed everyone had the same constant marginal utility of time and the data could not reject the null hypothesis that it was zero. Model 2 finds the marginal utility of time significant and positive for individuals with small children making those individuals, ceteris paribus, less likely to choose
therapy. For everyone else, one cannot reject the null that the marginal utility of time is zero.

Most individuals are found to be indifferent between type of treatment as long as treatment with anti-depressants does not include side effects. The exception is individuals with previous experience with anti-depressants; these individuals prefer treatments with anti-depressants and no side effects over treatments without anti-depressants.

When individual characteristics are accounted for, the impacts of the sexual 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.
Model 2 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. For example, Table 5 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. For example, if the treatment options were two hours of therapy a month at zero cost, or no treatment, only 4% of individuals from high-income households are predicted to choose no treatment (11% if they have small children), but 18% of low-income households are predicted to choose no treatment (37% if they have small children). Table 5 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 any given benefit, they are willing to pay less to achieve the benefit.

[Table 4 about here.]

Table 5 also shows the extent to which side effects from anti-depressants increase the probability of choosing no treatment. For example, if the choice
is no treatment or treatment with anti-depressants with all three side effects. Model 2 predicts that 50% of low-income individuals will choose no treatment, but only 18% will choose no treatment if the anti-depressants are side-effect free, an almost three-fold increase.

Consider how a clinician might use the Model 2 estimates. Assume, for example, that the clinic has a patient population like our sample and four treatment plans available, those listed in Table 6. Patients also have a fifth option available, no treatment. Column one of Table 6 reports the average choice probability associated with each option. The probability of choosing each treatment alternative was calculated for each individual in the sample; this probability was then averaged over the sample. Column one reports that 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%).
One of the primary messages from Table 6 is that there is no "one-size-fits-all" treatment; the preferred treatment depends greatly on the treatment characteristics and an individual’s characteristics, such as income, age, and gender.

However, the clinician can much more accurately predict what treatment option a given individual would prefer: individuals deviate greatly from the average as a function of their observable characteristics. Columns two and three of Table 6 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% of choosing this option. The patient most likely to choose no treatment (42%) is a 30 year old male who earns less than $30,000, has small children, and does not have a college degree. The patient most likely to choose expensive anti-depressants with no side
effects (Treatment $D$) is a 32 year old female with a college degree who earns between $30,000 and $80,000, and has small children. By collecting information from each patient on the covariates found to be important in this study, clinics could calculate a personalized treatment preference probability for each patients. For example, in the case of the study site, the needed information questions could easily be collected through the QPD. These probabilities could be used as a starting point for discussion in consultation between the patient and health care provider.

Model 2 can also be used to estimate each patient’s $WTP$ estimates to eliminate depression as a function of treatment attributes and individual characteristics. One would expect these to be high: other studies have found that individuals reliably rank MDD as worse than other chronic diseases (such as, [35, 36]) and in some cases view severe MDD as equivalently bad as or worse than death [26]. Another issue to consider when interpreting $WTP$ is that individuals may account for the associated labor effects of treating their MDD; individuals may believe that an improved emotional state will allow them to earn a higher wage. We do not have data that would allow us to test for this last possibility.

The survey indicated that the treatment plans would last for one year
and permanently eliminate or reduce the depression, so the amounts reported are $WTP$ per month for 12 months. Table 7 reports $WTP$ and $WTA$ for a number of different treatment scenarios; in each case, it shows the mean welfare measure for a representative individual in the sample as well as the minimum and maximum sample welfare measure. Calculations assume that individuals do not switch between income categories as a result of treatment choices. Three important points are made in Table 7: the two types of income effects cause a wedge between $WTP$ and $WTA$, estimates are of a large magnitude, and there is significant heterogeneity among the sample. The most that a representative individual is willing to pay for a ”magic pill” cure, one with no time costs and no side effects, is $686. Table 7 shows, as would be expected, that both $WTP$ and $WTA$ measures are lower in the presence of side-effects. A representative individual from the sample is willing to pay the most to avoid a weight gain, followed by reduced sex drive, and no-orgasm. Finally, as would be expected from Table 6, there is great variation in how much individuals are willing to pay each treatment. For example, in the ”worst” treatment of anti-depressants that result in all three side effects, some individuals are made significantly worse off by the treatment while others are still willing to pay a significant amount to
eliminate their depression.

