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Stated preferences for the removal of physical pain resulting from permanently disabling occupational injuries A contingent valuation study of Taiwan

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Abstract

Within the process of calculating the true costs of illness, physical pain is a component of intangible, or human, costs. One method of estimating the monetary value of such costs is the 'contingent valuation method' (CVM), a stated preference method based upon the elicitation of levels of willingness to pay (WTP) facilitated through surveys. This study is amongst the first of its kind to apply CVM to the estimation of the cost of the removal of physical pain resulting from permanently disabling occupational injuries. We assume that a painkilling drug has been invented to mitigate physical pain with the advantages of validity and instantaneity, and without any side effects. The WTP of each of the respondents is determined by a two-step sequential-bidding process. The maximum WTP under log normal distribution was NT $1791/day (US $65.1), whilst under Weibull distribution it was NT $1913/day (US $69.6). Older respondents, those with higher household income, fall injuries, longer periods of hospitalization, or with a perceived demand for the painkilling drug in excess of one day, displayed a positive independent effect on the eliciting of their WTP. In addition, respondents with higher 'out-of-pocket' expenses, or where the interview took place 2 years or more after the injury occurred, responded with a lower WTP.

Keywords: Occupational injury; Contingent valuation method; Stated preference method; Intangible costs; Permanently disabled workers; Painkilling drugs

1. Introduction

Physical pain is a symptom of discomfort which comes with illness or injury. The traditional 'specificity' theory of pain proposes that pain is a specific sensation and that the intensity of pain is generally proportional to the extent of the tissue damage (Melzack, 1986). There is, however, also some evidence to suggest that pain is not simply a function of the extent of bodily damage alone, but that rather, it is influenced by attention, anxiety, suggestion, prior conditioning and other psychological variables (Melzack and Wall, 1982). In any case, the discomfort and suffering associated with physical pain will invariably lead to the diminution of a subject's quality of life, and can lead to utility losses, or 'economic welfare losses' (Davies and Teasdale, 1994).

Within the process of estimating the overall costs of occupational injury, physical pain is regarded as a component of intangible, or human, costs (EPA, 2002; Jansson et al., 2001; Dorman, 2000; Salkeld et al., 1996a, 1996b), whilst the subject's personal grief, the suffering caused to the subject's family and the loss of amenity from permanent incapacity are further components of the intangible costs involved.

Although there is no generally accepted method for calculating human costs (Mossink, 1999), a number of economists agree that intangible costs can, in general, be measured

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indirectly by the information revealed by individuals in their market-related behavior (e.g., the purchase of goods that decrease health/security risks, or the purchase of painkillers) or directly, by statements which they make during surveys. One of the stated preference methods is the 'contingent valuation method' (CVM) which can be used to elicit WTP directly (EPA, 2002; Salkeld et al., 1996a, 1996b). However, the outcomes are often criticized, since different techniques will often yield different results. Moreover, some commentators have argued that human costs cannot be measured in monetary terms, and that they should, instead, be considered an element of non-economic costs (Dorman, 2000).

The CVM is an approach normally applied to the valuation of non-market goods, and one which assumes the hypothetical existence of a market for the goods; however, this approach has been applied to a variety of non-market goods, including health. CVM studies on health improvement grew steadily throughout the 1990s (see, e.g., Johannesson et al., 1991; Donaldson et al., 1995; Alberini et al., 1996; Kartman et al., 1996; Zethraeus, 1998; Bishai and Lang, 2000; Liu et al., 2000), although in their cost evaluations, most of these studies avoided episodes of diversified illness since they generally offered little comparability because of the differences between symptom episodes and study designs (Kenkel et al., 1994).

In a review of 48 healthcare CVM studies, Diener et al. (1998) found that 42 of the studies (91%) were designed as WTP studies within the context of a cost/benefit analysis (CBA), whilst 37 of the studies involved specific diseases such as respiratory diseases, hypertension, cardiovascular disease, or cystic fibrosis screening. However, none of these studies dealt with the intangible/human costs of occupational injury. In addition, since all of the elements of intangible/human costs have always been considered in their entirety, a number of reservations remain with regard to the ability of CVM studies to elicit true WTP values, largely because people may not have clear pre-formed preferences for non-market goods, whilst the procedure involved in CVM may also be too complex for many respondents to deal with (Ball, 2000).

The 'embedding effect', also known as the part-whole bias, may occur if the respondent does not clearly distinguish between the subjects of a good, vis-à-vis the good in its entirety (Mitchell and Carson, 1989; Jones-Lee et al., 1993; Bateman et al., 1997; Beattie et al., 1998; Gyldmark and Morrison, 2001). Thus, to our knowledge, there have been very few works published in the literature on WTP dealing with the issue of the intangible costs of occupational injuries.

Calculating the intangible costs of work-related injuries based upon the concept of relative utility loss (ascribed to the individual in 1990 dollars), the UK's Health and Safety Executive evaluated these costs as ranging from £50 for the mildest injury, to £120,000 for permanent disability (Davies and Teasdale, 1994). However, as the authors noted, many have argued that the indices of relative utility loss for injury victims are arbitrary. In an effort to evaluate the benefits of the prevention of road accidents in the UK, it has been further estimated that, based upon the CVM, the intangible costs involved for each accident casualty stand at an average of £22,319 (DETR, 1998). However, estimates of intangible costs are still very wide ranging, whilst the embedding effect of CVM, which can affect the accuracy of the evaluation, cannot be ignored.

