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Willingness to Pay for Dental Fear Treatment

Is Supplying Fear Treatment Socially Beneficial?

Abstract:
The aim of this paper is to discuss the social desirability of a treatment program for patients with dental fear. The program consisted of three different fear treatments, cognitive therapy, applied relaxation or nitrous oxide sedation, as well as dental treatment. To evaluate the effects of uncertainty on the patients' benefits from the program, we elicit their willingness to pay both before and after receiving treatment, since we expected patients to be uncertain about the outcome of the fear treatment. We find that the social desirability of the treatment is very sensitive towards uncertainty. While only 24 percent of the patients were willing to pay the actual cost of the treatment before attending, 71 percent were willing to pay afterwards. This implies that many patients who would benefit from the treatment ex post are not willing to pay the cost of the treatment ex ante, and will thus not receive any treatment unless it is subsidised.

Keywords: Dental fear treatment, willingness to pay.

JEL classification: I11, D61.

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1. Introduction

Dental phobia, or extreme dental fear, is a condition that affects approximately 5% of the population (Hakeberg et al. 1993, Vassend, 1993). Patients with extreme dental fear are characterised by intense physiological arousal and feelings of fear before and during dental treatment. Many of them avoid dental treatment completely. Scott et al. (1998) reports that the most common reasons for not seeing a dentist were the cost of the treatment and fear of dentists. Dental fear has been shown to be a major determinant of both dental health and mental well-being (Kaufmann et al 1992, Hakeberg et al. 1993). Aartmann (1997) finds that patients with dental fear have a higher score on general psychological distress tests than the general population.

There are numerous reports on dental fear treatment showing significant reductions in dental fear levels (see e.g. Ning & Lidell 1990, Liddell et al. 1994, Horowitz 1992, Krochak and Rubin 1993, Carpenter et al. 1994, Kent 1985, 1987, 1990, Kent and Gibbons 1987, Smith et al. 1987, de Jongh 1995, van der Bijl 1992, Ter Horst and De Wit 1993). Even in long-term follow-ups from 2-10 years the results are favourable. Positive treatment outcome of dental fear treatments is thus well documented. These studies focus on treatment outcomes only. To our knowledge, no treatment study has focused on the social desirability of supplying dental fear treatment to the public.

The purpose of this study is to examine if supplying fear treatment in addition to dental treatment to patients with dental fear is socially desirable. In order to investigate the benefits of fear treatment programs to dental fear patients, an experiment was conducted at the Institute for Clinical Odontology, Dental Faculty at the University of Oslo, testing three different fear treatments: Nitrous oxide sedation, cognitive therapy and applied relaxation. To investigate the social desirability of supplying these fear

treatments, the patients were asked to state their maximum willingness to pay (WTP) for the received treatment. These WTP statements were then compared with the actual cost of the treatment.

One major problem in treating dental fear patients is the lack of motivation. Many have avoided dental treatment for years and the thought of managing a regular dental treatment situation without urgent treatment needs seems almost impossible. Thus, these patients are often very sensitive and unsure about the benefits from dental and fear treatments. This dental aversion will most probably result in a low WTP, in particular before uncertainty about the benefits from the fear treatment is revealed. If the aversion is large, it may seriously influence the profitability of supplying the treatment, as patients who benefit from the treatment *ex post* may not purchase it without knowing the outcome. To investigate the effects of uncertainty, we asked the patients' to state their maximum WTP both before and after they received the treatment.

The reminder of this paper is organised as follows: In section 2 we describe in further detail the design of the experiment and the valuation survey. In section 3 we outline the theoretical foundation for the analyses presented in this paper, modelling the patients' decision problem and discussing how to evaluate profitability of dental fear treatments. In section 4 we present the results and conclusions from our analyses, and in section 5, some concluding remarks are made.

2. The experiment

From February 1995 to June 1996, patients who contacted the Institute for Clinical Odontology, Dental Faculty at the University of Oslo with dental fear problems were invited to attend a treatment program receiving dental fear treatment. Three patients were referred from dentists and two from other health workers, but the majority of patients made contact at their own initiative or through relatives or friends. In total, 65 patients met the inclusion criteria and were assigned to a 10-session treatment

programme with random allocation to three contrasting treatment principles: nitrous oxide sedation, cognitive therapy and applied relaxation. Half the patients had not been to the dentist the last 10 years or more. The average number of years since the last dental visit was 12 years, with a maximum of 30 years for one patient and a minimum of one year for five patients. The need for dental treatment did also vary considerably as one patient did not have to treat any surfaces, whereas the maximum number of treated surfaces was 53. The patients paid a small fee for participating (NOK 1000) in order to prevent dropout. Only three patients dropped out of treatment. At the end of the treatment, the patients' level of dental fear and general psychological distress were highly significantly reduced.

