

Alberini, Anna; Cropper, Maureen; Krupnick, Alan; Simon, Nathalie B.

Working Paper

Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?

Nota di Lavoro, No. 53.2004

Provided in Cooperation with:

Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Alberini, Anna; Cropper, Maureen; Krupnick, Alan; Simon, Nathalie B. (2004) : Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?, Nota di Lavoro, No. 53.2004, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/117932>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

**Willingness to Pay for
Mortality Risk Reductions:
Does Latency Matter?**

Anna Alberini, Maureen Cropper,
Alan Krupnick and Nathalie B. Simon

NOTA DI LAVORO 53.2004

MARCH 2004

SIEV – Sustainability Indicators and Environmental Valuation

Anna Alberini, *University of Maryland and Fondazione Eni Enrico Mattei*
Maureen Cropper, *University of Maryland and the World Bank*
Alan Krupnick, *Resources for the Future*
Nathalie B. Simon, *US Environmental Protection Agency*

This paper can be downloaded without charge at:

The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:
<http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm>

Social Science Research Network Electronic Paper Collection:
<http://ssrn.com/abstract=XXXXXXX>

The opinions expressed in this paper do not necessarily reflect the position of
Fondazione Eni Enrico Mattei

Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?

Summary

Using results from two contingent valuation surveys conducted in Canada and the U.S., we explore the effect of a latency period on willingness to pay (WTP) for reduced mortality risk using both structural and reduced form approaches. We find that delaying the time at which the risk reduction occurs by 10 to 30 years reduces WTP by more than half for respondents in both samples aged 40 to 60 years. Additionally, we estimate implicit discount rates equal to 8% for Canada and 4.5% for the U.S. – both well within the range established previously in the literature.

Keywords: Value of a statistical life, Mortality risks, Benefit-cost analysis

JEL Classification: Q51, Q58

The opinions reported in this paper are the authors' own and do not represent the views of their respective Agencies. This research was supported by a grant from the US Environmental Protection Agency.

Address for correspondence:

Anna Alberini
Department of Agricultural and Resource Economics
University of Maryland
2200 Symons Hall
College Park
MD 20742
USA
Phone: 301 405 1267
Fax: 301 314 9091
E-mail: aalberini@arec.umd.edu

For many environmental policies, such as those that seek to reduce exposure to carcinogens, the reduction in the risk of dying occurs many years after the initial investment in pollution reduction. To value the benefits of such policies it is necessary to ask people how much they would be willing to pay now for a reduction in risk that takes place in the future. Economic theory suggests that willingness to pay (WTP) for a future risk reduction should be less than WTP for an immediate risk reduction of the same size. This occurs for two reasons: (1) the individual may not be alive to enjoy the risk reduction and (2) if the individual is willing to substitute consumption for risk, the risk reduction should be discounted at the consumption rate of discount. A key question for policy is exactly how much WTP is reduced by a gap between the initiation of a program and time at which the risk reduction is delivered.

In a recent contingent valuation survey administered in Canada (Krupnick et al., 2002) and the U.S. (Alberini et al., forthcoming), we asked individual respondents how much they would be willing to pay today for a reduction in their risk of dying at age 70. In this paper, we use the responses to such payment questions to produce estimates of mean and median willingness to pay for the future risk reduction. Specifically, we present three sets of results: (1) a reduced-form model of WTP for the future risk reduction that examines how WTP varies with respondent age, income, health status, expected health status in the future, and self-assessed probability of survival until age 70; (2) a structural model that estimates the discount rate implicit in WTP responses; and (3) a comparison of WTP for the future risk reduction with WTP for a risk reduction of the same size that occurs today.

In our reduced-form model we find that WTP today for a risk reduction at age 70 is, as prescribed by economic theory, lower for persons who have a lower self-assessed chance of surviving to age 70 and lower for persons who believe their health will be worse at age 75 than it is today. In our structural model, which assumes (as predicted by the life-cycle model) that WTP today for a risk reduction at age 70 equals what the individual would pay for a current risk reduction at age 70 discounted to the present, we estimate the average discount rate at 8% for our Canada sample and 4.5% for our U.S. sample. These estimates are in line with those in Viscusi and Moore (1989) (1-14%), Horowitz and Carson (1990) (4.5%), and Johannesson and Johannesson (1996) (0.3 and 1.3%). Most importantly for policy, we find that WTP today for a risk reduction at age 70 is, for persons aged 40-60, less than half of WTP for a current risk reduction.

The remainder of this paper is organized as follows. Section 1 presents the life-cycle model with uncertain lifetime and reviews its implications for willingness to pay for a reduction in the conditional probability of dying at any age. It also elaborates on our plan of analysis. Section 2 discusses the administration and structure of our survey. Section 3 presents our econometric models and section 4 our results. We summarize our findings in section 5.

1. Theoretical Framework and Plan of Analysis

1.1 The Value of Mortality Risk Changes in the Life-Cycle Model

To provide a framework for our empirical work, in this section we derive WTP for a change in the conditional probability of dying (at any age) in the context of the life-cycle model with uncertain lifetime (Cropper and Sussman, 1990; Cropper and Freeman, 1991). The model assumes that at age j the individual chooses his future consumption stream to maximize expected lifetime utility,

$$V_j = \sum_{t=j}^T q_{j,t} (1 + \delta)^{j-t} U_t(C_t) \quad (1)$$

where V_j is the present value of expected utility of lifetime consumption, $U_t(C_t)$ is utility of consumption at age t , $q_{j,t}$ is the probability that the individual survives to age t , given that he is alive at age j , and δ is the subjective rate of time preference. We assume that (1) is maximized subject to a budget constraint that allows the individual to invest in annuities and to borrow via life-insured loans (Yaari, 1965). This is equivalent to assuming that the present value of expected consumption equals the present value of expected earnings plus initial wealth,

$$\sum_{t=j}^T q_{j,t} (1 + r)^{j-t} C_t = \sum_{t=j}^T q_{j,t} (1 + r)^{j-t} y_t + W_j, \quad (2)$$

where r is the riskless rate of interest, y_t is income at time t and W_j is initial wealth.