Viscusi (1993) provided a positive note on CVM, arguing that it is in fact a better measure because those studies adopting CVM provide an estimation of the respondent's utility function. As such, some of the estimation problems found in other stated preference methods (specifically heterogeneity) can thereby be avoided. Furthermore, CVM studies are not limited by the inability to acquire market data.

Most of the studies aimed at measuring injury costs tend to consider intangible costs in their entirety; thus respondents generally have problems in recognizing the benefits of the CVM approach. In addition, CVM healthcare studies have tended to focus on mild to moderate symptoms, as opposed to very serious symptoms, such as the physical pain suffered by permanent disability victims. Nevertheless, it is generally accepted that most people would be willing to pay something to alleviate the pain caused by serious illness or injury, or to see such alleviation of pain from their loved ones (EPA, 2002).

Where the intensity of pain is mild, a general painkilling drug can be readily purchased from a drugstore and consumed during daily life; however, most of the existing painkilling drugs or anesthetics cannot completely remove moderate or severe pain, particularly where this is complicated by permanent disability resulting from occupational injury. If some miracle drug invented to mitigate such physical pain were to become available, with certain advantages such as validity and instantaneity, and without any side effects, the demand for such a drug would be tremendous. The price of this miracle drug, if it existed, would represent one element of the entire intangible costs of occupational injury.

The purpose of this study is to estimate the WTP for the removal of physical pain resulting from occupational injuries, using the CVM, and to explore the determinants of WTP for such treatment.

2. Survey design

According to compensation claim data obtained from the Bureau of Labor Insurance (BLI), there were 8133 cases of permanently disabling work-related injuries in Taiwan between January 1994 and September 1995 (BLI, 1996). About 2300 of those injuries occurring in the Taipei metropolitan area are included in this study. After excluding 110 migrant workers, and 330 cases which involved traffic accidents that occurred outside of the factory, we randomly selected 287 workers (15%) on which to conduct personal interview surveys from December 1995 to March 1996. The major reasons for the limited sampling ratio were the budget and time

constraints, which demanded the completion of this project by April 1996.

The questionnaire items were decided by a committee of experts comprising of economics scholars and scholars of occupational health. Information was collected on the following five categories: (a) demographic factors of age, gender, education and marital status; (b) injury data including the type and severity of the injury, the cause of the injury, the type of medical intervention received, disability status, worker's job experience and wages before and after the injury; (c) necessary miscellaneous expenditure relating to the permanent disability; (d) the lump sum payment received from the BLI as compensation for the permanent disability; and (e) the respondent's WTP for the removal of physical pain.

A small pretest survey was arranged which involved six members of an association of victims of occupational injuries, following which, based upon the responses from the pretest, some revisions were made to the questionnaire in order to ensure the clarity of each statement or question, and to ensure that reasonable starting prices had been selected. Five undergraduate students were recruited and mutually standardized to serve as interviewers. They were instructed to ask each question in a uniform manner as prescribed by the authors. A booklet of guidelines was also provided, which detailed uniform and appropriate responses to any questions raised by the subjects.

The victims' responses were compared with the original compensation records held by the BLI in order to ensure the validity of these responses, and 1 month after the interview process, each of the interviewees was contacted by telephone so as to confirm the reliability of the responses on financial expenditure, and the current level of income.

Of the 287 cases under examination, 226 were male and 61 were female, aged between 17 and 66 years, with an average age of 39.5 years. There were no significant differences between the sample cases and all cases in the BLI data, with regard to the severity and the location of the disability ($p > 0.42$ and $p > 0.20$, respectively). A total of 157 cases were successfully interviewed giving a response rate of 55%. The major reasons for the lack of response included a change of address or wrong address held on file (66/130), no response to more than three attempts at making telephone contact (27/130), difficulty in locating the address (12/130), difficulty in arranging a convenient time for interview (10/130), refusal to be interviewed (10/130) and death (5/130). However, there were no significant differences between respondents and non-respondents with regard to the distribution of gender (126:31 versus 100:30), age (40.4 ± 11.4 versus 38.4 ± 11.9), severity and location of the disability, and the average compensation received for a permanent disability.[1]

Table 1 provides details on the distribution of demographic and injury characteristics amongst the respondents. Most of the interviewees were married males who had received high school education and who had sustained upper limb injuries. In about a quarter of all cases, the period of time which had elapsed between the occurrence of the injury and the interview was over 2 years. Furthermore, over half of the victims (61%) continued to suffer from feelings of guilt or grief at the time of interview, whilst most of their families were also going through some measure of suffering.

In order to elicit the respondents' WTP value for the removal of physical pain, we proposed a contingent circumstance of a hypothetical newly invented drug, which had the ability to completely remove a patient's pain for a full 24-h period, with no side effects. Based upon the prices of existing painkilling drugs in the Taipei metropolitan area, five different monetary values were allocated as the starting bid for the drug;[2] these five starting bids were chosen at random in order to avoid any starting point bias, with the maximum willingness to pay being elicited via a sequential-bidding process.

Prior to starting the bid, all respondents were asked about the sustainable duration of their physical pain and how many days supply of the painkillers were demanded. Since all respondents had already experienced their injury and were now fully recovered, they were well aware of their requirements for the drugs, in terms of the quantity or number of days supply, during the acute pain stage; thus, they were unlikely to misinterpret the CV question. In addition, in order to ensure the credibility of the scenario, five debriefing points were sequentially explained to each of the subjects.[3] All the respondents were reminded, for example, that the WTP was only related to the removal of physical pain. The method of eliciting the respondents' WTP is detailed in Appendix A.