During the experiment, the patients were asked to answer questionnaires concerning dental fear, a general distress survey, an assessment of personality three surveys three times during the experiment: At enrolment, before attending the treatment and after receiving the treatment. A separate valuation survey was conducted approximately one month after the treatment was finished in order to measure the patients' benefits from the treatment. The aim of this questionnaire was to elicit the patients' WTP for the treatment and their expectation prior to the experiment. The respondents were, among other things, asked an open-ended contingent valuation question (see e.g. Mitchell and Carson 1989 for more information) concerning their maximum WTP for the treatment. Before the WTP question, the respondents were informed that they were to pay the actual cost of the treatment. Then they were asked for the highest cost they were willing to cover in order to receive the treatment. This was done to avoid respondents answering strategically to the WTP questions, as some patients expressed concerns that their dentist would profit from supplying the fear treatment. In order to analyse the effect on the social desirability of uncertainty, the patients were also asked to state their maximum WTP for the treatment prior to the experiment.

To evaluate the net benefits from the fear treatment, we need to decompose the total WTP for the experiment into WTP for dental and fear treatment separately. This was done by asking the patients to

distribute 100 points between the two motivations according to their importance for the total WTP. We used a simultaneous approach to decompose the total WTP in order to avoid ordering effects. Ordering effects occur when the sequence of valuation questions affects the WTP estimates when a set of goods is valued in a sequence. (See e.g. Halvorsen, 1996 for more information)

3. Theoretical framework

In this section, we model the relation between the patients' expressed WTP and the benefits they receive from the treatment, both dental and fear treatment, before and after uncertainty is revealed. Then, we discuss the econometric specification of the model and how to use the data to obtain an estimate of the WTP-function. Finally, we discuss how to use this information to evaluate the desirability of the project, both for the consumers, the suppliers and for the society.

3.1. Benefits from the treatment

We use a two period model, before and after the experiment, for the patient's benefit from the treatment. We assume that a patient gains utility from the consumption of goods conditional on his dental and mental health, represented by the utility function:

$$U^t = U\left(\vec{X}^t; H_D^t, H_P^t\right) \qquad (1)$$

where $\vec{X}^t$ is a vector of private goods consumed in period *t (t=1, 2),* H_D^t is the patient's dental health at period *t* and H_P^t is the patient's mental health at period *t*. The utility is assumed to increase with diminishing returns in both the consumption of private goods and the health capital in all periods.

The patient has the ability to improve both his dental and his mental health capital in the second period by investing in dental and fear treatment in the first period. We denote the consumption of dental

treatment in the first period X_D^1 and the consumption of fear treatment in period 1 X_P^1. The health capital in the second period is assumed to be function of the initial health capital and the investments in health in the first period ($H_j^2 = H_j\left(H_j^1, X_j^1\right)$, j = *D, P*). The investments in both dental and mental health are given from the experimental design, represented by the type of fear treatment offered and the number of treated surfaces. Thus, the quantity of the health investment is exogenous to the patient after deciding whether to participate or not.

We assume that the patient's motivation for participating is to reduce his anxiety level and to enable him to go to an ordinary dentist in the future. The patient is assumed to be able to go to a normal dentist if his mental health exceeds a critical limit ($\tilde{H}_P$). Here we assume that none of the patients attending this experiment did have sufficient mental capital to go to a normal dentist in the first period.[1] Furthermore, we assume that the patient does not know *exactly* how much his investment in fear treatment in the first period will affect his mental health capital in the second period. His investment will, however, increase his probability of being able to go to the dentist in the second period, given by $\pi = P\left(H_P^2 \geq \tilde{H}_P\right)$. The probability of *not* being able to go to the dentist in the second period, evaluated in the first period, is thus $1-\pi$. In the second period, after uncertainty is revealed, the patient will either be able to go to the dentist (H_P^w if $H_P^2 \geq \tilde{H}_P$) or not (H_P^s if $H_P^2 < \tilde{H}_P$). The expected mental health capital in the second period, evaluated in the first period, is thus defined as: $E\left(H_P^2\right) = \pi H_P^w + (1-\pi)H_P^s$.[2]

Since the patient is not certain how his investment in health will affect him when deciding on participating in the experiment in the first period, he is also uncertain about his benefits from the fear

[1] The participants were, however, sufficiently motivated to volunteer for the experiment. That is, their mental health capital exceeded a lower limit deciding whether or not to attend such an experiment set in a University environment.

[2] Here, we assume all factors affecting the patient's dental fear, other than participating in the experiment, to be constant.

treatment. The expected utility in the second period, as evaluated in the first period, is thus the weighted utility of the patient being able to go to the dentist and not, given by:

$$E\left(U^2\right)=\pi U\left(\vec{X}^2;H_D^2,H_P^w\right)+(1-\pi)U\left(\vec{X}^2;H_D^2,H_P^s\right) \tag{2}$$