4 Conclusions

This study examines the treatment preferences of MDD patients at a HMO mental health clinic. We analyze choice question data using a random-utility discrete-choice model. The study demonstrates the feasibility of using choice question data to study treatment preferences for mental illnesses. Not surprisingly, individuals preferred treatment programs with lower costs, greater effectiveness, and fewer side effects. We found significant preference heterogeneity for depression treatment among individuals. Individual characteristics such as gender, age, current depression severity, income category, and previous treatment experience affect treatment preferences. Allowing preference heterogeneity shows that certain groups have a fairly high probability of choosing no treatment, even if the treatment is free. In addition to traditional income effects, we found that the value of market goods varies with emotional state: an individual values consumption less when depressed. This drives a wedge between \( WTA \) and \( WTP \). Because depressed individu-
als value money less, they must be paid more to remain depressed then they would be willing to pay to eliminate their depression.

All depressed individuals have experience with not being depressed. An issue is how accurately they call recall not being depressed. Research suggests that individuals might make mistakes with respect to judging what alternate emotional states would be like. It is not clear in which direction these mistakes would be. For example, would an individual be more likely to overestimate how wonderful life would be without depression or more likely to take the gloomy perspective that life wouldn’t be that much better without depression? Future work needs to more explicitly address this issue.

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.

References


tiveness and cost of fluoxetine vs. tricyclic antidepressants. *J Am Med Assoc* 1996; **275**:1897–1902


*Economic Journal* 1990; **100**:193–199


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[35] Wells K and Sherbourne C. Functioning and utility for current health of patients with depression or chronic medical conditions in managed primary care practices. *Archives of General Psychiatry* 1999; 56:897–904

Figure 1: Example choice question

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

<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 2: Sample Descriptive Statistics: Current Depression and Previous Treatment Experience

<table>
<thead>
<tr>
<th>Clinician’s Assessment of Depression Level (N=82)</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>23</td>
<td>22%</td>
</tr>
<tr>
<td>Moderate</td>
<td>51</td>
<td>48%</td>
</tr>
<tr>
<td>Severe</td>
<td>8</td>
<td>7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Side Effect Experience if Previously Used Anti Depressants (N=45)(^a)</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Gain Side Effect</td>
<td>19</td>
<td>42%</td>
</tr>
<tr>
<td>Diarrhea Side Effect</td>
<td>5</td>
<td>11%</td>
</tr>
<tr>
<td>Inability-to-Orgasm Side Effect</td>
<td>16</td>
<td>36%</td>
</tr>
<tr>
<td>Reduced Sex-Drive Side Effect</td>
<td>22</td>
<td>56%</td>
</tr>
<tr>
<td>Other Side Effect</td>
<td>11</td>
<td>24%</td>
</tr>
</tbody>
</table>

\(^a\)Individuals could experience multiple side effects.
Table 3: Model 1 Maximum Likelihood Parameter Estimates: LnL=-465.57, Choices = 506

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>S.E.</th>
<th>Est/s.e.</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_y$</td>
<td>3.08</td>
<td>0.81</td>
<td>3.78</td>
<td>0.00</td>
</tr>
<tr>
<td>$\alpha_{yd}$</td>
<td>-0.36</td>
<td>0.08</td>
<td>-4.55</td>
<td>0.00</td>
</tr>
<tr>
<td>$\alpha_{ys}$</td>
<td>-0.13</td>
<td>0.06</td>
<td>-2.19</td>
<td>0.01</td>
</tr>
<tr>
<td>$\alpha_t$</td>
<td>0.68</td>
<td>1.45</td>
<td>0.47</td>
<td>0.32</td>
</tr>
<tr>
<td>$\beta_d$</td>
<td>-1.26</td>
<td>0.44</td>
<td>-2.87</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{ds}$</td>
<td>-0.08</td>
<td>0.28</td>
<td>-0.28</td>
<td>0.39</td>
</tr>
<tr>
<td>$\beta_a$</td>
<td>0.12</td>
<td>0.18</td>
<td>0.65</td>
<td>0.26</td>
</tr>
<tr>
<td>$\beta_o$</td>
<td>-0.65</td>
<td>0.16</td>
<td>-4.04</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_s$</td>
<td>-0.25</td>
<td>0.16</td>
<td>-1.53</td>
<td>0.06</td>
</tr>
<tr>
<td>$\beta_w$</td>
<td>0.03</td>
<td>0.05</td>
<td>0.65</td>
<td>0.26</td>
</tr>
<tr>
<td>$\beta_{w2}$</td>
<td>-0.43</td>
<td>0.17</td>
<td>-2.54</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Table 4: Model 2 Maximum Likelihood Parameter Estimates: $LnL = -432.306$, Choices=506