In the initial stage of the sequential-bidding process, the reservation prices of most respondents were higher than the

[1] The distributions of age, lump sum compensation and insured wages were examined between 157 interviewed cases and 130 non-interviewed cases by conducting the Wilcoxon rank-sum test (the respective p-values were 0.24, 0.12 and 0.64). The distributions of gender and extent of disability were also compared using the χ^2-test (both p-values were 0.49).

[2] The cheapest existing painkiller found by this study was Scanol® (Acetaminophen) which had a general sale price of NT $120 and was easy to purchase as over-the-counter medication from any general drug store. The most expensive painkiller found by this study was Morphine (Opioid pharmacotherapy) which can only be issued under prescription from a physician and under co-payment by patients in hospitalization; this drug has a ceiling amount of NT $1000 per day. However, all the market prices were set at the elicited payment on the second/last round of the sequential bids amongst questionnaires with the lowest/highest starting price, respectively.

[3] In order to ensure the credibility of the scenario (i.e., a painkiller which completely removes pain and has no side effects), the following five debriefing points were sequentially explained to the respondents prior to the bidding process: (1) the painkiller has just been invented to completely mitigate physical pain for 24 h; (2) no side effects have been reported; (3) co-payment is required for such medication; (4) this drug is only for the temporary removal of pain and other medical treatments should be continued after taking the drug; (5) patients are reminded that the purchase of this drug will reduce his/her ability to consume other daily used goods or services. Patients were also asked to indicate how many days they required such medication. One of the main roles of the interviewers was to ensure that the patients completely understood all of these points.

Table 1
Definition and basic statistics of variables

Variable	Definition	Mean	S.D.
log(income)	log of household monthly income (NT$)	4.66	0.21
Age	Respondent's age in years	40.43	11.37
Married	Dummy = 1, if respondent is married and live with spouse, 0 otherwise	0.75	0.43
Genders	Dummy = 1, if respondent is male, 0 otherwise	0.80	0.40
Education	Years of schooling	9.03	3.78
Fallen/stumble	Dummy = 1, cases of fallen or stumble injuries, 0 cases of crashed injuries	0.07	0.25
Limb rolling-up	Dummy = 1, cases of limb-pressed, 0 cases of crashed injuries	0.60	0.49
Limb cutting	Dummy = 1, cases of passive collide, 0 cases of crashed injuries	0.16	0.37
Hospitalization days	Days of respondent's hospitalization	26.04	42.83
Period between injury occurrence and interview	Dummy = 1, cases of injury occurrence before December 1993, 0 otherwise	0.25	0.43
2–7 days of WTP	Dummy = 1, cases of respondent's willing to pay for the dose of 2–7 days, 0 cases of respondent's willing to pay for the dose of 1 day	0.33	0.47
≥8 days of WTP	Dummy = 1, cases of respondent's willing to pay for the dose larger than 8 days, 0 cases of respondent's willing to pay for the dose of 1 day	0.38	0.49
Out-of-pocket expenditure	Total expenditure of medication (NT$)	55285	154880
Suffering frequency	Suffering frequency of respondent's families, 1–4, 1 = never, 4 = always	2.52	1.14

random starting bids. As Table 2 shows, a total of 39 cases provided a zero response to the CV question. The major reasons for this may be attributable to their experience of milder pain after the injury, family poverty as a major financial constraint, or poor recognition of the scenario; for example, in 11 cases (7%), the respondents did not recognize the prerequisites of the CV question leading to them providing a zero bid or refusing to answer the question. In addition, in four other cases, the respondents thought that the painkiller pills should be paid for by the BLI instead of being purchased by the sufferer.

Following their injury, less than half of the respondents suffered from physical pain for more than 8 days. Table 3 provides details of the distribution of the yes/no mean and median ratio, with regard to the eliciting of respondents' WTP at the first time of bidding, under different starting prices. All the means have larger values than the medians, indicating a general pattern of skew to the right distribution. A simple regression, along with the one-way analysis of variance conducted within this study, also showed a non-statistical significant association between WTP and the starting bids.[4]

Table 2
Numbers of respondents were willing to pay for the removal of physical pain after injury

	N (%)
Willing to pay in the end	118 (75%)
Pain feeling was mild	16 (10%)
No extra money to pay	8 (5%)
Phobia of side effect of the painkilling pills	5 (3%)
Payment belong to the responsibility of BLI	4 (3%)
Unbelief of the efficacy of the pill	3 (2%)
Refuse to answer	3 (2%)
Willing to proceed on sequent-bid	
1st of bid yes/no	87/70
2nd of bid yes/no	75/82
Number of Days for purchasing the painkiller	
≤1 day	46 (29%)
2–7 days	52 (33%)
≥8 days	59 (38%)

3. Empirical methods and results

We assume that the WTP for the alleviation of physical pain varies with the characteristics of each specific injury (e.g., the cause of the injury) and with individual characteristics of each respondent (e.g., income). In order to measure the effects of covariates on WTP, we also assume that the logarithm of WTP is a linear function of these characteristics; formally:

$$\log \mathrm{WTP}_i = Z_i\beta + X_i\gamma + \varepsilon_i \quad (1)$$

where Z_i is a vector of injury attributes, X_i a vector of individual characteristics, and β and γ are vectors of the parameters. The unmeasured characteristics of the injury or the respondent, which are represented by ε_i, are assumed to have independent and identical normal distribution for all respondents, with variance σ^2. Under the assumption that after answering the payment questions, respondent i's WTP lies between two values, $\mathrm{WTP}_i^{\mathrm{L}}$ and $\mathrm{WTP}_i^{\mathrm{U}}$, which are determined by two steps within the sequential-bidding process and by the responses provided by the subject.[5] The complete procedure

[4] The starting point bias was examined by using a simple regression and the analysis of variance (ANOVA). In the simple regression analysis, the *t*-value was 1.71 for the WTP logarithmic transformation as a dependent variable, with the starting bid being the independent variable ($p \leq 0.090$). On the other hand, by using the five start bids as the nominal variables in one-way ANOVA procedure, the *F*-value was 1.58 ($p \leq 0.183$), with the WTP logarithmic transformation being a dependent variable. The above results imply that the WTP distributions might not remain around the initial values. However, since the *p*-values were on the statistical border, it was not necessarily the case that the effects of the starting bids could be completely mitigated by the design, with five starting points, as used in this study.

