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Patient Preferences for Depression Treatment Programs and Willingness to Pay for Treatment

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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 be willing to pay to eliminate their depression or how much they would have to be paid in order to accept continued depression. Choice-question 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: (i) To demonstrate how choice questions 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. (ii) To investigate whether consumption of goods provides less utility when one is depressed (an anhedonia effect) and, if so, the magnitude of the effect. (iii) To model and estimate the extent of heterogeneity in preferences for treatment programs for depression. (iv) To derive preliminary estimates of *WTP* and willingness-to-accept (*WTA*) for eliminating depression, both with, and without side effects.

Methods: The data are from a choice-question 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 is found to have a direct, negative impact on utility, as expected. It also has an indirect effect: utility from consumption is found to decrease the more severe one's level of depression. The magnitude of this indirect effect is estimated. This indirect effect manifests itself by driving a wedge between estimated *WTP* to eliminate depression and *WTA* to accept continued depression. Preferences for treatment are only being estimated for those individuals who are referred to or directly seek treatment at a mental-health clinic, not for the general population of depressed. The estimates are plausible but the sample size is small, so caution is warranted.

Implications: The *WTP* estimates suggest that depression imposes a high cost on society beyond the cost of treatment and the cost of lost output. *WTP* 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 reported here could provide a mechanism for better matching treatment programs to the patient and thus potentially reduce non-adherence. The *WTP* estimates suggest that the pharmaceutical industry could increase revenues by making anti-depressants more effective or reducing their side effects.

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Background

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 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 from lost output 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] See Berto *et al.*[5] for a literature review of depression cost-of-illness studies.

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These types of estimates exclude the ''cost'' of reduced enjoyment of life. Efficient allocation of limited resources requires knowing the values that individuals place on eliminating their depression. Policymakers can use this information to help 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.

One would expect both willingness-to-pay (*WTP*) to eliminate MDD and willingness-to-accept (*WTA*) continued MDD to be high: living with clinical depression greatly reduces one's quality of life. Studies have found that individuals consistently rank MDD as worse than other chronic diseases (such as asthma, diabetes, hypertension, arthritis, neurological disease, heart disease, back problems)[6] and impairments to physical health,[7] and in some cases view severe MDD as equivalently bad or worse than death.[8]

This study has multiple aims. One is to show how choice questions and discrete-choice random-utility models can be used to estimate preferences over treatment programs for depression and thus *WTP* to eliminate depression and *WTA* to remain depressed. Choice-question data and discrete-choice random-utility models are standard tools for valuing commodities and policies, and have been extensively used in many fields to estimate preferences and *WTP*.[9-12] This method has not been previously used to estimate preferences, *WTP*, or *WTA* for mental-health programs.

A small literature has used the standard gamble approach,[8] open-ended contingent valuation questions,[13] and a limited choice format[14] to learn about preferences over MDD treatment programs. With the exception of O'Brien *et al.*,[13] the focus of these studies has been on examining how patients feel about alternate treatment methods and demographic factors that explain these preferences, not quantifying *WTP* to reduce depression. O'Brien *et al.*[13] estimates *WTP* to avoid certain side effects. A recent article in this journal advocated using surveys to estimate *WTP* for a family member's treatment for mental illness.[15] To our knowledge, there has been no previous work that estimates *WTA* in the area of mental health.

Because of difficulties separating out patient preferences from those of the health care-provider, estimates of *WTP* are difficult to obtain by observing treatment choices. Estimating *WTA* is even more problematic. One reason to use a choice-question survey of stated preferences 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.

A second aim of the paper is to test whether there is an anhedonia effect of depression and if so, estimate its magnitude; the null hypothesis is that there is no anhedonia effect. 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. We test whether depression level reduces the utility received from consuming goods.

A third goal is to model 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 demographic characteristics such as age, income, gender, and family composition. Understanding systematic ways in which preferences for treatment vary is helpful in attempts to increase patient adherence and to design new drugs.

Finally, preliminary estimates of *WTP* and *WTA* are reported for eliminating and reducing depression, both with, and without side effects. If an anhedonia effect exists, it implies hat an individual would have to be paid more to accept continued depression than she is willing to pay to end her depression ($WTA > WTP$). To our knowledge, there have been no previous attempts to quantify, in dollars, the cost of depression to those depressed. The intent is not to suggest that these are the ''numbers'' but to indicate possible magnitudes and the extent to which the emotional costs of depression, in dollars, 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.[16] In addition, reduced side effects positively affect the demand for anti-depressants.[17] We consider 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.

Methods

Population of Interest and Sample

The focus of the study was on adults who suffered solely from MDD, were considering treatment, and were eligible for outpatient treatment. Eligible patients were recruited from those adults seeking treatment for a new episode of MDD at a Kaiser Permanente (HMO) outpatient, mental-health facility in Colorado. 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. The study includes individuals with and without prior treatment for depression.

We focus on this population for a number of reasons. A significant share of individuals with MDD seeks treatment; for example, Kessler *et al.*[18] finds that 57% of individuals

with MDD seek treatment. 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 treatment can provide insight and guidance about a significant segment of the depressed population. Limiting the sample to those without co-morbidities allows for 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 HMO. Clinicians were asked to use their best judgment 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 an investigator (Jennifer Thacher), who was available to answer any questions. Kaiser Permanente provided her with an office in the clinic.

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.