<table>
<thead>
<tr>
<th>VarName</th>
<th>Est</th>
<th>S.E.</th>
<th>Est/S.E.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_y$</td>
<td>3.09</td>
<td>0.83</td>
<td>3.71</td>
<td>0.00</td>
</tr>
<tr>
<td>$\alpha_{yd}$</td>
<td>-0.27</td>
<td>0.07</td>
<td>-3.96</td>
<td>0.00</td>
</tr>
<tr>
<td>$\alpha_{yds}$</td>
<td>-0.14</td>
<td>0.03</td>
<td>-4.31</td>
<td>0.00</td>
</tr>
<tr>
<td>$\alpha_{yl}$</td>
<td>0.87</td>
<td>0.25</td>
<td>3.47</td>
<td>0.00</td>
</tr>
<tr>
<td>$\alpha_{ym}$</td>
<td>0.29</td>
<td>0.13</td>
<td>2.13</td>
<td>0.02</td>
</tr>
<tr>
<td>$\alpha_t$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\alpha_{tk}$</td>
<td>5.04</td>
<td>2.13</td>
<td>2.36</td>
<td>0.01</td>
</tr>
<tr>
<td>$\beta_d$</td>
<td>-2.42</td>
<td>0.56</td>
<td>-4.29</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{de}$</td>
<td>1.33</td>
<td>0.47</td>
<td>2.81</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{ds}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_{dse}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_a$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_{apv}$</td>
<td>0.42</td>
<td>0.28</td>
<td>1.48</td>
<td>0.07</td>
</tr>
<tr>
<td>$\beta_o$</td>
<td>-1.67</td>
<td>0.54</td>
<td>-3.07</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{oa}$</td>
<td>0.24</td>
<td>0.13</td>
<td>1.91</td>
<td>0.03</td>
</tr>
<tr>
<td>$\beta_{og}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_{os}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_{sx}$</td>
<td>-1.03</td>
<td>0.27</td>
<td>-3.77</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{sxg}$</td>
<td>1.12</td>
<td>0.32</td>
<td>3.53</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{sxa}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_{sxg}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_w$</td>
<td>0.19</td>
<td>0.08</td>
<td>2.51</td>
<td>0.01</td>
</tr>
<tr>
<td>$\beta_{wg}$</td>
<td>-0.12</td>
<td>0.03</td>
<td>-4.26</td>
<td>0.00</td>
</tr>
<tr>
<td>$\beta_{wb}$</td>
<td>-3.99</td>
<td>1.97</td>
<td>-2.03</td>
<td>0.02</td>
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<tr>
<td>$\beta_{wa}$</td>
<td>0*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\beta_{w,5}$</td>
<td>-0.34</td>
<td>0.18</td>
<td>-1.93</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*a* Not significant - fixed at 0

---

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Table 5: Model 2: Probability of Choosing 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 a representative individual in the sample: $FreeTm = 7.944$, $K = 0$, $Ed = 1$, $Pv = 0$, $G = 1$, $BMI = .027$*
Table 6: Model 2: 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 7: Model 2: Monthly WTP and WTA Estimates for Example Treatments to Eliminate MDD: Representative Individual (R.I.) and Sample Range

<table>
<thead>
<tr>
<th>Treatment</th>
<th>WTP</th>
<th>WTA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.I.</td>
<td>Min</td>
</tr>
<tr>
<td>AD: Therapy - 2 hours</td>
<td>$686</td>
<td>$305</td>
</tr>
<tr>
<td>AD: No-Orgasm</td>
<td>$479</td>
<td>$327</td>
</tr>
<tr>
<td>AD: Reduced Sex Drive</td>
<td>$713</td>
<td>$327</td>
</tr>
<tr>
<td>AD: 5% Weight Gain</td>
<td>$406</td>
<td>$327</td>
</tr>
<tr>
<td>AD: No Side Effects</td>
<td>$686</td>
<td>$305</td>
</tr>
<tr>
<td>AD: Sexual Side Effects &amp; 5% Weight Gain</td>
<td>$225</td>
<td>$252</td>
</tr>
</tbody>
</table>

*For a representative individual in the sample, FreeTm = 7.944, K = 0, Ed = 1, Pv = 0, G = 1, BMI = .027, Y = 4.499, L = 0, M = 1, Age = 4.0.