To measure the patient's benefits from investments in dental and mental health, we apply the compensating variation (CV), which is defined as the difference in expenditures necessary to be indifferent between receiving the treatment and not.[3] The expenditure function (C) is defined as the minimum expenditure necessary to achieve a given utility level ($\overline{U}$) discounted over the two periods, for a given set of prices:

$$\begin{aligned} &C\left(p_X^1,p_X^2;H_P,H_D,\pi\right) \equiv \min_{X_i^1,X_i^2}\sum_{i=1}^{I^1}p_i^1\,X_i^1+\sum_{i=1}^{I^2}p_i^2\,X_i^2 \\ &s.t.\ \left\{U\left(\vec{X}^1;H_D^1,H_P^1\right)+\delta\left[\pi U\left(\vec{X}^2;H_D^2,H_P^w\right)+(1-\pi)U\left(\vec{X}^2;H_D^2,H_P^s\right)\right]=\overline{U}\right\} \end{aligned} \tag{3}$$

where p_X^t is a vector of all prices in period *t*, p_i^t is the price on good *i* in period *t*, X_i^t is the consumption of good *i* in period *t* and δ is the discount rate (*t = 1, 2* and *i = 1, 2, ...,* I^t).

Since the outcome of the treatment is uncertain, the CV measure for the treatment, evaluated in the first period, will also be uncertain for several reasons. If the patient does not receive the treatment, he is assumed to know the state of his mental health capital in the second period, but assumed to be uncertain of his dental health capital since he is not able to go to an ordinary dentist. If the patient attends the experiment, we assume that he does not know for certain if he can go to a normal dentist in the second period, but he will know the state of his dental health capital. That is, we assume all damaged surfaces to be fixed in the experiment. Evaluated in the first period, we denote the expected

dental health capital and the mental health capital in the second period without any treatment $E\left(H_D^2\right)^0$ and $H_P^{2^0}$ and the dental health capital and expected mental health capital with treatment $H_D^{2^1}$ and $E\left(H_P^2\right)^1$. The CV for the experiment evaluated in the first period is given by:

$$CV^1 = C\left(p_X^1, p_X^2; H_D^1, E\left(H_D^2\right)^0, H_P^1, H_P^{2^0}, \overline{U}\right) - C\left(p_X^1, p_X^2; H_D^1, H_D^{2^1}, H_P^1, E\left(H_P^2\right)^1, \overline{U}\right) \qquad (4)$$

This is the patient's maximum WTP for the total treatment (both dental and fear treatment) evaluated in period 1. In the second period, there is no uncertainty about the effect of the fear treatment if the respondent has participated. The patient's CV in the second period for participating in the experiment is thus given by:

$$CV^2 = C\left(p_X^1, p_X^2; H_D^1, E\left(H_D^2\right)^0, H_P^1, H_P^{2^0}, \overline{U}\right) - C\left(p_X^1, p_X^2; H_D^1, H_D^{2^1}, H_P^1, H_P^{2^1}, \overline{U}\right) \qquad (5)$$

Whether the maximum WTP for the total treatment in the first period (CV^1) exceeds the maximum WTP in the second period (CV^2) depends on the patient's expectations about the benefits from the fear treatment and his attitude towards dental treatment. Since all these patients have dental fear, it is reasonable to believe that they are reluctant to attend dental treatment programs. If a patient with dental fear and risk aversion has rational expectations, his CV for the treatment in the second period after uncertainty is revealed will exceed his CV in the first period. This is because uncertainty about the outcome of the treatment and dental fear reduces his expected utility and thus his WTP in the first period. If the patient exaggerates the positive effects of the fear treatment and the negative state of his dental health, it will reduce the effects of the dental fear and risk aversion on his WTP in the first period, making the difference smaller.

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[3] See Varian (1992) or Mitchell and Carson (1989) for a discussion of the compensating variation.

3.2. Econometric specification

We approximate the patient's expected WTP in the first period (equation 4) by a linear function of the patient's annual gross income (*Y*), the patient's dental and mental health capital in period one (H_D^1 and H_P^1) and a stochastic error term (ω). We also assume that the patient's stated WTP before the treatment reflects his CV in the first period, and that the stochastic error term (ω) is normally distributed with a zero expectation and a heteroscedastic variance.[4] The expected WTP-function in the first period before the treatment is given by:

$$WTP^1 = \beta_0 + \beta_2 Y + \beta_3 H_D^1 + \beta_4 H_P^1 + \omega \qquad (6)$$

As a measure of the patient's mental capital, we apply the results from the Symptom Checklist 90 Revised questionnaire, which is used to assess emotional distress. It consists of 90 items; each rated on a five-point scale, where 0 is *not relevant* and 4 is *very important* (Derogatis, 1983). The patients mean score of all 90 items is called *the global severity index*, which is the variable used in the estimations as a proxy for the patient's mental health capital. The state of the patient's dental health was recorded on the first session as the number of decayed, missing and filled surfaces in all 28 permanent teeth. Both these measures were recorded at enrolment to the experiment and before and after the treatment took place.