Survey Instrument

The survey consisted of 37 questions, took approximately 15 minutes to complete, and consisted of 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 five pair-wise choice questions and a question on the importance of each treatment characteristic in answering the choice questions. 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.

In a choice-question survey, individuals are presented with competing alternatives and asked to choose their preferred one. Thus, in this survey, for each choice pair, respondents chose their preferred treatment from two alternative depression-treatment programs. **Figure 1** shows an example choice pair from the survey. Each alternative 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. While there are other possible side effects of taking anti-depressants such as dry mouth and diarrhea, unlike the weight gain and sexual side effects, they are easily treatable.

For example, the question in **Figure 1** asks the respondent to choose between a treatment that eliminates her depression but causes a 5% weight gain and requires four hours of psychotherapy per month and a treatment that eliminates her depression but requires six hours of psychotherapy per month. Each treatment costs $300 per month. An additional question followed each choice pair and asked the individual to choose between the previously chosen treatment plan and no treatment. Asking a follow-up question generates more information about preferences than simply including the no-treatment option in the original choice.

In making the pair-wise and follow-up choices, individuals are choosing over three possible levels of depression: their current level of depression, some depressive symptoms, and no depression. Thus, respondents are making choices over both hypothetical levels of depression and their current level of depression. Respondents were told to assume that each treatment plan would last one year and permanently eliminate or reduce their 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. The alternatives in the pair-wise choices have varying money costs and side effects.

Figure 1 is just one example of a choice question seen by patients. Forty different configurations of treatment characteristics were used, resulting in 40 distinct alternatives and 20 different choice pairs. Using multiple configurations of these treatment characteristics allows estimation of the marginal values of the different treatment characteristics. Choice questions are designed so that there is independent variation in each characteristics of a treatment program, thus allowing the researcher to estimate the associated marginal values. The design for the choice question was created by first generating a factorial design that only included reasonable combinations of treatment characteristics. For example, side effects can 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 pair-wise choices for the final design and divided them into four different survey versions.[19,20] An additional simple first choice question was created by hand and added to each survey.

* The survey instruments can be found at www.unm.edu/~jthacher/DepressionSurvey.pdf.

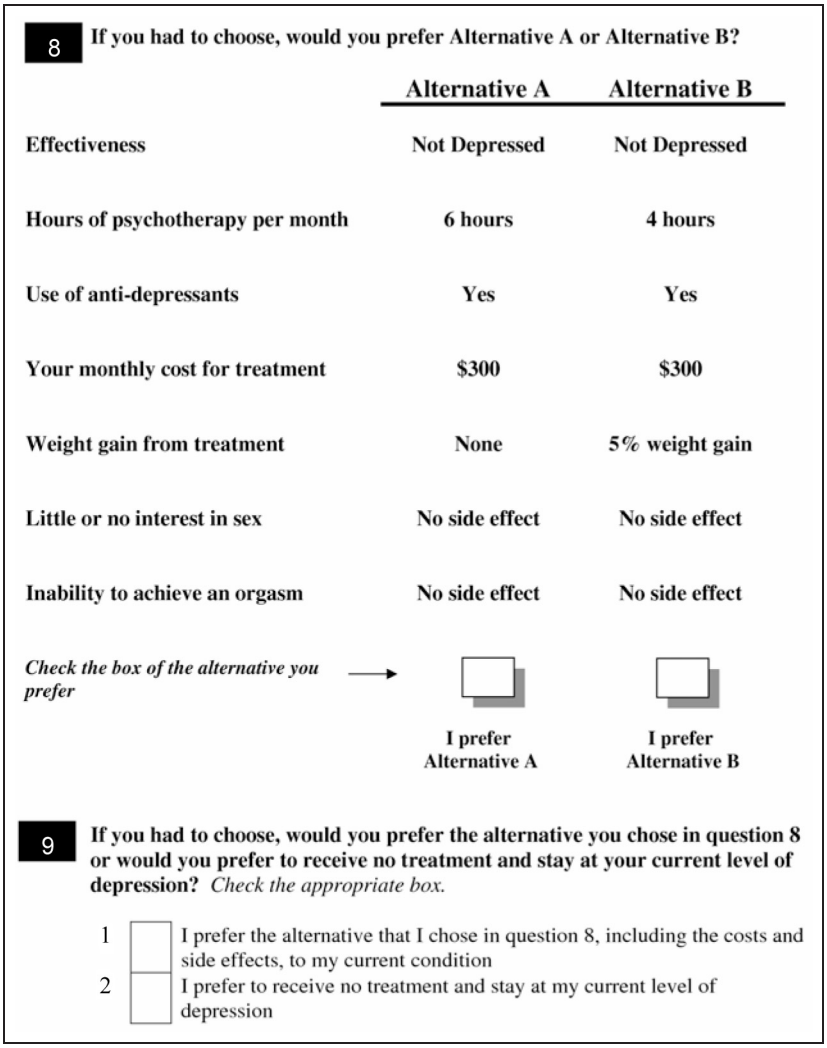

Figure 1. Example Choice Question.

Data Analytic Procedures

Choice Modeling

A discrete-choice random-utility model (RUM) is assumed. This model was developed by Daniel McFadden[21] in the 1970s; there are thousands of applications.

Assume there are K treatment alternatives available to an individual and the individual chooses the one that maximizes his or her utility. The individual chooses the preferred treatment 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. One does not always choose a treatment that results in no depression because of the monetary costs and side effects associated with treatments.