Now consider a program that alters D_k , the conditional probability of dying at age k , given that the individual survives to that age. Since $q_{j,t} = (1 - D_j)(1 - D_{j+1}) \dots (1 - D_{t-1})$, any program that alters D_k will necessarily alter the probability of surviving to all future ages. For small changes in D_k , willingness to pay may be written as the product of the rate at which the individual is willing to trade wealth W_j for a change in D_k , which we term $VSL_{j,k}$, times the size of the change in D_k ,

$$WTP_{j,k} = - \frac{dV_j / dD_k}{dV_j / dW_j} dD_k \equiv VSL_{j,k} dD_k. \quad (3)$$

Applying the Envelope Theorem to the Lagrangian function formed by (1) and (2), the rate at which the individual substitutes current wealth for D_k may be written (Cropper and Sussman, 1990) as:

$$VSL_{j,k} = \frac{1}{1 - D_k} \sum_{t=k+1}^T q_{j,t} [(1 + \delta)^{j-t} U_t(C_t) \lambda_j^{-1} + (1 + r)^{j-t} (y_t - C_t)]. \quad (4)$$

Equation (4) says that the value of a change in the probability of dying at age k equals the loss in expected utility from age $k+1$ onward, converted to dollars by dividing by the marginal utility of income (λ_j). Added to this is the effect of a change in D_k on the budget constraint. Cropper and Sussman (1990) show that, by substituting first-order conditions for utility maximization into (4) and rearranging terms, WTP at age j for a risk reduction at age k equals WTP for a current risk reduction at age k multiplied by the probability of surviving to age k and discounted to the present at the monetary rate of discount,

$$WTP_{j,k} = q_{j,k} (1+r)^{j-k} WTP_{k,k} \cdot ^1 \quad (5)$$

1.2 Plan of the Analysis

Our empirical work focuses on equation (5), and its goal is three-fold. First, as a test of internal validity of responses, we estimate a reduced-form version of (5) for persons for whom $40 \leq j \leq 60$ and $k = 70$. Equation (5) suggests that $WTP_{j,70}$ should be lower the lower is the probability of surviving to age 70 ($q_{j,70}$) and should increase with current age (j), holding $q_{j,70}$ constant. $WTP_{70,70}$ should be higher for wealthier respondents and may depend on the respondent's estimate of his health after age 70. The impact of other variables (e.g., education) on $WTP_{j,70}$ is, however, ambiguous.

Second, we then use equation (5) to estimate respondent discount rates (r). Because our survey elicits WTP for a current risk reduction (for persons of different ages) we can use models described elsewhere (Alberini et al. forthcoming) to estimate $WTP_{70,70}$ for each respondent. Given the respondent's estimate of $q_{j,70}$, we estimate a log-linear version of (5), where $(1+r)^{j-70}$ has been approximated by $\exp[r(j-70)]$ to obtain an estimate of the interest rate facing respondents:

$$\ln WTP_{j,70} = \ln WTP_{70,70} + \ln q_{j,70} + r \cdot (j - 70). \quad (6)$$

On appending an error term equation (6) becomes a regression model where the discount rate can be estimated as the coefficient on $(j - 70)$, the time until the risk reduction takes place, as long as the latter varies across respondents.

Finally, we use the responses to WTP questions for current and future risk reductions to estimate $WTP_{j,k}/WTP_{j,j}$ —i.e., to see by how much WTP is reduced when the risk valued occurs in the future. Equation (5) does not necessarily imply that $WTP_{j,j} > WTP_{j,k}$; however, if $WTP_{j,j} \geq WTP_{k,k}$ —if WTP for a given risk reduction is no larger at age 70 than between ages 40 and 60—equation (5) indeed implies that $WTP_{j,j} > WTP_{j,k}$. The question of interest for policy is exactly what the ratio of $WTP_{j,k}/WTP_{j,j}$ is.

2. Survey Administration and Structure

Our survey instrument was administered in Canada in 1999 and in the U.S. in 2000.² In the Canada study, the questionnaire was self-administered by respondents using a computer at a centralized facility in Hamilton, Ontario. Study participants were recruited through random digit dialing. In the U.S., we drew a national sample from the panel of consumers maintained by Knowledge Networks. The sample received and filled out the questionnaire via Web-TV.

The questionnaire began by asking the respondent to provide information about his or her self, including age, gender, health status. It also queried the respondent about the health status of family members (parents and siblings), and about the age of his or her parents. This was followed by a simple tutorial on probability, at the end of which respondents were introduced to the concept of risk of dying. To show risk and risk changes, we used a grid of 1,000 squares. White squares represent survival, while red squares represent death.

Respondents were subsequently told about their own risk of dying over the next 10 years (and shown this risk on the grid of squares), along with the most common causes of death for a person of their age and gender. When eliciting WTP for a risk reduction, it is important that respondents understand that it is possible to reduce risk through a number of actions (both medical and non-medical), but that doing so costs money. We described to the respondents common risk-reducing actions (such as exercise and medical screening or diagnostic tests), but, to avoid anchoring respondents to specific dollar figures, we simply told them whether these actions were “expensive,” “inexpensive,” or “moderately priced.”

Respondents were asked to report information about their WTP for each of three risk reductions: (i) 5 in 1000 over the next 10 years, (ii) 1 in 1000 over the next 10 years, and (iii) 5 in 1000, but beginning at age 70 and taking place over the subsequent 10 years.³ The latter question was asked only of respondents aged 60 and younger. We used the dichotomous choice approach (“Would you purchase a product that would deliver the risk reduction in question at a stated price?”) with a follow-up question. (See table A.1 in the Appendix for the bid values used.)

