WILLINGNESS TO PAY FOR HORMONE REPLACEMENT THERAPY

NIKLAS ZETHRAEUS*
Stockholm School of Economics, Centre for Health Economics, Sweden

SUMMARY
This study addresses the question of willingness to pay (WTP) for hormone replacement therapy (HRT) in order to alleviate menopausal symptoms. The woman obtains utility from consumption of goods and health. The purchase of a treatment is represented as a shift in the health production function during the treatment period. The mean WTP for the HRT is estimated using a parametric and a non-parametric method. The mean WTP based on these two methods is similar in both cases and amounts to about SEK 40 000 per year. Further, it is shown that the mean WTP is above the mean treatment cost of HRT. Finally, the implied WTP per gained quality adjusted life year (QALY) is estimated at about SEK 120 000 and SEK 160 000 based on the rating scale (RS) and time trade-off (TTO) methods, respectively. © 1998 John Wiley & Sons, Ltd.

KEY WORDS — hormone replacement therapy; menopausal symptoms; willingness to pay

INTRODUCTION
At menopause, around the age of 50, about 80% of women experience menopausal symptoms [1]. Symptoms, for example, are hot flushes, night sweats and atrophy-related symptoms in the urogenital tract. The presence of menopausal symptoms decreases the quality of life of women. The loss in quality of life may be substantial, which is indicated in Daly et al. [1] Hormone replacement therapy (HRT) may alleviate these symptoms and thus increase the quality of life of symptomatic women [2,3]. HRT may also have a cardioprotective effect and offers protection for osteoporosis and related fractures [3]. The evidence on the effect of HRT on breast cancer is inconclusive [4,5].

In recent years several studies have focused on the benefits and costs of HRT [6–13]. These are all examples of cost-utility analyses where costs are measured in monetary units and benefits are measured in gained quality adjusted life years (QALYs). An alternative way to assess the value of the change in quality of life due to HRT is to measure the willingness to pay (WTP) for HRT. Then it becomes possible to compare, directly, the benefits of HRT, measured in monetary units, with the costs of HRT. Further, it also becomes possible to calculate the WTP for a gained QALY, which may be compared with the costs for producing a gained QALY.

The purpose of this study is to use the contingent valuation method (CVM) to analyse how much symptomatic women are willing to pay for HRT. It is assumed that the woman maximises her expected present value utility and that she consumes goods and values her health, which is produced through a health production function. HRT is modelled as a (parametric) shift in the health production function. A WTP measure for
the shift in the health production function is then defined.

**METHODS**

The decision for a woman to use HRT is modelled using a life cycle model. It is assumed that the woman maximises her expected present value utility. She consumes goods and values her health, which is produced through a health production function. The treatment under investigation, HRT, is modelled as a shift in the health production function, i.e. it improves the individual’s ability to ‘produce’ health. Since the survival probability is assumed to be a positive function of an individual’s health capital, the considered treatment will, in addition to its direct impact on health and utility, also affect her survival probability. The WTP measure corresponds to the value of the change in the health production function caused by the treatment [14].

A questionnaire was consecutively administered to 104 women recruited from the Department of Gynaecology at Södertälje Hospital during the period 6 February 1995–18 March 1996. In Sweden, at the time of the study, a woman had to pay SEK 160 for the most costly pharmaceutical product in a prescription and SEK 60 per each further product in the prescription. The patient charge per surgery visit amounted to about SEK 120. However, the largest amount to pay for pharmaceutical products and outpatient care each year was SEK 1800. The overshooting cost for pharmaceuticals and outpatient care was paid for by the National Social Insurance Board (NSIB). The mean age of the entire patient group was 52.2 years (range 45–65 years). 82% of the women were treated with oestrogen in combination with a progestin, while 18% were treated with oestrogen alone. Women treated with oestrogen alone were all hysterectomised. A total of 51% of the women were given a transdermal HRT preparation while 49% were given pills. The mean treatment duration for the women was 3 years. After their consultation with the clinic doctor, all women were interviewed by a nurse at the clinic. The criteria for eligibility were that the women were between 45 and 65 years of age and that they had been treated with HRT for at least a period of 1 month.