[5] Each respondent was asked three times to decide their maximum WTP. The strategy behind each bid was dependent on whether the respondent was

Table 3
Distribution of the monetary values for the removal of physical pain per day that subjects are willing to pay elicited from five different start-points (unit = NT$)[a]

Questionnaire version (count of respondents)	Implied starting point	1st of bid yes/no (%)	Statistics for respondents with positive counts	
			Mean ± S.E.	Median in NT$
1 (28)	500	79	2480 ± 3062	1100
2 (29)	750	55	1414 ± 1171	1000
3 (36)	1000	42	2120 ± 2300	1500
4 (28)	1500	50	2952 ± 2750	2000
5 (36)	2000	47	2250 ± 1955	2000

[a] US $1 = NT $27.5 in December 1996.

is described in Appendix B. The likelihood function to be maximized is formally given by

$$\log L = \sum_{i=1}^{n} \log \left\{ \Phi \left[\frac{\log \mathrm{WTP}_i^{\mathrm{U}} - Z_i\beta - X_i\gamma}{\sigma} \right] - \Phi \left[\frac{\log \mathrm{WTP}_i^{\mathrm{L}} - Z_i\beta - X_i\gamma}{\sigma} \right] \right\} \quad (2)$$

where $\Phi(\cdot)$ is the standard normal cumulative density function (cdf).

The regression model is estimated by the maximum likelihood method. The covariates of Z_i within the model include the cause of injury, the number of days of WTP based upon the perceived demand for the painkilling drug, and the total period of hospitalization in days. A respondent's age, gender, education, marital status and total family income are included as individual characteristics, X_i. Clearly, there may be significant differences in the impact on the family of each of the respondents from the way in which the injury occurred, which may also affect the WTP value; therefore, a vector of family impact characteristics, including the period of injury occurrence, out-of-pocket expenses on medication and the frequency of suffering of family members, are also included within the model. On completion of the coding and editing process, accelerated failure time (AFT) model survival analyses were performed using SAS/STAT software for Windows, Release 6.08 edition.[6]

The regression estimates are summarized in Table 4, where the effects of respondent characteristics on WTP are seen as reasonable. As anticipated, household income indicated a positive sign and was significantly different from zero for different models. The values of income elasticity within our study were in the range of 0.61–0.65, which is greater than the value of 0.26 for minor coughing, sneezing/eye irritation complex, and 0.6 for severe shortness of breath, as reported by Loehman and De (1982). In a study of WTP for the avoidance of acute illness, Alberini et al. (1996) similarly estimated that income elasticity was in the region of 0.3, whilst Liu et al. (2000) found that income elasticities were around 0.4 for the avoidance of a common cold for the mother herself, and 0.3 for her child. In contrast, Brien et al. (1994) found that with regard to respondents' WTP for the avoidance of specific severe symptoms, income effects were very small, or even negative, and not statistically significant. The authors collected data on both personal and extended household income levels.

In order to avoid the collinearity of the two variables, we carried out two different fits in the models for household income and personal income, respectively. Consequently, we found that household income demonstrated a better goodness of fit than that of personal income, which is similar to other stated preference studies. Income elasticity, as shown in the models in Table 4, demonstrated two-fold meanings. First of all, it is assumed that the painkilling drug is, in nature, a normal good, with an increase in income leading to a corresponding increase in the demand for the good; and second, the pain and suffering from a disabling occupational injury was more severe than that inflicted by common acute respiratory symptoms, as reported in the earlier health-related CVM literature. The income elasticity value implied that the disutility for physical pain was very significant, and much stronger than that for general respiratory sickness or symptoms. These results provide support for the accuracy of this study.

Age has become widely regarded as an important determining factor in most studies on health economics, and indeed, our results do demonstrate a monotonic increase in WTP with the age of the respondents. In general, since the health stock decreases with age – as inferred by Grossman's (1972) health production function theory – there will be an increase in the demand for medical services with advancing years. As people become older, they may develop more health problems, which will naturally raise their demand for medical services; nevertheless, they will generally have

willing to pay the designated price for the removal of physical pain caused by their occupational injury. If the response was yes, the bid was increased by a further NT $500, or approximately US $18.2 (US $1 = 27.5 NT$). If the response was no, then the bid was reduced by the same amount, or down to half of the original starting price. The bidding on the different starting prices resulted in a total of 20 different ranges. The ceiling limit of the respondents' WTP was set at NT $10,000.

[6] Survival analysis of the accelerated failure time (AFT) model was carried out, with the upper and lower bounds of each range first being logarithmically transformed and then considered as the dependent variable. Based on two different assumptions of residues in the AFT model (normal scale or extreme value scale), the log normal distribution and Weibull distribution were compared under the log linear model to determine the WTP prediction variables and to estimate the confidence intervals for the range of WTP values. The likelihood ratio tests of both distributions with gamma distribution were also compared for the goodness of fit test.