Respondents were also asked to report their subjectively assessed life expectancy and probability of surviving until age 70. The survey ended with socio-demographic questions, debriefing questions, and questions from Short Form 36 (SF-36), a questionnaire widely used to assess health status and functionality in the medical literature.⁴

A total of 930 and 1135 respondents completed the survey in Canada and in the U.S., respectively. The WTP questions about the future risk reductions were answered by 650 persons in Canada and 699 in the US.⁵ We exclude from the usable samples respondents who failed simple probability questions, which results in 638 respondents for the Canada study, and all 699 for the US study.⁶

3. Econometric Model

As indicated in section 1 we use two approaches to estimate $WTP_{j,70}$. The first is a reduced-form approach, where $WTP_{j,70}$ is assumed to follow the Weibull distribution with scale parameter $\sigma_i = \exp(\mathbf{x}_i\beta)$ and shape parameter θ (i.e, an accelerated life model). This is equivalent to the regression equation:

$$\log WTP_{j,70}^i = \mathbf{x}_i\beta + \varepsilon_i, \quad (7)$$

where i denotes the respondent, the error term follows the type I extreme value distribution with scale θ , and the vector of regressors \mathbf{x} includes variables thought to influence WTP. Since information about WTP was elicited using dichotomous choice questions with a follow-up, we form intervals around the respondent's (unobserved) WTP amount, specify a double-bounded interval-data likelihood function, and estimate the parameters of equation (7) using the method of maximum likelihood.

To test internal validity in a reduced-form context, \mathbf{x}_i includes age, gender, current and future health status of the respondent, education and income and the respondent's estimate of $q_{j,70}$. From equation (5) we expect the coefficients on $q_{j,70}$ and on age to be positive. To the extent that current income is correlated with wealth, it should increase $WTP_{j,70}$ and so, presumably, should a more optimistic estimate of the respondent's health state at age 75 (midway between the beginning (70) and ending age (80) of the risk change being valued).⁷

Our second estimation approach is a structural-form approach. To implement it, we begin with an interval-data maximum likelihood regression for WTP for the immediate 5 in 1000 risk reduction on income, gender, age group dummies, etc. based on the underlying equation:

$$\log WTP_{j,j}^i = \mathbf{x}_i \boldsymbol{\gamma} + \eta_i \quad (8)$$

where η is a Type I Extreme value error term with scale τ . We use the maximum likelihood estimates $\hat{\boldsymbol{\gamma}}$ and $\hat{\tau}$ to predict what each respondent's median WTP would be, if his or her age were 70. We denote this prediction as $PWTP_{70,70}$, and its logarithmic transformation as $\log PWTP_{70,70}$.

In the next step, we regress $\log WTP_{j,70}$ on $(j-70)$ (j being current age), $\log PWTP_{70,70}$ and $\log q_{j,70}$, where $\log q_{j,70}$ is the respondent-reported probability of surviving until age 70. Following equation (6), we restrict the coefficients on $\log PWTP_{70,70}$ and $\log q_{j,70}$ to be equal to one. The coefficient on $(j-70)$ is the interest rate, r .

Clearly, this approach assumes that the interest rate r is constant over time and across individuals. In subsequent runs, we relax this assumption by allowing individuals with different characteristics to have different discount rates. Specifically, we posit that $r_i = \exp(\mathbf{z}_i \boldsymbol{\lambda})$, where \mathbf{z}_i is a $1 \times k$ vector of individual characteristics. Data limitations do not allow us to discriminate between a linear discount rate or a hyperbolic one, but we do check whether the discount rate is affected by the time until the discounting takes place by including a dummy variable that takes on a value of one for respondents in the age group from 50 to 60 years.

4. Results

4.1. Reduced Form

Results from the reduced-form model with covariates are reported in Table 1. Column (A) refers to the data from the Canada study, column (B) to the WTP responses from the U.S.

study, as does (C), except that it omits African Americans for ease of comparison with the Canada sample, which does not include this group.

Table 1. Interval-data reduced-form regressions. Weibull distribution of WTP.
(Standard errors in parentheses.)

Variable	(A) Canada (n=632)	(B) US (n=668)	(C) US, no Blacks (n=600)
Intercept	4.7777** (0.933)	5.3234** (0.539)	5.1902** (0.591)
Wave 1	-0.2206 (0.203)	-0.1253 (0.129)	-0.1166 (0.137)
Age 50 to 59	0.1067 (0.199)	0.0089 (0.134)	0.0129 (0.143)
Male	-0.1038 (0.194)	-0.1378^ (0.129)	-0.2103 (0.138)
Black		0.3715 (0.225)	
Education	-0.0030 (0.041)	-0.0175 (0.0283)	-0.0203 (0.0296)
Bottom 25% of distribution of income (dummy)	-0.2726 (0.245)	-0.1789 (0.157)	-0.1327 (0.164)
Health75worse	-0.4382** (0.199)	-0.3013* (0.132)	-0.3028* (0.140)
Log CHANCE70	0.0927 (0.160)	0.1735* (0.086)	0.2243* (0.098)
Chronic	0.2929 (0.210)	0.2542* (0.135)	0.2588^ (0.143)
Scale parameter	0.4752** (0.029)	0.7262** (0.041)	0.7207** (0.043)

* = significant at the 5% level. ** = significant at the 1% level.