The interview consisted of three parts. In the first part the woman was asked to indicate her health status before initiating HRT and her present health status with HRT on a rating scale (RS) between 0 (dead) and 100 (full health). Based on the answers to the two RS questions we estimated the QALY weight with and without HRT.

Another method used to estimate QALY weights is the time trade-off (TTO) method [15]. In the study the woman was asked two TTO questions to estimate the QALY weight with and without HRT. The first TTO question was phrased as: ‘Suppose that you would experience the symptoms you had before the HRT was initiated for a period of 30 years. Indicate on the scale below how many years in full health followed by death you consider to be equivalent to 30 years with the experienced symptoms followed by death’. This question was then repeated for the current health status of the woman with HRT.

In the third part of the interview the WTP for HRT was investigated using the CVM. In the CVM, survey methods are used to investigate the hypothetical WTP for a good. The CVM was originally developed in the environmental field to measure the value of changes in the environment, but recently a number of health care applications have also appeared [16,17]. In Sweden the CVM has been used in several applications, e.g. to investigate the WTP for antihypertensive therapy [18–21].

Contingent valuation questions can be classified either as open-ended or binary contingent valuation questions [22]. In open-ended questions the maximum willingness to pay is elicited from each respondent, and in binary questions each respondent only accepts or rejects one price (bid). By varying the price in different subsamples the mean and median WTP can be estimated based on binary questions [23,24]. Due to problems of non-response a bidding game is often used to elicit the WTP in open-ended questions [25]. A bidding game resembles an auction. A first bid is made to the respondent, who accepts or rejects, and then the bid is raised or lowered depending on the answer. The process goes on until the respondent’s maximum WTP is reached. An important problem when using a bidding game is that the WTP is often affected by the first bid made [19,26–28]. This is referred to as starting point bias in the literature [19,22,26–28]. Due to the problems of open-ended questions most studies in
the environmental field now use binary contingent valuation questions. The use of binary questions was also recommended by an expert panel, appointed by the National Oceanic and Atmospheric Administration (NOAA) in the US, to assess the validity and reliability of the CVM [29].

The CVM based on binary questions is, however, not without problems, and important issues remain to be resolved in order to establish the validity of the method. The two perhaps most important problems are that some experimental results indicate that hypothetical WTP overestimates real WTP, and that some studies indicate that hypothetical WTP is insensitive to the size of the programme (often referred to as insensitivity of scope). To test the validity of the WTP estimates in a contingent valuation study, it can be tested whether the hypothesized theoretical relationships are supported by the data [22]. It may for instance, be tested whether the WTP increases with income and whether the WTP increases with the size (scope) of the programme. In the health field testing for scope would mean testing whether the WTP increases with the size of the health change.

In this study we used a binary contingent valuation question, which means that each individual is asked if they would pay a specific price \( P \) or not. By varying the price in different subsamples it is possible to trace the relationship between the price and the proportion of individuals who are willing to pay.

In the WTP question the woman was asked if she would continue her current HRT if she had to pay SEK \( P \) per month out of her own money. The price \( P \) was randomly varied between SEK 100 and SEK 10 000 in eight different sub samples, and each individual only received one of these prices [30]. The eight different prices were SEK 100, SEK 500, SEK 1000, SEK 1500, SEK 2000, SEK 3000, SEK 5000 and SEK 10 000 (Appendix A) [31]. Data was also collected about the following socio-economic variables: pre-tax household income, education level, age, and household size.