Table 4
Estimation of WTP values from each independent variables based on Weibull and log normal distributions

Independent variables	log normal (*t*-statistics)	Weibull coefficient	log normal (*t*-statistics)	Weibull coefficient	log normal (*t*-statistics)	Weibull coefficient
Intercept	0.620 (0.10)	0.431 (0.05)	−1.208 (0.34)	−1.508 (0.66)	−0.906 (0.21)	−1.057 (0.32)
Demographical factors						
log(income)	0.557 (9.66)***	0.599 (11.93)***	0.632 (12.46)***	0.673 (17.54)***	0.610 (12.55)***	0.651 (15.68)***
Age	0.022 (5.73)**	0.023 (6.65)**	0.020 (5.24)**	0.021 (6.53)**	0.023 (7.24)***	0.025 (9.92)***
Marital status	−0.258 (1.48)	−0.261 (1.84)	−0.315 (2.30)	−0.315 (2.86)*	−0.298 (2.25)	−0.232 (1.72)
Genders	0.192 (0.94)	0.176 (0.77)	0.174 (0.78)	0.176 (0.84)	0.189 (0.99)	0.076 (0.16)
Education	0.008 (0.10)	0.007 (0.09)	0.005 (0.04)	0.004 (0.04)	0.025 (1.07)	0.025 (1.48)
Injury characteristics						
Causes of injury						
Fallen/stumble			0.446 (1.35)	0.661 (3.12)*	0.361 (1.03)	0.550 (2.45)
Limb rolling-up			0.350 (2.99)*	0.353 (3.32)*	0.279 (1.95)	0.209 (0.96)
Limb cutting			0.392 (2.24)	0.323 (1.66)	0.406 (2.46)	0.233 (0.80)
Hospitalization days			0.002 (0.48)	2E−4 (0.01)	0.006 (4.65)**	0.005 (2.62)*
Days of WTP						
2–7 days vs. 1 days			0.896 (6.44)**	0.981 (11.36)***	0.669 (4.01)**	0.724 (6.80)***
≥8 days vs. 1 days			0.805 (5.28)**	0.892 (9.11)***	0.669 (4.14)**	0.726 (6.97)***
Impact on household						
Interval period between injury occurrence and interview						
≥2 years vs. <2 years					−0.558 (9.86)***	−0.623 (12.2)***
Out-of-pocket expenditure					−1.3E−6 (4.96)**	−1.5E−6 (6.78)***
Suffering frequency of family member(s)					−0.141 (0.83)	−0.246 (2.26)
Log-likelihood value	−105.23	−104.90	−100.73	−99.50	−94.80	−92.98
Estimation of WTP mean ± S.E. (NT$)	1924 ± 633	2082 ± 728	1705 ± 840	1812 ± 975	1791 ± 975	1913 ± 1101

* $p \leq 0.10$.
** $p \leq 0.05$.
*** $p \leq 0.01$.

accumulated greater wealth, and thus, such services will be more affordable to them. Older people in Taiwan are accustomed to saving money in order to ensure their stability in later life; therefore, they may be more readily prepared to reduce their level of consumption of other goods. The effects of age within this study therefore seem consistent with the concepts of general health economics and oriental culture.

Although economic theory suggests that those with higher levels of education will have a higher WTP to avoid illness, the true determinants of WTP are still debatable. For example, in a comparison of two studies on the effects of education on a person's WTP to avoid minor illnesses, in contrast to the findings of Liu et al. (2000), Alberini et al. (1996) had earlier found that education had an expected positive sign and was statistically significant. Our study provides similar findings on the effects of education to those of Alberini et al. (1996), with a positive sign and borderline statistical significance. This may imply that since people with a higher level of education will usually make more money, they will therefore be more willing to pay a higher price for the alleviation of moderate to severe pain. We also found that for those respondents who were married and living with their spouse, the marital status coefficient sign was consistently negative, indicating a lower ability to pay.

It is reasonable to anticipate that a respondent's WTP will increase with a rise in disutility, such as the period of hospitalization or the intensity of physical pain. The intensity, frequency and duration of pain, as perceived by a subject, will generally depend upon the cause and location of the injury, as well as its severity. The results indicate a significant increase in the WTP values for those respondents with stumbling or falling injuries which result in a greater number of days spent in hospital. As Table 4 shows, for most of the dummy variables for the causes of injuries, the *t*-values were different in the Weibull and log normal models; however, the consistent positive signs do provide some evidence that different causes of injury could affect the WTP for the alleviation of pain. For example, the higher WTP for those respondents with stumbling or falling injuries than for those injuries resulting from crashes may come as a result of different levels of intensity of pain. Furthermore, as anticipated, the positive sign for greater number of days spent in hospital indicates that the more severe cases do have a higher WTP value.[7]

[7] On the other hand, different levels of severity of permanent disability, categorized by the BLI, were put into the construction of the regression model. As anticipated, this did not lead to any statistical significance in the amount of WTP, as the extent of the loss of physical functions may

Table 5
Distributions of the household income, victim's personal income after injury occurrence, their differences and average ratio stratified by different categories (unit = NT$)

Categories	Household income (mean)	Victim's income after injury (mean)	Income difference (mean)	Victim/family ratio (mean)
Duration				
<2 years	52738	29975	22764	0.625
≥2 years	46476	23697	22778	0.516
Frequency of suffering in family members				
Never	46775	31913	14862	0.750
Occasionally	56638	38213	18425	0.692
Often	54795	28593	26202	0.603
Always	47610	16955	30655	0.359

In addition, based upon their WTP, the number of days supply (doses) of the painkiller drug which respondents would be willing to purchase might directly impact upon the demand for the good and thereby affect the value of WTP. The distribution of the number of days, as WTP, also indicates a trend of skewing to the right. Therefore, it is difficult to depict the relationship in terms of a demand curve for painless days and the willingness to pay per each painless day. Nevertheless, the dummy variable for the number of the days does demonstrate a positive sign which implies that those cases with a willingness to purchase the drug for more than 2 days would have a higher WTP than those with a willingness to purchase the drug for only 1 day. This result could clearly imply stronger demand for the hypothetical drug for those cases with a greater number of painful days.