Furthermore, we assume the WTP-functions for the total, the fear and the dental treatment in the second period after all uncertainty is revealed (see equation 5) is given by:

$$WTP_j^2 = \alpha_0^j + \alpha_1^j CT + \alpha_{21}^j Y + \alpha_3^j \Delta H_D + \alpha_4^j \Delta H_P + \alpha_5^j B_D + \alpha_6^j B_P + \varepsilon^j \qquad (7)$$

where WTP_j^2 is the patient's stated WTP for good *j (j= total, dental and fear treatment)* in the second period, *CT* is a dummy for receiving cognitive therapy, *Y* is the patient's annual gross income and ΔH_D and ΔH_P are the patient's change in health capital from the first to the second period. The number of surfaces treated by the dentist measure the change in dental capital, and change in mental capital is measured as the difference in the global severity index before and after the treatment. We also include discrete variables, which measure the perceived benefits from both dental and fear treatment (B_D, B_P). These variables equal 1 if the patient reported the benefits from the treatment to be low, 2 if the benefits are medium and 3 if the patient reports the benefits from the treatment to be high. Finally we include a stochastic error term (ε^j), which we assume is normally distributed with a zero expectation and a heteroscedastic variance.

3.3. Evaluating the social desirability

One major concern of this experiment was to evaluate whether supplying fear treatment was socially desirable. Since investments in health capital must be considered a private good, a competitive market insures an efficient allocation when all externalities are reflected by the WTP and/or production cost.[5] It is reasonable to believe that the patients include all positive effects to themselves of increased dental and mental health in their expressed WTP for the treatment. There might, however, be some positive external effects to other family members, friends, the labour marked etc. not captured in the WTP statements.

The socially optimal provision of the service is where the socially weighted marginal utility and cost of providing the good are equal for all consumers and producers. Since an investment in health capital is a private good, we may evaluate social desirability by comparing the socially weighted WTP and

[4] See e.g. Greene (1995) or Battatjaraya and Johnson (1977) for more information.
[5] See Myles (1995) for a definition of private and public goods.

the cost of supplying the treatment for the marginal consumer. The social welfare weights equal the marginal utility of income times the marginal welfare weights (see e.g. Johansson 1993, chapter 7). Since the social welfare weights consist of two unobservable components, it is not possible to evaluate whether the project is socially optimal allocated, regardless of the choice of welfare function. Thus, when discussing the social desirability of providing the good, we mainly focus an efficient allocation of the good, not the optimal distribution between different patients as measured by the social welfare function. We will, however, indicate in which direction including social welfare weights will affect the conclusions.

4. The results

The treatment outcome of the patients who finished the experiment was very good. All patients were able to receive regular dental treatment within the experiment. On average, the patients had filled 13 surfaces of dental fillings during their exposure part of the treatment programme. Their scores on dental fear assessment and the general psychological distress test dropped significantly during and after the treatment (see Willumsen, 1999).

4.1. The probability of being able to go to a dentist

The patients' motivation for attending the experiment was both to fix their teeth and to increase their mental capital. It is thus interesting to compare the different fear treatments' effect on the patients' ability to go to an ordinary dentist appointment. In table 1, we present the share of patients for the total sample and by treatment groups, who reported that they would be able to go to a dentist by themselves after completing the treatment.

Table 1. Proportion of the patients expecting to be able to return to an ordinary dentist appointment after the treatment, for the total sample and by treatment groups. T-value in parentheses.

	Total sample	*Nitrous oxide sedation*	*Cognitive therapy*	*Applied relaxation*
Proportion of sample who expect to be able to go to an ordinary dentist after the treatment	0.69	0.46	0.86	0.77
(T-value)	(1.47)	(0.90)	(2.49)	(1.83)

We see from the table that 69 percent of the patients expected to be able to go to a dentist after the treatment, but the results in the different treatment groups differ considerably. Nitrous sedation has a much lower success rate than treatments focusing on the patient's ability to handle the situation. The fear treatments with a significant effect on the patient's probability of being able to go to the dentist afterwards are cognitive therapy and applied relaxation training.

4.2. Willingness to pay for dental and fear treatment

In table 2, we present the mean WTP responses for the total treatment, dental and fear treatment separately, and the expected total WTP before the treatment started. We also present the T-values under the null hypothesis of a zero WTP for the treatment. This information is given separately for each of the three treatment groups (nitrous oxide sedation, cognitive therapy and applied relaxation) and for all patients combined.

We see from table 2 that the total WTP for both dental and fear treatment is higher after uncertainty is revealed than the expected WTP before the treatment. This is true for all treatment groups and for all patients combined. The expected WTP amount to approximately 50 percent of the WTP after uncertainty is revealed. The relative share of the maximum WTP before and after the treatment is highest for the group receiving cognitive therapy (56.5 percent) and lowest for the group receiving

nitrous sedation (46.4 percent). This is probably because uncertainty concerning the benefits from the fear treatment is likely to be larger for treatment forms applying psychological techniques than sedatives. Due to a lack of degrees of freedom, this difference is not significant for any of the groups.

Table 2. Maximum willingness-to-pay (WTP) before and after receiving the treatment, WTP for fear treatment and WTP for dental treatment. By treatment groups and for all patients combined. T-values in parentheses. NOK.