We attempted to estimate a per capita demand function for the considered (take it or leave it) commodity, i.e. we wanted to estimate the probability that the commodity would be purchased. In estimating the probability of agreeing to pay a specified amount of money \( P \) in exchange for the considered treatment, i.e. HRT, we assumed a logistic model. The acceptance probability \( \Pi \) is written as follows:

\[
\Pi = F(P) = 1/[1 + e^{-\Delta v}]
\]  

(1)

where \( F(P) \) is the ‘survivor’ function yielding the probability of accepting to pay at least SEK \( P \) in exchange for the treatment, and \( \Delta v \) is the change in utility caused by the considered improvement in health if the person pays SEK \( P \) for the improvement. In what follows, we assume a linear approximation of the change in utility: \( \Delta v = \eta_0 + \eta_1 P + \eta_2 h + \eta_3 S \), where \( h \) is a measure of the change in health status (or quality of life) due to the treatment, \( S \) is a vector of socio-economic variables, \( \eta_i \) for \( i = 0, 1, 2 \) are parameters to be estimated, and \( \eta_3 \) is a vector of parameters to be estimated. The change in health status \( h \) is measured using either the RS or the TTO method. Then it is possible to test the hypothesis that the probability of accepting to pay increases if the size of the change in health status increases (sensitivity of scope).

In order to estimate the mean WTP for HRT the following equation was estimated [32]:

\[
\ln[\Pi/(1-\Pi)] = \eta_0 + \eta_1 P + \eta_2 h + \eta_3 S
\]  

(2)

As can be seen from Equation (1), the regression equations predict that a certain proportion of respondents have a negative WTP since \( \Pi \) will approach one as \( P \) approaches minus infinity. However, medical treatment is a private commodity, which you freely may or may not elect to buy. For this reason, we rule out a negative WTP in the estimation of the mean WTP for the treatment. WTP is set equal to zero for the proportion of respondents which are predicted to have a negative WTP.

In the case where the WTP is non-negative, but the probability of a zero WTP is strictly positive, the mean WTP is equal to [17,33]:

\[
dI = \int_0^\infty \frac{1}{1 + e^{-(\eta_0 + \eta_1 P)}} \, dP = -\frac{1}{\eta_1} \ln(1 + e^{\eta_1 P})
\]  

(3)

where \( dI \) denotes the mean WTP for the treatment and \( \eta_1 \) denotes the magnitude of the constant term in Equation (1) when the elements of \( S \) and \( h \) are assigned particular values. The mean WTP was estimated with the explanatory variables set at their sample means. Thus, we are estimating WTP for an average respondent.

To estimate the mean and median WTP for HRT based on the answers to the contingent valuation question, a non-parametric method was also used [34]. With this method, the proportion of yes answers at the different price levels were
Table 1. Mean values of the explanatory variables included in the logistic regressions\textsuperscript{a}

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bid</th>
<th>ΔTTO\textsuperscript{b}</th>
<th>ΔRS\textsuperscript{b}</th>
<th>Age</th>
<th>Household Size</th>
<th>Education\textsuperscript{d}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2640</td>
<td>0.29</td>
<td>0.37</td>
<td>52.2</td>
<td>27 840</td>
<td>2.15</td>
</tr>
<tr>
<td>S.D.</td>
<td>(2936)</td>
<td>(0.28)</td>
<td>(0.26)</td>
<td>(3.87)</td>
<td>(12 092)</td>
<td>(0.98)</td>
</tr>
</tbody>
</table>

\textsuperscript{a} To be noted in interpreting the results of the present study is that the patient sample in the study may not be representative of the overall patient population receiving HRT in Sweden. Care should thus be taken in extrapolating the results to other populations and settings. To compare the patient population with women from the Swedish population, the mean values of the socio-economic variables household income, household size and education level were compared with the mean values for the Swedish population. The mean household size in the Swedish population is 2.1 and the monthly mean pre-tax household-income is SEK 18 500 \[35\]. The mean education level for women, 45–54 years of age, is 0.7 \[35,36\]. Thus, the mean education level in the patient sample is lower compared to the mean education level for women in the Swedish population. However, the mean household income in the patient sample is above the mean household income in the Swedish population. Only the household size is similar in the patient sample and in the Swedish population.

\textsuperscript{b} The difference in the quality of life score with and without HRT.