In contrast, those cases with greater out-of-pocket expenses and those with persistent suffering of family members leaned towards a lower WTP. In cases where the respondents had suffered from their injuries for more than 2 years, the WTP displayed a negative sign, whereas the sign was positive for those whose injury had occurred during the previous two years. All the signs of the estimated coefficients on the explanatory variables were consistent across both the Weibull and log normal model; however, the estimates in the Weibull model were generally greater than those in the log normal model.[8]

Table 5 provides details of the personal income distributions of the sample, including household income, its difference and average ratio, stratified by the difference in the period since the injury. The average personal income level declined over the 2-year period after the occurrence of the injury. Furthermore, the proportional loss of income for the families of those victims who suffered constantly was higher than for those who suffered relatively less.

4. Discussion

As a fairly flexible approach to the evaluation of non-market goods, the CVM has been applied to a number of diversified fields in an effort to determine a measure of WTP. However, it is virtually impossible to verify the accuracy of the values reported in many studies because the true WTP value has invariably been unobservable. In this study, we undertake the review of a number of issues from the extensive literature in this area in order to assess the accuracy of the estimated values. These issues include questionnaire design, potential bias and other factors systematically related to income and/or implied by economic theory.

The bidding process and the information content were major points considered in the design of the main question under discussion, with two possible general approaches that could be taken to evaluate the illnesses or injuries under examination; one approach would be to allow the respondents to describe the illness/injury themselves (Rowe and Chestnut, 1985), whilst the other would be to describe for the respondents the symptoms that they were being asked to evaluate (Loehman and De, 1982). The advantage of describing the symptoms to the respondents is that the issue that they are being asked to evaluate is well defined. Conversely, the disadvantage of this approach is that for those respondents who may have never experienced the symptoms exactly as stated, the evaluation exercise may tend to appear meaningless (Alberini et al., 1996).

In our study, the experience of severe pain is highly personal because of different pain threshold levels and varying perceptions amongst different people. We cannot define the pain symptoms being evaluated too vividly because of the wide range of subjective levels of discomfort following occupational injuries of differing severity. Thus, in order to ensure that the scenario is rational and clear, the question was designed with reference to a painkilling drug taken orally in accordance with most peoples' daily practice. As a result, the

not have any direct connection with the pain suffered at the time that the injury occurred. It would seem, however, that the variable correlated with other variables, such as injury types; for example, the levels of severity of those cases with falling injuries were more severe than those of cases with laceration injuries. Therefore, in order to avoid the problem of collinearity, this variable was not entered into the regression model.

[8] Both the Weibull and log normal distributions represented special cases in the generalized gamma distribution; the likelihood ratio test was conducted in order to compare the goodness of fit for both distributions, whilst the alternative hypothesis was set as the generalized gamma distribution. The results showed that if α error was set at 0.05, only the Weibull distribution as the null hypothesis was accepted, which revealed that Weibull distribution fits better than log normal distribution. However, if the α error was set at 0.01, then both distributions were accepted, which implied that the log normal distribution could be accepted with moderate explanation.

trade-off during the sequential-bidding process seems feasible because most of the respondents with zero responses had very little relevance to the contingent question posed.

Although all medical fees and subsequent medication expenses were covered by compulsory labor insurance, three-quarters of the respondents would still be willing to pay out of their own pocket for any newly invented painkilling drug that was proven to have no complications or side effects. Detailed discussions with six of the cases under examination (formed as the focus group during the pretest interviews) also revealed strong support for such formulation of the main question. All of the above conditions showed that the purchase of contingent painkilling drugs could be an appropriate medium for reflecting the demand for the alleviation of physical pain amongst Taiwanese victims of occupational injuries. We therefore concluded that there was little misunderstanding of the CV question amongst the respondents to our study, and that the informational or hypothetical bias was minimal, or negligible.

The significant relationship between income and WTP represented the most important criterion in evaluating the accuracy of the CVM study. Both the models in our study demonstrated a statistically significant association between WTP values and household income. We attempted to replace this variable in the regression model by the respondent's personal wage; however, the model did not fit well because around 16% of the subjects were not in receipt of any wages at all after the occurrence of the injury; thus, for this significant group, personal income was generally synonymous with household income. In addition, there is a discernible trend in Table 3 showing that the response to the higher starting prices was a lower ratio of initial yes/no bids, which corroborates our study with regard to common economic sense.

It is widely acknowledged that time dependency can be an important feature in survival analysis, and in general, recall bias has been shown to be a major factor in the reduction of WTP levels with the passage of time. Nevertheless, in this study, the effect of recall bias may be minimal because most of the occupational injuries which led to permanent disability occurred within the 2-year period prior to this study, and thus, the painful experiences were still fresh in the minds of the victims. Thus, the WTP of respondents whose injuries had occurred in excess of 2 years prior to this study demonstrated a lower WTP than those respondents whose injuries had occurred within the past 2 years. There are two possible explanatory reasons for this result. First of all, the respondents' painful experiences could be less vivid after the passage of longer periods of time, which shows up as a negative effect on the estimation of WTP. The second reason, as shown in Table 5, may be lower affordability for the purchase of painkilling drugs. For those cases where the injury resulted in a lower victim/household income ratio, the injury will clearly have had a much greater impact on the family and a resultant lowering of their ability to pay for the hypothetical goods.