Three main findings emerge from the reduced-form regressions of Table 1. First, individual characteristics like age, race, education and income are not important predictors of a person's WTP for the future risk reduction. (The only exception is gender in specification (C).) The only significant determinants of WTP are current health status, future health status and the subjective probability of surviving until age 70. As a consequence of the relatively large number of regression coefficients that are individually insignificant, likelihood ratio tests of the null hypothesis that all slopes are zero fail to reject the null for model (A) and marginally reject it at the 5% level for models (B) and (C).⁸

Second, the signs of two coefficients are consistent with expectations. Specifically, the coefficient on the low-income dummy (bottom 25% of the income distribution), which takes on a value of one if income is less than \$24,500, is negative, although insignificant, and the sign on the log of the probability of living until age 70 is positive (and significant at the 5% level in the U.S. study).

Moreover, respondents who expect that their health will become worse when they are older are willing to pay less: their WTP is about one-third lower than that of all other individuals in Canada, and about 27% lower for U.S. respondents. This seems reasonable, and in sharp contrast with the fact that the coefficient on CHRONIC, a dummy taking on a value if the respondent has a chronic respiratory or cardiovascular disease, or cancer, is *positive* (and significant, at least in the U.S. study). The presence of one such chronic illness raises WTP by 28 to 33%.

Third, many coefficients are very similar across the two studies. Indeed, a Wald test comparing columns (A) and (C) does not reject the null that the coefficients are the same across the two studies.

These similarities and the result of the Wald test prompted us to pool the data from the two studies, and estimate the following regression:

$$\log WTP_i = \mathbf{x}_i \boldsymbol{\beta} + CANADA_i \cdot \lambda + \varepsilon_i, \quad (9)$$

where CANADA is a dummy denoting the study. The scale of the error term ε is allowed to vary across the two countries: $\theta_i = \theta_0 + CANADA_i \cdot \theta_1$.

Results from this specification are reported in Table 2. They confirm that many individual characteristics, such as income, education, and age, are not important determinants of WTP, although the low-income dummy has the expected negative association with WTP. The coefficient on gender is now significant at the 5% level, implying that males hold lower WTP values: all else the same, men's WTP figures are 10% lower than those of women.

Table 2. Interval-data reduced form regressions.
Pooled samples, Weibull distribution of WTP with country-specific shape parameter (African Americans excluded from the sample).

Variable	Coefficient	Standard error
Constant	4.0165	0.560
Wave 1	-0.1375	0.116
Age 50 to 59	0.0845	0.111
Male	-0.2302*	0.114
Education	-0.0058	0.024
Bottom 25% of the distribution of income	-0.1160	0.138
Health75worse	-0.1944^	0.114
Log chance70	0.1541	0.095
Chronic illness	0.4173**	0.116
Canada	-0.8922**	0.137
Weibull shape: θ_0	1.1488**	0.066
Weibull shape: θ_1	0.1968*	0.085

^ = significant at the 10% level. * = significant at the 5% level; ** = significant at the 1% level.

Table 2 also confirms that WTP for the future risk reduction is significantly lower if (all else the same) the respondent believes that in the future his health will deteriorate relative to the present. Specifically, respondents who believe their health at age 75 will be worse than it is now hold WTP values that are 18% less than the values of all other respondents. WTP is over 50% greater if the respondent currently has a chronic illness. As before, the WTP for the future risk reduction increases with the (logarithmic transformation of) the subjective probability of surviving to age 70, but this effect is weak.

4.2. Structural Form

We estimate the structural form using only respondents in wave 1.⁹ Assuming that the discount rate is constant for all respondents and all ages, we estimate the discount rate to be 8% in the Canada study and 4.5% in the U.S. study. The discount rates are estimated very precisely: the standard errors around the estimates are 0.7% and 0.55%, respectively.

Results from the structural-form model with covariates are displayed in Table 3. Since the sample size is smaller when attention is restricted to wave 1 respondents, we pool the data from the two studies, but exclude U.S. African Americans. Coefficients are often large, and so are the standard errors, implying that results should be interpreted with caution. For example, the coefficient on the chronic illness dummy is equal to -0.59, and significant at the 10% level, implying that persons with these illnesses have discount rates that are 45% lower than those of respondents without chronic illnesses. At the same time, the discount rate of low-income respondents is 43% greater than that of the other respondents, but this effect is not statistically significant. Older respondents have higher discount rates: those in the age group between 50 and 59 have a discount rate that is 51% greater than that of younger respondents, the p-value of the coefficient being about 0.09.

Table 3. Structural Form results. $r = \exp(z_i\gamma)$

	Coefficient	Standard error
Constant	-2.7212**	0.184
Male	-0.1677	0.227
Chronic	-0.5897 [^]	0.307
Bottom 25% distribution of income	0.3570	0.264
Age 50 to 59 years	0.4131 [^]	0.245
θ	2.7630**	0.134

[^] = significant at the 10% level. * = significant at the 5% level; ** = significant at the 1% level.

We attempted to estimate a function where the discount rate is a linear function of age (and hence of the time until the discounting takes place, which is 70 minus current age), but this model behaved poorly, as did the model with hyperbolic discounting. These results are probably due to the insufficient variation in the time until the risk reduction occurs. We also attempted to control for the country of the study, but the model behaved very poorly when the Canada dummy was included. Models that included chronic illness variables in a more disaggregate form experienced the same problem. This suggests that the regression results for the structural form with covariates are not very robust, and should be interpreted with caution.

We end by comparing mean and median WTP for a future risk reduction, estimated using all respondents but with no covariates, with mean and median WTP for a current reduction, estimated using the same respondents. These results appear in Table 4. We have previously argued that it is likely that WTP for a future risk reduction should be less than WTP for a risk reduction that starts immediately. This is borne out by the data. The ratio of mean $WTP_{j,k}$ to mean $WTP_{j,j}$ for $40 \leq j \leq 60$ and $k = 70$ is 0.44 in the Canadian sample and 0.48 in the U.S. sample. This suggests that a latency period of 10 to 30 years, experienced late in life, significantly reduces WTP for a reduction in risk of dying.