The utility individual i gets if she chooses treatment k consists of two components:

$$U_{ik} = V_{ik} + \varepsilon_{ik}. \qquad (1)$$

V_{ik} is a function of the characteristics of treatment k and demographic characteristics of individual i. These characteristics are observed by both the individual and the researcher. ε_{ik} is a random term that varies across individuals and treatments. ε_{ik} is known to the individual but not observed by the researcher, so utility is random from the researcher's perspective. See Ben-Akiva and Lerman[22] for more details.

Assume, for depression-treatment programs,

$$V_{ik} = f(Y_i - P_k) + h(T_i - Hr_k) + g(\mathbf{X}_k), \qquad (2)$$

where Y_i is income, P_k is the money cost of alternative k, T_i is free time, Hr_k is the number of therapy hours, and $\mathbf{X}_k$ 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 consumption and time not spent on therapy, $(T_i - Hr_k)$, is spent in other activities.

In summary, one's long-term utility is assumed a function of the characteristics of the treatment chosen. The research goal is to estimate how treatment characteristics influences utility and therefore choice.

Assume $\varepsilon_{ik} = \mu_i + \nu_{ik}$. That is, ε_{ik} has two components: one that varies across individuals but not across alternatives (μ_i), and one that varies across both individuals and alternatives (ν_{ik}). The μ_i and ν_{ik} are each independent draws

from the same distribution. The μ_i term causes the individual's utility to be correlated across the choice pairs they are presented. The term $\mu_i + \nu_{ik}$ is identical to the common random-effects specification used with panel data (see, for example, Green[23]). If there are K alternatives, the probability that individual i chooses alternative m is:

$$\begin{aligned}\Pr_i(m) &= \Pr(U_{im} \geq U_{ik})\ \forall\, k,\ k \neq m \\ &= \Pr(V_{im} - V_{ik} \geq (\nu_{im} + \mu_i) - (\nu_{ik} + \mu_i))\ \forall\, k,\ k \neq m \\ &= \Pr(V_{im} - V_{ik} \geq \nu_{im} - \nu_{ik})\ \forall\, k,\ k \neq m. \end{aligned} \quad (3)$$

Assuming each ν_{ik} term is an independent draw from an Extreme Value distribution, one has a random-utility logit model, and the probability that individual i chooses alternative m from the K alternatives is:

$$\Pr_{im} = \frac{e^{V_{im}}}{\sum_{k=1}^{K} e^{V_{ik}}}. \quad (4)$$

After placing some restrictions on the functional forms of the V, the estimation goal is to find those values of the V's that best explain observed treatment choices.

Consider now the data. As shown in **Figure 1**, individuals were presented with pairs of treatment alternatives and asked to choose the alternative they prefer. They were then asked whether they prefer the alternative just chosen or the no-treatment alternative. So, first the individual was asked to choose between two treatments ($K = 2$) and then asked to choose between two other alternatives: no treatment and the treatment just chosen. The probability that individual i chooses alternative A from the j^{th} choice pair is:

$$\Pr_{ijA} = \frac{e^{V_{ijA}}}{e^{V_{ijA}} + e^{V_{ijB}}}. \quad (5)$$

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

$$\Pr_{ijNT} = \frac{e^{V_{ijNT}}}{e^{V_{ijA}} + e^{V_{ijB}} + e^{V_{ijNT}}}. \quad (6)$$

Each individual answered five sets of A, B choice pairs with follow-up.

We estimate two specifications of the utility function, Equation 2. In both specifications, utility from treatment is modeled as a function of the time and money costs of treatment, the type of treatment (whether it includes anti-depressants), the effectiveness of treatment (whether it eliminates depression or only reduces it), and the presence of side effects. As noted, the attribute levels in the choice questions were chosen so one could statistically identify the influence of each of these characteristics on choice.

The first specification, the homogeneous-preference specification, restrictively assumes that all individuals have the same preferences. The second specification, the heterogeneous-preference specification, allows preferences to vary across individuals as a function of their demographic characteristics. **Table 1** defines all variables used in these two specifications.

In the homogeneous-preference specification, the utility individual i gets from treatment k is:

$$\begin{aligned} U_{ik} = {} & \beta_{d1} Depr_k + \beta_{ds1} DeprSym_k + \\ & + (\alpha_{y1} + \alpha_{y2} Depr_k + \alpha_{y3} DeprSym_k)(Y_i - P_k) \\ & + \alpha_{t1}(T_i - Hr_k) \\ & + \left[\beta_{a1} + \beta_{o1} Org_k + \beta_{s1} Sex_k + \beta_{w1} Wt_k + \beta_{w2} Wt_k^{0.5}\right] AD_k \\ & + \varepsilon_{ik}. \end{aligned} \quad (7)$$

In this specification, depression affects utility both directly and indirectly. The first line of Equation 7 allows one's level of depression to have a direct (and presumably negative) impact on utility, independent of consumption. $Depr_k$ and $DeprSym_k$ take a value of one if the emotional state in treatment k is depression or depressive symptoms, respectively. These terms are zero if the chosen treatment eliminates depression. The parameter β_{d1} is how much utility changes if one is depressed rather than not depressed, and β_{ds1} is how much utility changes if one has depressive symptoms.