	Nitrous oxide sedation		*Cognitive therapy*		*Applied relaxation*		*All patients*	
	Mean	*(T-value)*	*Mean*	*(T-value)*	*Mean*	*(T-value)*	*Mean*	*(T-value)*
WTP before treatment	2 706	(0.964)	3 618	(0.959)	2 890	(1.128)	3 061	(1.010)
WTP after treatment	5 833	(2.045)	6 405	(1.691)	5 591	(1.495)	5 938	(1.720)
WTP fear treatment	2 680	(1.531)	3 126	(1.545)	2 987	(1.525)	2 931	(1.548)
WTP dental treatment	2 991	(1.625)	3 279	(1.423)	2 870	(1.221)	3 047	(1.418)

4.3. Determinants of willingness to pay

Looking at the decomposition of the maximum WTP into WTP for dental and fear treatment, it seems that, on average, the patients have divided their WTP equally between the two treatments. In order to reveal if there are any systematic differences, we estimate a WTP-function for both the maximum WTP before and after receiving the treatment and the WTP for the dental and fear treatment separately.

4.3.1. Expected WTP

We estimate the expected WTP-function in equation (6) applying ordinary least squares (OLS) corrected for heteroscedasticity. The results from this estimation are presented in table 3. In the first column, the explanatory variables are listed. In the second column, we present the estimated coefficient. In the third column, we present the T-values and in the last column we present the P-values, that is, the probability of falsely rejecting the hypothesis of no effect.

Table 3. Estimated determinants of expected WTP (in NOK) *before* the treatment.

	Coefficient	*t-value*	*p-value*
Constant	194	0.2933	0.7709
Income (in 1000 NOK)	9.2	7.6476	0.0000
Dental health capital in period one, holes and tooth decay	18	1.4366	0.1591
Mental health capital in period one, psychological strain	509	0.7977	0.4300
R^2	*0.26*	R^2*-adj*	*0.20*

Wee see from table 3 that the only variable with a significant influence on the expected WTP is household income. If household income increase by 1 000 NOK (approximately $111 US), the expected WTP for the treatment increases by 9 NOK (approximately $1 US). If we calculate the income elasticity, that is the estimated coefficient divided by the budget share, we find that a one-percent increase in income gives a 0.5 percent increase in expected WTP for the treatment. The treatment is thus considered to be a necessity good by the patients before the treatment is carried out. We also see from table 3 that the expected WTP increases with increased mental stress and the damage to the teeth, even though these effects are not significant on an acceptable level (*p-value* < 0.1). One reason for the lack of significance and explanation power is the small sample. Out of the 62 patients responding to the questionnaire, only 54 answered the expected WTP question and only 41 of these had observations on all explanatory variables.

4.3.2. WTP after the treatment

We now turn to the estimation of the total WTP, and the WTP for the dental and phobia treatment after the experiment was over. The results from this analysis are reported in the table 4. First, we look at the WTP for the total treatment, presented in the first column of table 4.

Of the 64 respondents who answered the WTP question, 52 had observations on all explanatory variables. As we see from table 4, several variables have a significant impact on the WTP after the treatment was concluded in spite of the low degrees of freedom. First, income still influences the WTP

significantly, where a 1 000 NOK increase in income results in an 8.6 NOK increase in WTP. Since the mean WTP after all uncertainty is revealed exceeds the expected WTP by approximately 50 percent (see table 2), the estimated income elasticity is halved, to 0.25. I.e., a one-percent increase in income results in a 0.25 percent increase in the stated WTP. Thus, investments in dental and mental capital are less income elastic after the treatment than before the treatment. The stated WTP also increases with the benefits from the dental treatment, with the number of treated surfaces, with benefits from fear treatment and a reduction in the global severity index, although the last two effects are not significant. Whether the patient received cognitive therapy as compared to nitrous oxide sedation or applied relaxation do not have a significant effect on the stated WTP.

Table 4. Estimated determinants of the total WTP and the WTP for dental and mental treatment (in NOK) *after* the experiment was concluded.

	Total WTP	*WTP for dental treatment*	*WTP for fear treatment*
Constant	4290***	815	3909***
Cognitive therapy	84	-164	426
Income (in 1000 NOK)	8.6***	4.2***	2.0
Benefits from dental treatment	1041**	871**	324
Benefits from fear treatment	513	-901**	1385***
Change in dental health capital, treated surfaces	165***	91***	76***
Change in mental health capital, reduction in strain	1651	1356*	210
R^2	*0.53*	*0.46*	*0.45*

[a)] *** implies that the coefficient differ significantly from zero with a probability of falsely rejecting the zero hypothesis at less than 1 percent. ** implies that the coefficient differ significantly from zero with a probability of falsely rejecting the zero hypothesis at less than 5 percent. * implies that the coefficient differ significantly from zero with a probability of falsely rejecting the zero hypothesis at less than 10 percent.