Table 4 also translates the WTP estimates into VSL estimates by dividing the WTP by 5/10,000. Mean VSLs derived from WTP estimates for the future risk reductions for this 40-60 age group range from \$533,000 for Canada to \$700,000 for the U.S. As is generally the case with estimates from CV surveys, the median VSLs are lower still.

Table 4. Mean and Median WTP and VSLs for present v. future risk reductions. Weibull interval-data model with no covariates. All Figures in 2000 US dollars (PPP conversion from the Canadian dollar). Cleaned samples, 40-60 year-olds.

	Canada		US	
	Current risk reduction*	Future risk reduction	Current risk reduction*	Future risk reduction
Mean WTP (standard error)	609 (59.02)	265 (32.85)	727 (53.12)	348 (25.29)
Mean VSL (\$million)	1.22	0.53	1.45	0.70
Median WTP (standard error)	317 (26.71)	55 (7.73)	395 (27.69)	167 (13.86)
Median VSL (\$million)	0.63	0.11	0.79	0.33

* wave 1 only. N= 438 for Canada, N= 361 for the US.

5. Conclusions

This paper reports the results of a contingent valuation survey that elicits WTP for current and future mortality risk reductions. The survey questionnaire was self-administered by respondents in Canada and the US using a computerized format.

We examine the responses to the payment questions for the future risk reduction using both reduced form and structural form approaches. Using a reduced-form approach, we find that WTP for a risk reduction at age 70 relates to the respondent's expectations about his or her future health status.

Using a structural-form approach, we estimate the implicit discount rates to be 8% in Canada and 4.5% in the U.S. The discount rate appears to depend on age and health status, but inference should be made with caution. Our estimates of the discount rate are in line with previous estimates of the discount rate in risk reduction tradeoffs, which range from 0.3% (Johannesson and Johansson, 1996) to 14% (Viscusi and Moore, 1989).

Finally, we note that for respondents aged 40 to 60, WTP today for a risk reduction occurring at age 70 is less than half of WTP for a current risk reduction of the same size. Delaying the time at which the risk reduction occurs significantly reduces WTP, at least for respondents in the 40 to 60 age group.

What are the policy implications of this finding? In its primary analysis of the benefits of reducing the maximum contaminant level (MCL) of arsenic in drinking water from 50 ppb to 10 ppb, the USEPA (2000) did not discount the value of a statistical life used to value the reduction in lung and bladder cancers that were predicted to occur as a result of the rule, even though there is likely to be a cessation lag between the reduction in exposure and the reduction in cancers.¹⁰ The study estimated that there would be between 21 and 30 fewer cancers per year from the reduction in exposure, starting immediately, and used a VSL of \$6.1 million (1999 USD) to value each case. The resulting mortality benefits (\$128-\$183 million) accounted for over 90% of the monetized benefits of the rule. Total annual costs were estimated to be \$205.6 million, implying that the upper bound estimate of benefits was approximately equal to costs. Adjusting the \$6.1 million VSL to reflect an average gap of 20 years between reduction in exposure and reduction in cancer would, according to the results reported above, cause the benefit-cost ratio to fall below one-half. Using the VSLs estimated in our study for this valuation exercise would have even more dramatic effects in lowering benefits, as our VSL for the U.S. is almost a factor of 10 lower than that used by EPA.

The decision to reduce the MCL for arsenic is, of course, more complicated than the previous paragraph would suggest.¹¹ Our purpose in citing this example is to show that allowing for a gap between reduction in exposure and reduction in risk can indeed make a difference in a policy context.

References

- Alberini, Anna, et al. (forthcoming). "Does the Value of a Statistical Life Vary with Age and Health Status? Evidence from the U.S. and Canada," *Journal of Environmental Economics and Management*.
- Cropper, Maureen and Frances G. Sussman. (1990). "Valuing Future Risks to Life," *Journal of Environmental Economics and Management* 19, 160-74.
- Cropper, Maureen and A. Myrick Freeman III. (1991). "Environmental Health Effects," in *Measuring the Demand for Environmental Quality*, John Braden and Charles Kolstad (eds). Elsevier Science Publishers.
- Horowitz, John and Richard Carson. (1990). "Discounting Statistical Lives," *Journal of Risk and Uncertainty*, 3, 403-413.
- Johannesson, Magnus and Per-Olov Johansson. (1996). "To Be, or Not to Be, That is the Question: An Empirical Study of the WTP for an Increased Life Expectancy at an Advanced Age," *Journal of Risk and Uncertainty* 13: 163-174.
- Krupnick, Alan, et al. (2002). "Age, Health, and the Willingness to Pay for Mortality Risk Reductions: A Contingent Valuation Survey of Ontario Residents," *Journal of Risk and Uncertainty*, 24, 161-186.
- USEPA (2000), *Arsenic in Drinking Water Rule Economic Analysis*. EPA 815-R-00-026, December.
- USEPA (2001), *Arsenic Rule Benefits Analysis: An SAB Review*, EPA-SAB-EC-01-008, August.
- Viscusi, W. Kip and Michael Moore. (1989). "Rates of Time Preference and Valuations of the Duration of Life," *Journal of Public Economics*, 38, 297-317.
- Yaari, Menahem. (1965). "Uncertain Lifetime, Life Insurance and the Theory of the Consumer," *Review of Economic Studies*, 32, 137-150.

Appendix.

Table A.1. Bid design by country.

	Initial bid	If yes	If no
US (2000 US dollars)	70	150	30
	150	500	70
	500	725	150
	725	1000	500
Canada (1999 Canadian dollars)	100	225	50
	225	750	100
	750	1100	225
	1100	1500	750

Notes:

¹ Equation (5) of course holds for $VSL_{j,k}$ and $VSL_{k,k}$ as well.