The second line in Equation 7 captures the impact of consumption ($Y_i - P_k$) on utility. The last two parameters, α_{y2} and α_{y3}, indicate the extent to which depression affects utility indirectly through the utility one obtains from consuming goods. Thus, α_{y2} and α_{y3} indicate the magnitude, if any, of the anhedonia effect. The null hypothesis of no anhedonia effect is $\alpha_{y2} = \alpha_{y3} = 0$. Note that the homogeneous-preference specification restricts the marginal utility of consumption to be constant for a given level of depression but allows the marginal utility of consumption to vary with the level of depression.

The third line of Equation 7 captures the time costs of treatment ($T_i - Hr_k$) while the fourth line shows the impact of three side effects: no orgasm (Org_k), reduced sex-drive (Sex_k), and weight gain (Wt_k). The side effect terms are zero if the treatment has no anti-depressant side effects. The parameter β_{s1}, for example, indicates how much utility changes if one's sex drive is diminished by taking an anti-depressant.

This homogeneous-preference specification assumes that 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 is likely to vary greatly across individuals.

In the heterogeneous-preference specification, the utility individual i gets from treatment k is:

$$\begin{aligned} U_{ik} = {} & (\beta_{d1} + \beta_{d2} Educ_i) Depr_k + (\beta_{ds1} + \beta_{ds2} Educ_i) DeprSym_k \\ & + (\alpha_{y1} + \alpha_{y2} Depr_k + \alpha_{y3} DeprSym_k + \alpha_{y4} LowY_i + \alpha_{y5} MidY_i)(Y_i - P_k) \\ & + (\alpha_{t1} + \alpha_{t2} Kid_i)(T_i - Hr_k) \\ & + \begin{bmatrix} \beta_{a1} + \beta_{a2} \mathrm{Prev} AD_i + \\ (\beta_{o1} + \beta_{o2} Age_i + \beta_{o3} Female_i + \beta_{o4} Partner_i) Org_k + \\ (\beta_{s1} + \beta_{s2} Female_i + \beta_{s3} Age_i + \beta_{s4} Partner_i) Sex_k + \\ (\beta_{w1} + \beta_{w3} Female_i + \beta_{w4} BMI_i + \beta_{w5} Age_i) Wt_k + \beta_{w2} Wt_k^{0.5} \end{bmatrix} AD_k \\ & + \varepsilon_{ik}. \end{aligned} \quad (8)$$

In this specification, preference parameters are allowed to vary with a variety of demographic characteristics. The first line of this specification allows the direct effects of MDD and depressive symptoms on utility to vary with education level; *Educ* takes a value of one if the individual has less than a college degree.

The second line allows marginal utility of consumption to vary with both level of depression and household income level ($LowY_i$ and $MidY_i$). Thus, there are two types of income effects: the marginal utility from consumption depends on both the level of depression and the income category.

The third line allows the marginal utility of time to vary as a function of whether the individual has children under five (Kid_i); people with small children are likely to be more time constrained. In the last four lines, the dis-utility associated with side effects is allowed to vary as a function of age (Age_i), previous experience with anti-depressants ($PrevAD_1$), gender ($Female_i$), the presence of a live-in partner ($Partner_i$), and Body Mass Index (BMI_i). All were factors that we thought might influence how individuals would feel about the sexual and weight-gain side effects of anti-depressants.

Maximum likelihood estimation proceeds for both the homogeneous- and heterogeneous-preference specifications by finding the parameter values (the β and α) that maximize the likelihood function:

$$L = \prod_{i=1}^{107}\prod_{j=1}^{5}(\Pr_{ijA})^{r_{ijA}}(1-\Pr_{ijA})^{1-r_{ijA}}(\Pr_{ijNT})^{r_{ijNT}}(1-\Pr_{ijNT})^{1-r_{ijNT}}, \quad (9)$$

where r_{ijA} takes a value of one when alternative A is chosen over B in choice pair j and zero otherwise, and r_{ijNT} takes a value of one if no treatment is chosen over the chosen alternative in the A/B pair. The maximum likelihood parameter estimates are those values of the preference parameters that maximize the likelihood of observing the 506 choices that were made; this is less than the 520 choices possible, as not all 104 respondents answered all five of the choice questions. Estimation is with the *maxlik* procedure in the statistical software Gauss.[24] This optimization algorithm uses a number of different search algorithms to find the vector of β and α parameters that maximize the function.

WTP and WTA

Because the marginal utility of consumption is modeled as a function of depression level in both the homogeneous and heterogeneous specifications, there are income effects in both specifications. Thus, *WTP* does not equal *WTA*. Define *WTP* for the homogeneous specification and consider an individual's *WTP* to go from a state with MDD ($\mathbf{X}^0$) to a state of non-depression ($\mathbf{X}^1$), holding time cost constant across the two states. The formulas for *WTP* and *WTA* are similar in the heterogeneous-preference specification, but also include traditional income effects and interactions with demographic characteristics. An individual would be willing to pay an amount such that utility in the non-depressed state, after compensation is paid, equals her utility in the pre-treatment depressed state:

$$\begin{aligned} &g(\mathbf{X}^1) + \alpha_{y1}(Y_i - WTP_i) + \varepsilon_{i1} \\ &= g(\mathbf{X}^0) + (\alpha_{y1} + \alpha_{y2})Y_i + \varepsilon_{i0}, \end{aligned} \quad (10)$$

where $g(\mathbf{X})$ is a function of the characteristics of treatment k. Thus the deterministic portion of *WTP* is:

$$WTP_i = \frac{g(\mathbf{X}^1) - g(\mathbf{X}^0)}{\alpha_{y1}} - \frac{\alpha_{y2}}{\alpha_{y1}}Y_i. \quad (11)$$

The numerator in the first term, $g(\mathbf{X}^1) - g(\mathbf{X}^0)$, is the direct change in utility resulting from the elimination of the depression. Dividing it by α_{y1}, the marginal utility of consumption when one is not depressed, converts it into dollars. The second term, $-\frac{\alpha_{y2}}{\alpha_{y1}}Y_i$, is the dollar value of the indirect effect on utility from a change in depression level. If α_{y2} is negative and significantly different from zero (an anhedonia effect) it causes *WTP* to increase.