\textsuperscript{c} Per month pre-tax household income.

\textsuperscript{d} Coded 0 for primary education and 1 for secondary and university or higher education.

used to construct a curve that shows the relationship between the price and the proportion of yes answers. This curve can be interpreted as a demand curve and the mean WTP is measured as the area below the curve. In the estimation of the mean WTP we assumed that the highest WTP is equal to the highest price of SEK 10 000 used in the study. We also assumed that every woman would continue her HRT if the bid was SEK 0. The median WTP is the price where 50% would accept to pay and 50% would reject to pay.

RESULTS

Table 1 shows mean values and standard deviations in parenthesis for the included explanatory variables in the logistic regression equations according to Equation (2). It can be noted that the patient group is relatively homogeneous with respect to age which reports a standard deviation of 3.87. This is explained by the inclusion criterion which restricts the patient sample to women at the age of 45–65 years.

Table 2 shows the results of the logistic regressions of the intention to pay for the HRT. We report two goodness-of-fit measures: the percentage of correctly predicted responses and the likelihood ratio index (LRI) \[37\]. The estimated parameter of the bid variable is significant at the 1 percent level in the two regressions with the expected sign. In the first regression the perceived change in health status is represented by the change in the TTO score with and without HRT. The estimated parameter of ΔTTO has the expected sign and is significant at the 10% level using a one-sided \(t\)-test \[22,38\]. In the second regression the perceived change in health is represented by the change in the RS score with and without treatment. The estimated parameter of ΔRS has the expected sign and is significant at the 10% level using a one-sided \(t\)-test \[39\]. The income variable is not significant but has the expected sign. The education variable is significant at the 10% level using a one-sided \(t\)-test (since the hypothesis is that a higher education level increases the probability of agreeing to pay). The estimated mean WTP in the two regression equations is SEK 3772 and SEK 3651 per month, respectively \[40\].

Figure 1 below shows the relationship between the price on the WTP question and the proportion of patients accepting to pay the price.

Based on the curve in Figure 1 the mean and median WTP were estimated. The mean and median WTP was SEK 3508 and SEK 2000, respectively. Thus, 50% of the women accept to pay SEK 2000 for continuing their treatment of menopausal symptoms.

Finally, the implied WTP for a gained QALY was calculated by dividing the mean WTP (Table
2) by the mean gain in quality of life (Table 1). Based on the TTO method the WTP per gained QALY was estimated at SEK 156 100. Based on the RS method the WTP per gained QALY was estimated at SEK 118 400.

CONCLUDING REMARKS

The purpose of this study was to use the CVM to analyse how much symptomatic women are willing to pay for HRT. The mean WTP per month for HRT is estimated at about SEK 3700 using logistic regression analysis. The mean WTP per month using a non-parametric method is estimated at about SEK 3500. The results based on the parametric and non-parametric method are thus similar. The yearly WTP for HRT amounts to about SEK 42 000. This amount can be compared with the yearly WTP for reducing high blood pressure which was estimated at about SEK 9600 [21]. The WTP for HRT is thus quite high and can be compared with the average yearly pre-tax household income in the sample of SEK 334 000. An average woman is then prepared to pay 12% of her yearly pre-tax household income for continuing the HRT. In Johansson et al. [21] an average individual was prepared to pay 4% of his/her yearly pre-tax household income for continuing the treatment for high blood pressure.

The estimated equations are in accordance with the predictions of the theory. An increased price reduces the demand for HRT and an increased perceived change in health status between HRT and no HRT implies that the WTP for HRT increases. Also the education variable was significant and showed that a higher education level implied an increased WTP for HRT. This result conforms with the predictions of Grossman investment model, where education is positively related to health because education increases the ability of producing health [41]. Thus, the marginal cost of investing in health is reduced. A given increase in health status is more easily produced if an individual has a higher education level.