In order to examine if there are any systematic differences in the factors determining the stated WTP for the dental and fear treatments, we have estimated the model for the WTP for dental and fear treatment separately. The results from these estimations are presented in the second and third column of table 4. First, we look at the result from the WTP estimation on dental treatment. We see from the table that most explanatory variables have a significant effect on the WTP for dental treatment. The only exception is the coefficient for receiving cognitive therapy. First, looking at the income sensitivity, the estimated income elasticity for the demand for dental treatment is 0.24. This is approximately the same income elasticity as for the total WTP. Second, we see that patients with high benefits from the dental treatment have a higher WTP for dental treatment than patients who reported the benefits to be low. We also find that patients who reported high benefits from the fear treatment have a lower WTP for dental treatment than patients who reported low benefits from the fear treatment. This indicates that these patients have allocated a larger share of their total WTP to the fear treatment than to the dental treatment. Third, we find that the WTP for dental treatment increases with both the number of treated surfaces and the measured reduction in mental strain. That is, those patients who have benefited most from the treatment, both with regards to the reduction in distress and work done on their teeth, are willing to pay more for the dental care than other patients are. Finally, we see that this model have a relative good explanatory power as almost 40 percent of the total variation in WTP for dental treatment is explained by the estimation. The explanatory power of the model is, however, less than for the estimation on the total WTP.

Second, we turn to the estimation results for the WTP for fear treatment, reported in the last column of table 4. We see from the table that the level of significance is not as good as in the previous estimations. Only the coefficients for reported benefits from the fear treatment and the number of treated surfaces differ significantly from zero at a 10 present level. We also see that patients who reported high benefits from the fear treatment have as substantially larger WTP for the fear treatment

than other patients do. As for the WTP for the dental treatment, this model explains almost 40 percent of the total variation in the expressed WTP for the fear treatment.

4.4. Is the treatment socially beneficial?

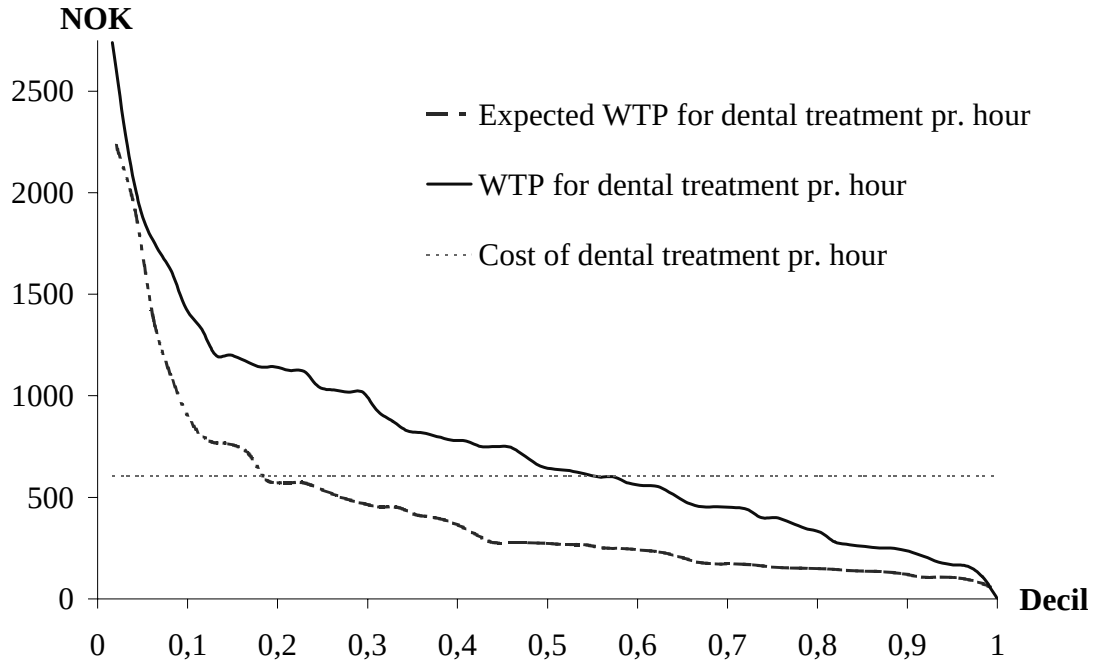
In Norway, dental treatment for adults is privately financed. The Public Dental Service offers treatment to children 0-18 years, all mentally handicapped, groups of institutionalised, chronically ill and elderly patients. This treatment is offered free of charge or at reduced rates. Until 1995, fees were regulated by a fixed fee schedule negotiated between the Dental Association and national authorities. The fees for adult patients in the Public Dental Service Treatment are still regulated by these annual negotiations. In 1996, the official price tariff had two levels, depending on what kind of treatment performed: one high tariff at 604 NOK per hour (which is approximately US$67) and one low tariff at 497 NOK per hour (which is approximately US$55). The cost of nitrous oxide sedation was 224 NOK per hour (which is approximately US$25).

In this paper, we assume that the public dental ward will supply the dental fear treatment. The market for dental services in the public ward is not competitive because, among other things, the price is still regulated by a set of recommended prices. If the official price tariffs do not clear the market, we will experience either excess demand or supply in the treatment of dental fear. Furthermore, we do not have information on the actual costs of producing various dental services in the public dental ward. Thus, we have to assume that supplying dental services is profitable at the official tariffs and that the tariff equals costs at the margin.