For the same scenario, willingness-to-accept continued depression rather than a treatment that eliminates the depression is:

$$WTA_i = \frac{g(\mathbf{X}^1) - g(\mathbf{X}^0)}{\alpha_{y1} + \alpha_{y2}} - \frac{\alpha_{y2}}{\alpha_{y1} + \alpha_{y2}}Y_i. \quad (12)$$

For *WTA*, the direct on utility effect of eliminating depression is converted into dollars using the constant marginal of utility of consumption in the depressed state ($\alpha_{y1} + \alpha_{t2}$).

Note that once the β and α vectors are estimated, one can estimate *WTP* and *WTA* for any change in the range of treatment levels. Thus *WTP* and *WTA* estimates can be calculated for treatment programs that that did not appear in the choice pairs.

Subtracting Equation 11 from Equation 12 shows that if $\alpha_{y2} < 0$, then *WTA*>*WTP*, in absolute terms: you must pay an individual more to remain depressed than she is willing to pay to eliminate her depression. Looking ahead to the results section of the paper, estimated α_{y2} is negative and significantly different from zero. The finding that individuals value dollars less when depressed (the anhedonia effect), implies that depressed individuals must be paid significantly more to accept continuing MDD than they would pay to eliminate their depression.

Sample and Attribute 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 MDD. For the remaining 23%, the clinicians identified them as having MDD, but did not identify a level. Forty-five percent of the sample were receiving their first-ever treatment for depression. Of those who had previously received treatment, 76% received anti- depressants; 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**. 74% of the sample had less than a college degree. The average monthly income in the sample was $4,519, with 23% of the sample earning less than $30,000 per year and 43% earning between $30,000 and $80,000. Women comprised 74% of the sample. The average age of participants was 40.

Table 1 also includes descriptive statistics for the attribute levels used in the choice questions. For example, 66% of the

Table 1: Descriptive Statistics for Variables Used in Model

Variable	Description	Mean	Std Dev	N
Determinants of choice: socio-demographics				
$Educ_i$	Individual *i* has less than a college degree (1=No college degree, 0=College degree)	0.74	0.44	104
$LowY_i$	Individual *i* has annual household income less than $30,000 (1=Yes, 0=No)	0.23	0.42	104
$MidY_i$	Individual *i* has annual household income between $30,000 and $80,000 (1=Yes, 0=No)	0.43	0.50	104
Y_i	Monthly household income	$4519	$2496	104
Kid_i	Respondent has children under age 5	0.25	0.43	104
T_i	Average hours of free time per month	317	85	104
$PrevAd_i$	Previously received treatment with anti-depressants (1=Yes, 0=No)	0.42	0.50	104
Age_i	Age[a]	40	11	101
$Female_i$	Female (1=Yes, 0=No)	0.74	0.44	104
$Partner_i$	Has live-in partner (1=Yes, 0=No)	0.67	0.47	104
BMI_i	Body Mass Index score	28	7	104
Determinants of choice: treatment attributes[b]				
$Depr_k$	Emotional state in treatment *k* is continued MDD (1=Yes, 0=No)	0.33	0.47	1518
$DeprSym_k$	Emotional state in treatment *k* is Some Depressive Symptoms (1=Yes, 0=No)	0.24	0.43	1518
P_k	Average monthly price of treatment	$102	$121	1518
Hr_k	Average monthly therapy hours	2.6	2.7	1518
AD_k	Treatment involves use of anti-depressants (1=Yes, 0=No)	0.66	0.47	1518
Org_k	Treatment k results in no-orgasm side effect (1=Yes, 0=No)	0.16	0.36	1518
Sex_k	Treatment k results in reduced sex-drive side effect (1=Yes, 0=No)	0.22	0.42	1518
Wt_k	Percent increase in weight gain resulting from treatment k	2.8	4.7	1518
Observed choices				
r_{ijA}	Individual chose Alternative A as preferred over Alternative B (1=Yes, 0=No)	0.59	0.49	506
r_{ijNT}	Individual chose No Treatment as preferred over Treatment in follow-up question (1=Yes, 0=No)	0.12	0.33	506

[a] Missing observations were mean filled for estimation purposes
[b] Mean levels for the choice question attributes are based on the three choice alternatives (A,B, follow-up) for all 506 choice questions answered

treatments presented in the survey included the use of anti-depressants. The average weight gain among the three alternatives (*A*, *B*, and follow-up) in the choice questions 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.

Results

Value of Treatment Characteristics

Table 2 and **Table 3** report the parameters estimates from both the homogeneous and heterogeneous-preference specifications (Equations 7 and 8). On the basis of a likelihood ratio test, the heterogeneous-preference specification explains the answers to the choice questions significantly better than does the homogeneous-preference specification and correctly predicts more of the choices made: 72% (67% in the homogeneous-preference specification) 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 conclude that demographic characteristics matter: there is no ''one size fits all'' treatment for depression. Preferences for depression treatment vary in predictable and observable ways.