Most of the lump sum compensation payments and reimbursement of out-of-pocket expenses were made during the first 2 years after the occurrence of the injury; however, since victims may have also totally lost, or lost some degree of, their prior working capabilities, which in turn will have resulted in a general reduction in their average income levels, it was not until about 2 years later that those respondents that were so affected managed to regain some of their earlier physical functions and personal income, as shown in Table 5. This concurs with an earlier calculation of loss of salary and loss of potential working days as a result of permanent disability stemming from occupational injuries (Chang and Wang, 1995).

Our results also demonstrate a negative trend in WTP where subjects had already been saddled with higher out-of-pocket expenses. All of the respondents to this study were victims of occupational injuries and had succeeded in securing their rightful claims to compensation. Since occupational injury is legally compensated by both the BLI and employers, this may bring with it some measure of disincentive to the victims, in terms of their willingness to pay additional costs for a painkilling drug, particularly where they had already spent significant sums of money in medical expenses directly attributable to their injury. Thus, this study may well provide, at best, only an underestimation of the overall WTP.

Although BLI coverage for medical expenses is comprehensive, it does not cover the opportunity costs incurred by family members who accompany the victims during their period of hospitalization. Thus, a family may feel some degree of stress or suffering if the period of hospitalization was protracted. Magni et al. (1993) provided evidence to show that depression was the most important variable associated with persistent chronic pain, and that this inevitably caused suffering to both the victims and their families. Indeed, as our models in Table 4 show, the suffering felt by the victims and their families does lead to a lower WTP. Table 5 also indicates that the average income ratio between a victim and his/her family seemed inversely proportional to the frequency of the family's suffering following the injury. This may imply that there is greater impact on the quality of life for the families of victims who were once the major breadwinners.

Many different distributions can be used to model lifetime data, with one of the most widely used lifetime distributions being the Weibull distribution. This is a versatile distribution which, based upon the value of the shape parameter β, can take on the characteristics of other types of distributions. Due to its flexible shape and ability to model a wide range of failure times, Weibull distribution has been used in general CVM studies. There are, however, two reasons which explain the relevance, and thereby our consideration of using Weibull distribution in this study. First, the residues of the respondents' WTP demonstrated a wide range, giving an approximation of about NT $10,000 (US $363.6). As a result, the residues could be attributable to the extreme value distribution, which indicates the appropriateness of Weibull distribution. Second, we assumed that the failure rate of a respondent's willingness to pay would increase with an increase in the value of WTP during the bidding process. Under this condition, the above

assumption would have a better goodness of fit under Weibull distribution where $\beta > 1$. Our result supports the assumption that the β values of the Weibull model were estimated on the interval of 2–3.

The available sample size has been a major limitation of this study, affecting the log-likelihood value in all of our models. In addition, the small sample size also leads to greater imbalance in the frequency distribution of the different determinants in each category, which in turn directly affects the variation of both the parameter values and statistical significance. The respective means of the WTP estimations in the Weibull and log normal models were NT $1913 and NT $1791, representing around 1–2 times the average daily income of the subjects of this study at the time that the interviews took place, and 14–16 times the sale prices of general over-the-counter painkilling drugs in Taiwanese stores. The WTP value implied the average price of other means of physical pain removal with the same attributes.

Moreover, as the results in Table 3 show, there were also apparent differences between the median estimates of WTP for the hypothetical drug and the market prices of existing drugs. All of the above information presents two-fold meanings. The differences first of all imply a level of benefit derived from the 24-h effects of the painkilling dose, which is obviously longer than that of existing drugs and thereby certainly capable of attracting a higher price. Second, the WTP estimates in CV are not really market price predictions at all, since they are based upon 'complete price discrimination'. Thus, for comparison with CV estimates, they are much more interesting than market prices, since the differences are an estimated consumer surplus from the existing drugs.

From our experiences in this study, the CVM has strengths in terms of estimating the dollar-value of non-market goods, one example being the flexibility of the CV question. Based upon the careful design of the structure of the CV question, a proper bidding framework and sufficient samples, this would achieve results with theoretical support. Our study tends to provide support for the use of the CVM, based upon the stated preference approach, as a feasible method of acquiring an estimation of the intangible costs resulting from occupational injuries, with economic implications. However, in terms of a demand curve for any hypothetical goods, this study suggests that in future studies, more attention needs to be paid to the various problems, such as the number of painless days and the level of WTP. One of the limitations of the CVM is that there is invariably a lack of relevant evidence for use in comparing the accuracy of the results. In addition, there will be limitations on the number of case to be examined based upon the higher costs involved in conducting personal interviews.

5. Conclusions

To our knowledge, no previous studies have elicited the WTP for the removal of physical pain from victims of occupational injuries resulting in permanent disability. In our study, the referendum bid process for eliciting WTP followed the suggestions of the National Oceanic and Atmospheric Administration (NOAA, 1993). We found several statistically significant variables that were consistent with the CVM literature and general economic theories, and concluded that despite the slight possibilities of starting price bias and underestimation, the estimation was moderately accurate.

The estimated WTP in this study could serve not only as a reference for the government to guide the future payment of compensation to victims, but may also substantiate the theory of partial welfare losses from occupational injuries. Future studies should aim to increase the sample size and possibly consider a more balanced design of the sample in order to explore other domains of economic welfare losses relating to occupational injuries.

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Appendix A. Scenario for eliciting WTP in the contingent valuation question

We will now pose a hypothetical scenario.