² The survey instruments we used in our Canada and U.S. studies were almost identical, except for currency and baseline risk adjustments, and the fact that U.S. respondents were asked more detailed questions about their own health status, and the health status and ages of family members. For more information, see Alberini et al. (forthcoming).

³ People were randomly assigned to one of two subsamples, “wave 1” and “wave 2.” The two subsamples received identical questionnaires, except for the order in which the risk reductions to be valued were presented to the respondents. In wave 2, the order of (i) and (ii) was reversed, but the future risk reduction was the third commodity to be valued in both subsamples.

⁴ The SF-36 questions were given to respondents in a pencil-and-paper questionnaire in the Canada study, but were included in the web-TV questionnaire in the US study. The SF-36 questions were asked at the end of both surveys.

⁵ We remind the reader that the questions about WTP for the future risk reduction were asked of individuals up to 60 years of age.

⁶ Following the probability tutorial, respondents were asked to identify which of two grids represented the individual with the higher risk and which of the two they personally would rather be. Individuals who answered these questions incorrectly were deleted from the sample used in this paper.

⁷ As a special case, we also consider a simple version of the model that includes only the intercept in the right-hand side of equation (7). We use this model without covariates to estimate mean and median WTP,

which we discuss in section V.B. Mean WTP is $\sigma \cdot \Gamma(1/\theta + 1)$, where $\Gamma(\bullet)$ is the gamma function, and median WTP is $\sigma \cdot [-\ln(0.5)]^{1/\theta}$.

⁸ The likelihood ratio test of the null hypothesis that all slope coefficients are zero are 10.38 for model (A), 20.02 for specification (B), and 18.46 for specification (C).

⁹ We choose to do so because our procedure relies on predicting willingness to pay for a 5 in 1000 risk reduction at age 70 for respondents who are currently between 40 and 60 years old. But willingness to pay for an immediate risk reduction is sensitive to the order in which the risk reductions were valued by the respondents in the survey. To be conservative, when we estimate models of willingness to pay for the 5 in 1000 risk change, we restrict attention to the responses from those respondents who valued the 5 in 1000 risk reduction first.

¹⁰ In evaluating the health benefits of a reduction in exposure to a carcinogen, the *cessation-lag* matters, i.e., the time between cessation of exposure and the reduction in risk.

¹¹ The USEPA Science Advisory Board (USEPA, 2001) criticized the benefits analysis for assuming a zero cessation lag, but also noted that no attempt was made to quantify other health benefits, in spite of a rich epidemiological literature.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:

<http://www.feem.it/Feem/Pub/Publications/WPapers/default.html>

<http://www.ssrn.com/link/feem.html>

NOTE DI LAVORO PUBLISHED IN 2003

PRIV	1.2003	<i>Gabriella CHIESA and Giovanna NICODANO</i> : <u>Privatization and Financial Market Development: Theoretical Issues</u>
PRIV	2.2003	<i>Ibolya SCHINDELE</i> : <u>Theory of Privatization in Eastern Europe: Literature Review</u>
PRIV	3.2003	<i>Wietze LISE, Claudia KEMFERT and Richard S.J. TOL</i> : <u>Strategic Action in the Liberalised German Electricity Market</u>
CLIM	4.2003	<i>Laura MARSILIANI and Thomas I. RENSTRÖM</i> : <u>Environmental Policy and Capital Movements: The Role of Government Commitment</u>
KNOW	5.2003	<i>Reyer GERLAGH</i> : <u>Induced Technological Change under Technological Competition</u>
ETA	6.2003	<i>Efrem CASTELNUOVO</i> : <u>Squeezing the Interest Rate Smoothing Weight with a Hybrid Expectations Model</u>
SIEV	7.2003	<i>Anna ALBERINI, Alberto LONGO, Stefania TONIN, Francesco TROMBETTA and Margherita TURVANI</i> : <u>The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers</u>
NRM	8.2003	<i>Elissaios POPYRAKIS and Reyner GERLAGH</i> : <u>Natural Resources: A Blessing or a Curse?</u>
CLIM	9.2003	<i>A. CAPARRÓS, J.-C. PEREAU and T. TAZDAÏT</i> : <u>North-South Climate Change Negotiations: a Sequential Game with Asymmetric Information</u>
KNOW	10.2003	<i>Giorgio BRUNELLO and Daniele CHECCHI</i> : <u>School Quality and Family Background in Italy</u>
CLIM	11.2003	<i>Efrem CASTELNUOVO and Marzio GALEOTTI</i> : <u>Learning By Doing vs Learning By Researching in a Model of Climate Change Policy Analysis</u>
KNOW	12.2003	<i>Carole MAIGNAN, Gianmarco OTTAVIANO and Dino PINELLI (eds.)</i> : <u>Economic Growth, Innovation, Cultural Diversity: What are we all talking about? A critical survey of the state-of-the-art</u>
KNOW	13.2003	<i>Carole MAIGNAN, Gianmarco OTTAVIANO, Dino PINELLI and Francesco RULLANI (lix)</i> : <u>Bio-Ecological Diversity vs. Socio-Economic Diversity. A Comparison of Existing Measures</u>
KNOW	14.2003	<i>Maddy JANSSENS and Chris STEYAERT (lix)</i> : <u>Theories of Diversity within Organisation Studies: Debates and Future Trajectories</u>
KNOW	15.2003	<i>Tuzin BAYCAN LEVENT, Enno MASUREL and Peter NIJKAMP (lix)</i> : <u>Diversity in Entrepreneurship: Ethnic and Female Roles in Urban Economic Life</u>
KNOW	16.2003	<i>Alexandra BITUSIKOVA (lix)</i> : <u>Post-Communist City on its Way from Grey to Colourful: The Case Study from Slovakia</u>
KNOW	17.2003	<i>Billy E. VAUGHN and Katarina MLEKOV (lix)</i> : <u>A Stage Model of Developing an Inclusive Community</u>
KNOW	18.2003	<i>Selma van LONDEN and Arie de RUIJTER (lix)</i> : <u>Managing Diversity in a Globalizing World</u>
Coalition		
Theory	19.2003	<i>Sergio CURRARINI</i> : <u>On the Stability of Hierarchies in Games with Externalities</u>
Network		
PRIV	20.2003	<i>Giacomo CALZOLARI and Alessandro PAVAN (lx)</i> : <u>Monopoly with Resale</u>
PRIV	21.2003	<i>Claudio MEZZETTI (lx)</i> : <u>Auction Design with Interdependent Valuations: The Generalized Revelation Principle, Efficiency, Full Surplus Extraction and Information Acquisition</u>
PRIV	22.2003	<i>Marco LiCalzi and Alessandro PAVAN (lx)</i> : <u>Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions</u>
PRIV	23.2003	<i>David ETTINGER (lx)</i> : <u>Bidding among Friends and Enemies</u>
PRIV	24.2003	<i>Hannu VARTIAINEN (lx)</i> : <u>Auction Design without Commitment</u>
PRIV	25.2003	<i>Matti KELOHARJU, Kjell G. NYBORG and Kristian RYDQVIST (lx)</i> : <u>Strategic Behavior and Underpricing in Uniform Price Auctions: Evidence from Finnish Treasury Auctions</u>
PRIV	26.2003	<i>Christine A. PARLOUR and Uday RAJAN (lx)</i> : <u>Rationing in IPOs</u>
PRIV	27.2003	<i>Kjell G. NYBORG and Ilya A. STREBULAIEV (lx)</i> : <u>Multiple Unit Auctions and Short Squeezes</u>
PRIV	28.2003	<i>Anders LUNANDER and Jan-Eric NILSSON (lx)</i> : <u>Taking the Lab to the Field: Experimental Tests of Alternative Mechanisms to Procure Multiple Contracts</u>
PRIV	29.2003	<i>TangaMcDANIEL and Karsten NEUHOFF (lx)</i> : <u>Use of Long-term Auctions for Network Investment</u>
PRIV	30.2003	<i>Emiel MAASLAND and Sander ONDERSTAL (lx)</i> : <u>Auctions with Financial Externalities</u>
ETA	31.2003	<i>Michael FINUS and Bianca RUNDSHAGEN</i> : <u>A Non-cooperative Foundation of Core-Stability in Positive Externality NTU-Coalition Games</u>
KNOW	32.2003	<i>Michele MORETTO</i> : <u>Competition and Irreversible Investments under Uncertainty</u>
PRIV	33.2003	<i>Philippe QUIRION</i> : <u>Relative Quotas: Correct Answer to Uncertainty or Case of Regulatory Capture?</u>
KNOW	34.2003	<i>Giuseppe MEDA, Claudio PIGA and Donald SIEGEL</i> : <u>On the Relationship between R&D and Productivity: A Treatment Effect Analysis</u>
ETA	35.2003	<i>Alessandra DEL BOCA, Marzio GALEOTTI and Paola ROTA</i> : <u>Non-convexities in the Adjustment of Different Capital Inputs: A Firm-level Investigation</u>