As can be seen in **Table 2** and **Table 3**, most parameters are highly significant and of the expected sign across both specifications. Ceteris paribus, individuals prefer treatments that cost less ($\alpha_{y1} > 0$). The presence of either MDD or depressive symptoms lowers utility directly ($\beta_{d1} < 0$ and $\beta_{ds1} < 0$); as would be expected, the effect is stronger for MDD than for depressive symptoms ($\beta_{d1} < \beta_{ds1}$). The direct effect of MDD on utility is greatest for those with a college degree ($\beta_{d2} > 0$) while the parameter β_{ds2} is insignificant, suggesting that education level does not affect the dis-utility directly caused by depressive symptoms.

Depression also affects utility indirectly by reducing the utility from consumption ($\alpha_{y2} < 0$). The null hypothesis that depression level does not affect the utility from consumption is rejected ($LRT = 25.44 > \chi^{2,2}(0.5) = 5.99$). Thus, we conclude that an anhedonia effect exists. As would be expected, the heterogeneous-preference specification shows that for a given level of depression, marginal utility from

Table 2. Homogeneous-Preferences Specification: Maximum Likelihood Estimates (506 Choices)

Independent Variable	Coeff	Coeff Est	S.E.	P-value
Direct effects of depression on utility				
Emotional state is continued MDD	β_{d1}	−1.26	0.44	0.00
Emotional state is Some Depressive Symptoms	β_{ds}	−0.08	0.28	0.39
Income Effects				
Consumption[a]	α_{y1}	3.08	0.81	0.00
(Consumption) x (Emotional state is continued MDD)	α_{y2}	−0.36	0.08	0.00
(Consumption) x (Emotional state is Some Depressive Symptoms)	α_{y3}	−0.13	0.06	0.01
Time				
Free-Time	α_{t1}	0.68	1.45	0.32
Use of anti-depressants				
Treatment involves use of anti-depressants	β_{a1}	0.12	0.18	0.26
No-orgasm side effect				
Treatment results in no-orgasm side effect	β_{o1}	−0.65	0.16	0.00
Sex drive side effect				
Treatment results in sex drive side effect	β_{s1}	−0.25	0.16	0.06
Weight-gain side effect				
Percent increase in weight gain from treatment	β_{w1}	0.03	0.05	0.26
Square-root of percent increase in weight gain from treatment	β_{w2}	−0.43	0.17	0.01
LnL			−465.57	

[a] Consumption measured in thousands of dollars

consumption drops as household income increases ($\alpha_{y4} > \alpha_{y5} > 0$). In summary, eliminating MDD increases an individual's utility level both because she prefers being not depressed ($\beta_d 1 < 0$) and because she values goods more when she is not depressed ($\alpha_{y2} < 0$).

In the heterogeneous preference model, the marginal utility of time is significant and positive for individuals with small children (α_{t2}), making those individuals, ceteris paribus, less likely to choose therapy. For everyone else, and like in the homogeneous-preference specification, one cannot reject the null that the marginal utility of time is zero.

The fact that β_{a1} is insignificant while β_{a2} is significant suggests that some patients don't care whether treatment includes anti-depressants as long as treatment has no side effects; however, those with previous experience with anti-depressants prefer treatment programs that include them.

The negative parameter values for side effects in Table 2 show that, on average, side effects decrease the utility from treatment. However, when demographic characteristics are accounted for (**Table 3**), the impacts of the side effects on utility are mixed. Not being able to orgasm is a negative ($\beta_{o1} < 0$) whose magnitude is unaffected by gender, but its negative impact declines significantly with age ($\beta_{o2} > 0$). 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.

For all but the men with the lowest BMI, gaining weight from taking anti-depressants makes individuals worse off; utility decreases at an increasing rate as the percent of weight gain increases. Females are impacted more than males ($\beta_{w3} > 0$). The negative impact increases with an individual's body-mass-index score ($\beta_{w4} < 0$).

All results in the following sections are based on the heterogeneous-preference specification results, as it provides the superior fit.

Predicting Treatment Choice

The heterogeneous-preference specification 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 4** 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. These are the estimated probabilities that a representative individual will choose no treatment when the alternatives are no treatment and the treatment described in that row. They are calculated using Equation 5. The representative individual is defined to have the mean values of those demographic characteristics that are continuous variables, and the modal values of those demographic characteristics that are zero-one variables. For example, if the treatment options were two hours of therapy a

Table 3. Heterogeneous-Preferences Specification: Maximum Likelihood Estimates (506 Choices)