In figure 1, we have plotted the patients' maximum and expected WTP per hour for *dental treatment*, by the rank in the WTP distribution. Here, we assume that the patients have the same distribution of their expected WTP on dental and fear treatment as for their maximum WTP. The curve to the left of the point 0.1 shows the expressed WTPs of the 10 percent of the patients with highest WTP per hour,

that is the first decil of the WTP distribution. The median WTP, which parts the sample in two, may be read off at the point 0.5. We have also plotted the cost of dental treatment, using the high price tariff for active treatment.

Figure 1: WTP before and after the treatment and cost (in NOK) of dental treatment pr. hour. Ranked by WTP.

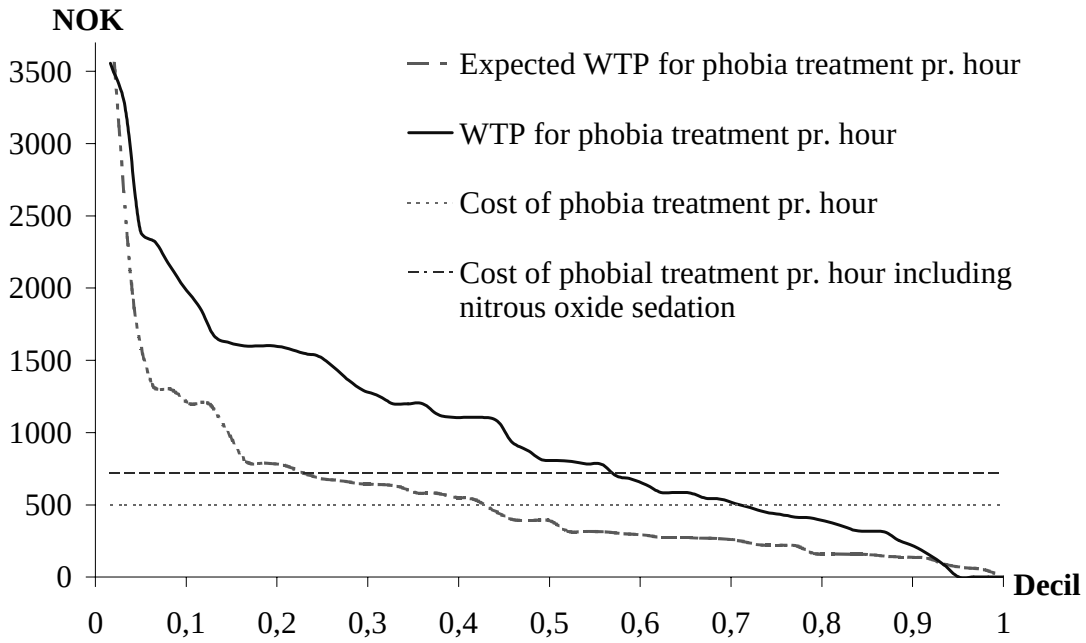


We see from figure 1 that patients with dental fear do not have a high WTP for dental treatment as compared to the price. Only 54 percent of the patients had a WTP exceeding the cost per hour for dental treatment after all uncertainty is revealed, and a little less than 17 percent were willing to pay the cost before the treatment started.

In figure 2, we have plotted the patients' maximum and expected WTP per hour for *fear treatment*, by the rank in the WTP distribution. We have also plotted the cost of fear treatment, assuming it to be at the low rate of the official price tariff (497 NOK), and the cost including nitrous oxide sedation. We see from the figure that the profitability of supplying the fear treatment is higher than for the dental

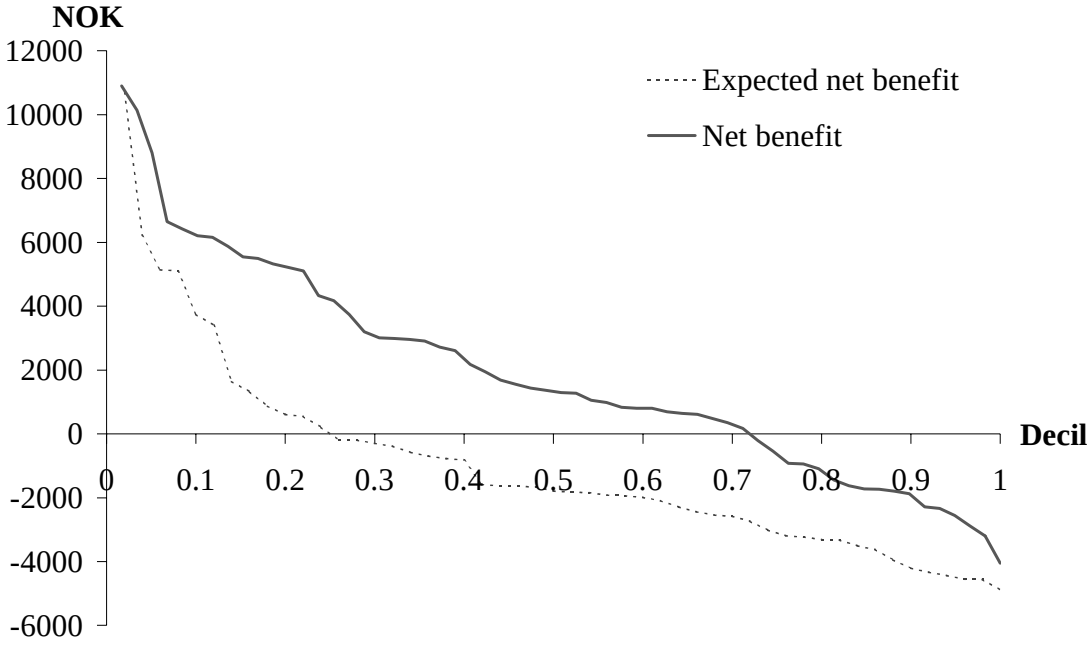
treatment, partly because the cost of providing the treatment is assumed to be lower. A little more than 70 percent of the patients had a WTP that exceeded the cost of providing one hour of fear treatment, whereas 42 percent of the patients were willing to pay the cost before the treatment started. If we include the cost of nitrous oxide sedation, the shares are reduced to 56 and 23 percent.