The mean WTP can also be compared with the treatment costs of HRT. Based on the total patient sample we estimated the yearly mean treatment costs of HRT [42]. The annual treatment costs per patient amounted to about SEK 1600 for patients treated with oestrogen alone and to about SEK 2200 for patients treated with oestrogen in combination with a progestin. Thus, the yearly mean WTP for HRT is well above the mean treatment costs associated with HRT.

The implied WTP for a gained QALY was estimated at SEK 156 100 and SEK 118 400 using the TTO and RS method, respectively. These figures may be compared with the costs for producing QALYs. If the WTP for a gained QALY exceeds the costs for producing a QALY, it is indicated that the treatment is motivated from an economical perspective. In Sweden the price per QALY gained is implicitly stated in cost-benefit analysis of road investments where the price per discounted QALY gained was estimated at about SEK 700 000 (the discount rate was 3%) [43].

The results in this study demonstrate that the increase in quality of life from using HRT greatly exceeds the assumed increases made in earlier studies. Weinstein, for instance, assumed an increase in the quality of life weight of 0.01 due to HRT for women with menopausal symptoms.
Figure 1. The relationship between the bid level and the proportion of patients willing to pay the bid. $N = 104$.

[6,7]. This shows the importance of carrying out empirical studies on quality of life rather than making arbitrary assumptions. Thus, the high WTP for HRT for symptomatic women can be explained by a considerable increase in the quality of life in terms of changes in the TTO and RS [1,44].

ACKNOWLEDGEMENTS

Comments from Magnus Johannesson, Per-Olov Johansson and two anonymous referees are highly appreciated. Financial support from the National Corporation of Swedish Pharmacies is gratefully acknowledged.

APPENDIX A: THE FORMULATION OF THE WILLINGNESS-TO-PAY QUESTION

This question focuses on how much you value the continuation of your hormone replacement therapy. Presume that you have to pay the majority of the treatment costs for drugs and physician visits by yourself. Would you choose to continue your current treatment for menopausal symptoms if you had to pay SEK 1000 [45] each month as patient charges for the treatment? Be aware that the money is taken from your own disposable income and hence decreases your private consumption.

Alternatives:

Yes
No

Statements of your motives:

Follow-up question:

Are you sure or uncertain that you want to pay SEK 1000 for continuing the hormone replacement therapy?

Certain
Uncertain

© 1998 John Wiley & Sons, Ltd.  
REFERENCES


30. The bid vector was established after a small pilot study of 12 patients.

31. SEK = Swedish crowns. The exchange rates 21 May 1996 were: GB£1 = SEK 10.3; US$1 = SEK 6.8.

32. The following equation was also estimated: \( \ln[P/(1 - P)] = \eta_0 + \eta_1 \ln(P) + \eta_2 h + \eta_3 S \). However, since \([1/\eta_1] < -1\) the integral did not converge, resulting in an infinite willingness to pay for HRT.


36. Coded 0 for primary education and 1 for secondary and university or higher education. 1 January 1995.


38. This test is relevant for the hypothesis that the perceived change in health status represented by TTO or RS increases the probability of agreeing to pay. For a further discussion of one-sided hypothesis tests, see Mitchell and Carson (1989).

39. A reason why the health status variables are significant only at the 10% level using a one-sided test, may be measurement errors in these variables (according to TTO and RS). Measurement errors in one variable imply that the estimated coefficient of the variable is biased towards zero, which is denoted attenuation (Greene, 1993).

40. We also tested for if there was a significant difference in the WTP of patients given pills versus patients given transdermal HRT preparations. No significant difference was found.


42. The treatment costs included the costs for the drugs, the physician’s visits, and the patients’ time and traveling costs. Costs for oestrogen only: Drugs SEK 860, 1 physician outpatient visit SEK 601, costs for time and traveling SEK 180; Costs for oestrogen combined with a progestin: Drugs SEK 1055, 1.5 physician outpatient visit SEK 901, time and traveling SEK 270.


44. The improvement in the quality of life based on the RS method is similar to the results in the study by Daly et al., 1993.

45. The bid varies from SEK 100 to SEK 10000 in eight sub-samples.