Independent Variable	Coeff	Coeff Est	S.E.	P-value
Direct effects of depression on utility				
Emotional state is continued MDD	β_{d1}	−2.42	0.56	0.00
(Emotional state is continued MDD) x (Individual has less than a college degree)	β_{d2}	1.33	0.47	0.00
Emotional state is Some Depressive Symptoms	β_{ds1}	0*	–	–
(Emotional state is Some Depressive Symptoms) x (Individual has less than a college degree)	β_{ds2}	0*	–	–
Income effects				
Consumption[a]	α_{y1}	3.09	0.83	0.00
(Consumption) x (Emotional state is continued MDD)	α_{y2}	−0.27	0.07	0.00
(Consumption) x (Emotional state is Some Depressive Symptoms)	α_{y3}	−0.14	0.03	0.00
(Consumption) x (In low income bracket)	α_{y4}	0.87	0.25	0.00
(Consumption) x (In middle income bracket)	α_{y5}	0.29	0.13	0.02
Time				
Free time	α_{t1}	0*	–	–
(Free time) x (Has children under age five)	α_{t2}	5.04	2.13	0.01
Use of anti-depressants				
Treatment involves use of anti-depressants	β_{a1}	0*	–	–
(Treatment involves use of anti-depressants) x (Previously treated with anti-depressants)	β_{a2}	0.42	0.28	0.07
No-orgasm side effect				
Treatment results in no-orgasm side effect	β_{o1}	−1.67	0.54	0.00
(Treatment results in no-orgasm side effect) x (Age)	β_{o2}	0.02	0.01	0.03
(Treatment results in no-orgasm side effect) x (Female)	β_{o3}	0*	–	–
(Treatment results in no-orgasm side effect) x (Has live-in partner)	β_{o4}	0*	–	–
Sex drive side effect				
Treatment results in sex drive side effect	β_{s1}	−1.03	0.27	0.00
(Treatment results in sex drive side effect) x (Female)	β_{s2}	1.12	0.32	0.00
(Treatment results in sex drive side effect) x (Age)	β_{s3}	0*	–	–
(Treatment results in sex drive side effect) x (Has live-in partner)	β_{s4}	0*	–	–
Weight-gain side effect				
Percent increase in weight gain from treatment	β_{w1}	0.19	0.08	0.01
(Percent increase in weight gain from treatment) x (Female)	β_{w3}	−0.12	0.03	0.00
(Percent increase in weight gain from treatment) x (BMI)	β_{w4}	−0.0040	0.0020	0.02
(Percent increase in weight gain from treatment) x (Age)	β_{w5}	0*	–	–
Square-root of percent increase in weight gain from treatment	β_{w2}	−0.34	0.18	0.03
LnL		−432.306		

* Not significant - fixed at 0

[a] Consumption measured in thousands of dollars

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 the table).

Table 4 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 and treatment with anti-depressants with all three side effects, the heterogeneous-preference specification 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 decrease.

Table 4 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: (i) eliminating MDD benefits lower-income individuals less because they consume less, and (ii) for a given benefit, they are willing to pay less to achieve the benefit.

Table 4. Probability by Income Level, that a Representative Individual Chooses No Treatment Rather than each Listed Treatment

Treatment	Probability of Choosing No Treatment at Zero Cost		
	Income =20K	Income =55K	Income =90K
2 Hours of Therapy per Month	18%	9%	4%
Anti-depressants: No Side Effects	18%	9%	4%
No Orgasm Side Effect	30%	16%	8%
No Sex Drive	16%	8%	4%
5% Weight Gain	35%	20%	10%
All 3 Side Effects	50%	31%	17%

Representative Individual: $T = 7.944$, $Kid = 0$, $Educ = 1$, $PrevAD = 0$, $Female = 1$, $BMI = 27$, $Y = 4.499$, $LowY = 0$, $MidY = 1$, $Age = 40$

Table 5. Sample Variation in Probability of Choosing Competing Treatment Plans

Treatment Option	Treatment Details	Probability Choose Treatment		
		Mean	Min	Max
A: Therapy Only	4 hours of therapy/month; Cost=$400/month	13%	2%	25%
B: Anti-depressants Only	Sexual side effects; Cost=$50/month	31%	7%	54%
C: Anti-depressants & Therapy	2 hours of therapy/month; 5% Weight Gain; Cost=$250/month	13%	4%	30%
D: Anti-depressants Only	No side effects; Cost=$350/month	24%	16%	37%
E: No Treatment	Cost=$0	19%	4%	42%

Table 5 shows the variation in the probability of choosing competing treatment alternatives, including no treatment. The first four treatments listed in **Table 5** (in contrast to non-treatment) each eliminate depression. The probabilities were calculated using Equation 4. There is nothing special about the five treatment options presented in **Table 5**. One could do the same calculation for any number of treatment options, each with any combination of the treatment characteristics. These five were chosen to represent the types of alternative treatments that might be available. Using the sample population, we calculated for each individual the probability of choosing from one of these five possible treatment programs, including no treatment. **Table 5** reports the minimum, maximum, and mean probabilities of choosing the competing alternatives. These probabilities vary across individuals because of differences in their demographic characteristics, such as income level, age, and gender. Treatment *B*, anti-depressants with the sexual side effects and a cost of $50 per month, has the highest mean 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 from among these five alternatives 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 per month has the second highest probability of being chosen (24%).

As would be expected given the superior fit of the heterogeneous-preference specification, the estimated probabilities vary greatly as a function of an individual's demographic characteristics; few have the average probabilities for the sample. Columns two and three of **Table 5** 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 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. He has only a 7% probability of choosing this alternative. 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; she has a 54% probability of choosing this alternative.

WTA and WTP Estimates

Table 6 reports *WTP* and *WTA* estimates for five different treatments, each compared to no treatment. The estimates are based on the parameter estimates from the heterogenous specification reported in **Table 3**. The estimated expected WTP to eliminate depression is high for many individuals. This is consistent with other studies that find individuals rank depression as worse than other chronic diseases[6] and impairments to physical health,[7] and that severe MDD is

Table 6. Monthly Expected *WTP* and *WTA* for Example Treatments that Eliminate MDD: Minimum and Maximum as a Function of Individual Characteristics and Estimate for a Representative Individual (R.I.)