Figure 2: WTP before and after the treatment and cost (in NOK) of fear treatment (including nitrous oxide sedation) pr. hour. Ranked by WTP.



Based on this discussion, it seems that the social desirability per hour of supplying dental and fear treatment differs considerably when supplied to patients with dental fear. We have also calculated each patient's net benefit from the experiment in order to evaluate the social desirability of the total treatment when differences in need for dental and fear treatment between patients are accounted for. The net benefit is defined as the patient's maximum WTP for the total treatment net of the cost of his individual treatment. The cost of the treatment was calculated based on the recorded time used for different parts of treatment. The mean cost for the total treatment (both dental and fear treatment) was NOK 4 344, which is approximately US$483.

Figure 3. Expected and total consumers surplus (WTP net of costs in NOK) for both dental and fear treatment by income groups. Decil.



In figure 3 we have plotted the net benefits and expected net benefits from the total treatment by the rank in the distribution. If the patient's WTP exceeds the price he has to pay for the treatment, the net benefit is positive, and vice versa. We see from the figure that 71 percent of the patients had a WTP that exceeds the cost for the total treatment *ex post*, whereas only 24 percent of the patients were willing to pay this cost before the treatment started.

6. Conclusions and concluding remarks

In conclusion, we find that a very small share of the patients participating in the experiment are willing to pay what it actually costs to get their teeth fixed before they know the effect of the fear treatment. If a combination of dental and fear treatment were offered to the public at the official price tariffs, only one out of four of the patients would be expected to make use of this offer. This is because the

investment decisions are made in the first period under uncertainty. After the treatment, seven out of ten of patients are willing to pay what the treatment costs.

Assuming that all externalities are included, it will not be economically efficient to supply more than what the patients are willing to pay before the treatment has started, even if the number of patients who are willing to pay the costs almost triples *ex post*. However, if we are concerned with the distribution of well being in addition to an efficient allocation of resources, it might be optimal to subsidise the fear treatment in order to increase the demand. First, one may argue that applying standard rules for economic efficiency, assuming both rational behaviour and rational preferences, are not meaningful in cases concerning treatment of mental sufferings. Thus, the desired level of supply may be where the WTP *ex post* equals the cost, since this is the patients' WTP under full certainty about the effects of the fear treatment and with reduced mental stress. Second, the high score on general psychological distress tests often seen in this patient group (Aartmann, 1997 and Willumsen, 1999) may be an indication of reduced ability to function in the work place. Thus, dental fear may both have external effects on the patients' productivity and reduce their income. In our sample, the mean private income is very low, less than 43 percent of mean Norwegian private income in 1994. If this is the case for dental fear patients in general, it has several impacts on the evaluation of efficiency and social desirability of the fear treatment. If the external effects in the work place are not reflected in the patients' expressed WTP for the treatment, the costs of dental fear is underestimated, and it may be economically efficient to subsidise the supply of dental fear treatment. Furthermore, the low income in this patient group implies that they have a large marginal utility of income as compared to more wealthy groups.[6] For this reason, the social desirability of the treatment is likely to be underestimated, and it will be beneficial for the society to subsidise dental fear treatment. This is both because of the

[6] Because the marginal utility of consumption is assumed to decline with quantity, it follows that the marginal utility of income decreases with income.

high marginal utility of income in this patient group and because society often wants to redistribute resources to the less wealthy consumers (inequality aversion).

Since we are not able to measure neither the external effects through the labour market, the marginal utility of income or the individual welfare weights, it is not possible to determine the exact subsidy level which secure either economic efficiency or the social optimal allocation of resources. All these effects do, however, suggest that the supply of dental fear treatment should bee subsidised to some degree by the government. However, when discussing the social desirability of subsidising dental fear treatment, one also need to take into consideration efficiency losses in the economy due to additional tax increases in order to finance the subsidies.

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