A specific remedy has just been invented for the removal of physical pain. If you take this oral painkilling drug as part of your medication, all of the physical pain resulting from your injury will be removed immediately. The effects of the drug will completely remove all painful feelings for a period of 24 h without any side effects.

Given that this painkilling drug has just been invented, it cannot be reimbursed by the BLI for medical services. Therefore, should you decide to use the drug as part of your medication following the occurrence of your injury, it can only be issued under co-payment.

You should bear in mind that this drug is only used for the removal of physical pain; all other medical treatment must continue irrespective of whether you decided to take the drug.

Your decision to purchase the painkilling drug will also mean that you will have to give up some other expenditure in your daily life. For example, you may have to reduce your expenditure on entertainment or education. (Five debriefing points were sequentially explained to the respondent.)

Now that we are sure that you have completely understood the scenario, we would like to ascertain your willingness to purchase such a painkilling drug and, if so, based upon your experience of the pain after the occurrence of your injury, how many days supply (doses) of the drug you would need to purchase.

If you are unwilling to purchase the painkilling drug, can you tell us why?

[QUESTIONS] - * Example Provided for Questionnaire Version 1 *

Would you be willing to pay **NT$ 500** to purchase a specific remedy to avoid all physical pain?

(1) **No** → Would you be willing to pay **NT$ 250** to purchase the specific remedy?

(A) **No** → Would you be willing to pay **NT$ 120** to purchase the specific remedy?

(a) **No** → Please indicate below why you would be unwilling to purchase the remedy:

……...

(b) **Yes** → Exactly how much would you be willing to pay? NT$ _____

(B) **Yes** → Would you be willing to pay **NT$ 370** to purchase the specific remedy?

(a) **No** → Exactly how much would you be willing to pay? NT$ _____

(b) **Yes** → Exactly how much would you be willing to pay? NT$ _____

(2) **Yes** → Would you be willing to pay **NT$ 1,000** to purchase the specific remedy?

(A) **No** → Would you be willing to pay **NT$ 750** to purchase the specific remedy?

(a) **No** → Exactly how much would you be willing to pay? NT$ _____

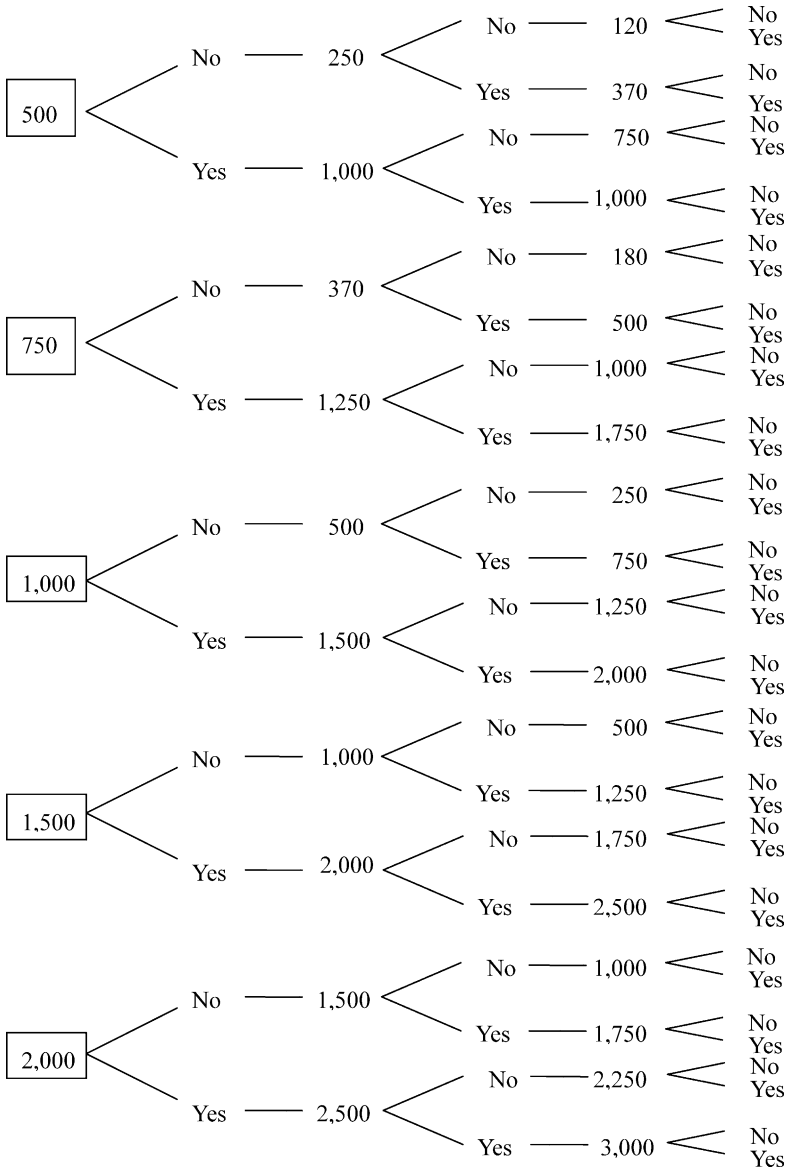
(b) **Yes** → Exactly how much would you be willing to pay? NT$ _____

(B) **Yes** → Would you be willing to pay **NT$ 1,500** to purchase the specific remedy?

(a) **No** → Exactly how much would you be willing to pay? NT$ _____

(b) **Yes** → Exactly how much would you be willing to pay? NT$ _____

Appendix B. Procedure of sequent-bid among five different start bids (NT$)



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