Treatment	WTP for Treatment			WTA to Forego Treatment		
	Min	Max	R.I.	Min	Max	R.I.
Anti-Depressants: No Side Effects	\$305	\$1700	\$686	\$327	\$1864	\$747
Anti-depressants: Therapy - 2 hours	\$107	\$1700	\$686	\$115	\$864	\$747
Anti-depressants: No-Orgasm	−\$1	\$1480	\$478	−\$1	\$1623	\$520
Anti-depressants: 5% Weight Gain	\$19	\$1547	\$409	\$20	\$1696	\$440
Anti-depressants: Sexual Side Effects & 5% Weight Gain	−\$252	\$1098	\$227	−\$271	\$1203	\$247

Representative Individual: $T = 7.944$, $Kid = 0$, $Educ = 1$, $PrevAD = 0$, $Female = 1$, $BMI = 27$, $Y = 4.499$, $LowY = 0$, $MidY = 1$, $Age = 40$

viewed as equivalently bad or worse than death.[8]

The survey indicated that the treatment plans would last for one year and permanently eliminate or reduce the depression, so the *WTP* and *WTA* amounts reported are per month for 12 months. **Table 6** reports *WTP* and *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 in the sample.

There are several important points to note about **Table 6**. For our representative individual, expected *WTP* is highest for a ''magic-pill'' cure (effective anti-depressant treatment with no side effects): \$686 per month. But the estimated amount varies across the individuals from \$305 to \$1700 as a function of the individual's demographic characteristics. 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 has a *WTP* of \$305 for the magic-pill. An individual with a college degree, earning an annual income of \$150,000 or more, and who has no previous experience with anti-depressants is willing to pay \$1700.

WTP 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 \$409; adding both sexual side effects reduces her *WTP* to \$227 - a three-fold drop. As shown by **Table 6**, *WTP* for a treatment varies substantially with demographic characteristics. Consider the treatment with only one side effect: no orgasm. The maximum *WTP* reported (\$1480) is for a 41 year old with a college education earning \$125,000 per year; the minimum *WTP* (–\$1) is for a 19 year old without a college degree earning less than \$5000 per year. The –\$1 estimate indicates that the said 19 year old marginally prefers no treatment to the treatment with the no-orgasm side effect. A young average-weight man without a college degree, without previous experience with anti-depressants, earning \$15,000 per year has the lowest overall *WTP* (–\$252) for a treatment that results in all three side effects: one would have to pay him \$252 a month to accept the treatment (negative *WTP* is *WTA*).

WTA is how much the individual would have to be compensated to forego a treatment plan. For example, while the representative individual in **Table 6** has an estimated *WTP* of \$686 per month for the magic-pill cure, she would have to be compensated \$747 per month to forego this treatment and remain depressed. In comparison, she would only have to be compensated \$247 a month to forgo a treatment with weight gain and all three side effects. The difference between \$686 and \$747 (and between \$227 and \$247) is because one values consumption less when one is depressed (the anhedonia effect). The estimated *WTA* of -\$271 in **Table 6** indicates that there is a configuration of demographic characteristics such that an individual with those characteristics would pay \$271 a month to avoid treatment that resulted in weight gain and all three sexual side effects (negative *WTA* is *WTP*).

Discussion

We find that preferences for treating MDD vary significantly as a function of demographic characteristics. As a result, there is strong variation in *WTP*, *WTA*, and the probability of choosing competing treatments. O'Brien *et al.*[13] also found significant variation in *WTP* among patients. Our finding that demographic characteristics are a significant factor in explaining treatment preferences is shared by Dwight-Johnson *et al.*[14] but not by Revicki and Wood.[8] While O'Brien *et al.*[13] 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: an additional dollar of consumption 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: Revicki and Wood[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. In particular, since the majority of people seek care from general medical providers this sample may be more depressed than the general population of depressed individuals. Thus, results may only be generalizable to the those who are referred to or directly seek treatment at a mental-health clinic. That said, these caveats do not negate our results that those in the sample have significant estimated *WTP* to change their depression level 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.

Implications for Policy and Treatment

For Allocating Resources to the Treatment of Depression

The *WTP* estimates suggest that depression imposes a high cost 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 utility loss from depression, in dollars, needs to be included, along with treatment costs and the cost of lost output, in any benefit-cost analysis designed to determine whether additional societal resources should be allocated to the treatment of depression.

For Treating the Individual

Our finding that one treatment does not fit all is not new. However, our estimates suggest a mechanism for better matching treatment programs to the patient. 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 not pay for each option) and easily observable demographic characteristics (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 help reduce 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.

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. The magnitude of these differences makes it less easy to dismiss the affect of sexual and weight-gain side effects on peoples' lives.

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 hint at 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.

For Economic Theory

Economists, for the most part, ignore the impact of emotional state on choice and the utility from consumption, so overlook emotional-state shifts as a reason for *WTP* and *WTA* divergence. An interesting result of this study is that this research provides estimates of how much the two can diverge because of depression.

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 questions required that they consider what it would be like to experience a lower level of depression or no depression. Recent research shows that individuals sometimes mispredict how much changes will affect their long-run utility.[25] 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 questions 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 demographic characteristics. One could investigate probabilistic heterogeneity using a random-parameters framework[26] or a latent-class choice model.[27] Or, one could estimate models that allow for both explained and unexplained heterogeneity. Such models require large data sets.[28,29]

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