GG	36.2003	<i>Matthieu GLACHANT</i> : <u>Voluntary Agreements under Endogenous Legislative Threats</u>
PRIV	37.2003	<i>Narjess BOUBAKRI, Jean-Claude COSSET and Omrane GUEDHAMI</i> : <u>Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection</u>
CLIM	38.2003	<i>Rolf GOLOMBEK and Michael HOEL</i> : <u>Climate Policy under Technology Spillovers</u>
KNOW	39.2003	<i>Slim BEN YOUSSEF</i> : <u>Transboundary Pollution, R&D Spillovers and International Trade</u>
CTN	40.2003	<i>Carlo CARRARO and Carmen MARCHIORI</i> : <u>Endogenous Strategic Issue Linkage in International Negotiations</u>
KNOW	41.2003	<i>Sonia OREFFICE</i> : <u>Abortion and Female Power in the Household: Evidence from Labor Supply</u>
KNOW	42.2003	<i>Timo GOESCHL and Timothy SWANSON</i> : <u>On Biology and Technology: The Economics of Managing Biotechnologies</u>
ETA	43.2003	<i>Giorgio Busetti and Matteo MANERA</i> : <u>STAR-GARCH Models for Stock Market Interactions in the Pacific Basin Region, Japan and US</u>
CLIM	44.2003	<i>Katrin MILLOCK and Céline NAUGES</i> : <u>The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness</u>
PRIV	45.2003	<i>Bernardo BORTOLOTTI and Paolo PINOTTI</i> : <u>The Political Economy of Privatization</u>
SIEV	46.2003	<i>Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH</i> : <u>Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods</u>
ETA	47.2003	<i>Jens HORBACH</i> : <u>Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany</u>
CLIM	48.2003	<i>Lori SNYDER, Nolan MILLER and Robert STAVINS</i> : <u>The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing</u>
CLIM	49.2003	<i>Lori SNYDER, Robert STAVINS and Alexander F. WAGNER</i> : <u>Private Options to Use Public Goods. Exploiting Revealed Preferences to Estimate Environmental Benefits</u>
CTN	50.2003	<i>László Á. KÓCZY and Luc LAUWERS</i> (Ixi): <u>The Minimal Dominant Set is a Non-Empty Core-Extension</u>
CTN	51.2003	<i>Matthew O. JACKSON</i> (Ixi): <u>Allocation Rules for Network Games</u>
CTN	52.2003	<i>Ana MAULEON and Vincent VANNETELBOSCH</i> (Ixi): <u>Farsightedness and Cautiousness in Coalition Formation</u>
CTN	53.2003	<i>Fernando VEGA-REDONDO</i> (Ixi): <u>Building Up Social Capital in a Changing World: a network approach</u>
CTN	54.2003	<i>Matthew HAAG and Roger LAGUNOFF</i> (Ixi): <u>On the Size and Structure of Group Cooperation</u>
CTN	55.2003	<i>Taiji FURUSAWA and Hideo KONISHI</i> (Ixi): <u>Free Trade Networks</u>
CTN	56.2003	<i>Halis Murat YILDIZ</i> (Ixi): <u>National Versus International Mergers and Trade Liberalization</u>
CTN	57.2003	<i>Santiago RUBIO and Alistair ULPH</i> (Ixi): <u>An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements</u>
KNOW	58.2003	<i>Carole MAIGNAN, Dino PINELLI and Gianmarco I.P. OTTAVIANO</i> : <u>ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research</u>
KNOW	59.2003	<i>Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO</i> : <u>Special Interests and Technological Change</u>
ETA	60.2003	<i>Ronnie SCHÖB</i> : <u>The Double Dividend Hypothesis of Environmental Taxes: A Survey</u>
CLIM	61.2003	<i>Michael FINUS, Ekko van IERLAND and Robert DELLINK</i> : <u>Stability of Climate Coalitions in a Cartel Formation Game</u>
GG	62.2003	<i>Michael FINUS and Bianca RUNDSHAGEN</i> : <u>How the Rules of Coalition Formation Affect Stability of International Environmental Agreements</u>
SIEV	63.2003	<i>Alberto PETRUCCI</i> : <u>Taxing Land Rent in an Open Economy</u>
CLIM	64.2003	<i>Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS</i> : <u>Thirteen Plus One: A Comparison of Global Climate Policy Architectures</u>
SIEV	65.2003	<i>Edi DEFRANCESCO</i> : <u>The Beginning of Organic Fish Farming in Italy</u>
SIEV	66.2003	<i>Klaus CONRAD</i> : <u>Price Competition and Product Differentiation when Consumers Care for the Environment</u>
SIEV	67.2003	<i>Paulo A.L.D. NUNES, Luca ROSSETTO, Arianne DE BLAEIJ</i> : <u>Monetary Value Assessment of Clam Fishing Management Practices in the Venice Lagoon: Results from a Stated Choice Exercise</u>
CLIM	68.2003	<i>ZhongXiang ZHANG</i> : <u>Open Trade with the U.S. Without Compromising Canada's Ability to Comply with its Kyoto Target</u>
KNOW	69.2003	<i>David FRANTZ</i> (Iix): <u>Lorenzo Market between Diversity and Mutation</u>
KNOW	70.2003	<i>Ercole SORI</i> (Iix): <u>Mapping Diversity in Social History</u>
KNOW	71.2003	<i>Ljiljana DERU SIMIC</i> (Ixi): <u>What is Specific about Art/Cultural Projects?</u>
KNOW	72.2003	<i>Natalya V. TARANOVA</i> (Ixi): <u>The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg's Case</u>
KNOW	73.2003	<i>Kristine CRANE</i> (Ixi): <u>The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration</u>
KNOW	74.2003	<i>Kazuma MATOBA</i> (Ixi): <u>Glocal Dialogue- Transformation through Transcultural Communication</u>
KNOW	75.2003	<i>Catarina REIS OLIVEIRA</i> (Ixi): <u>Immigrants' Entrepreneurial Opportunities: The Case of the Chinese in Portugal</u>
KNOW	76.2003	<i>Sandra WALLMAN</i> (Ixi): <u>The Diversity of Diversity - towards a typology of urban systems</u>
KNOW	77.2003	<i>Richard PEARCE</i> (Ixi): <u>A Biologist's View of Individual Cultural Identity for the Study of Cities</u>
KNOW	78.2003	<i>Vincent MERK</i> (Ixi): <u>Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas</u>
KNOW	79.2003	<i>Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P. OTTAVIANO</i> : <u>Child Labor and Resistance to Change</u>
ETA	80.2003	<i>Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA</i> : <u>Investment Size and Firm's Value under Profit Sharing Regulation</u>

IEM	81.2003	<i>Alessandro LANZA, Matteo MANERA and Massimo GIOVANNINI: <u>Oil and Product Dynamics in International Petroleum Markets</u></i>
CLIM	82.2003	<i>Y. Hossein FARZIN and Jinhua ZHAO: <u>Pollution Abatement Investment When Firms Lobby Against Environmental Regulation</u></i>
CLIM	83.2003	<i>Giuseppe DI VITA: <u>Is the Discount Rate Relevant in Explaining the Environmental Kuznets Curve?</u></i>
CLIM	84.2003	<i>Reyer GERLAGH and Wietze LISE: <u>Induced Technological Change Under Carbon Taxes</u></i>
NRM	85.2003	<i>Rinaldo BRAU, Alessandro LANZA and Francesco PIGLIARU: <u>How Fast are the Tourism Countries Growing? The cross-country evidence</u></i>
KNOW	86.2003	<i>Elena BELLINI, Gianmarco I.P. OTTAVIANO and Dino PINELLI: <u>The ICT Revolution: opportunities and risks for the Mezzogiorno</u></i>
SIEV	87.2003	<i>Lucas BRETSCGHER and Sjak SMULDERS: <u>Sustainability and Substitution of Exhaustible Natural Resources. How resource prices affect long-term R&D investments</u></i>
CLIM	88.2003	<i>Johan EYCKMANS and Michael FINUS: <u>New Roads to International Environmental Agreements: The Case of Global Warming</u></i>
CLIM	89.2003	<i>Marzio GALEOTTI: <u>Economic Development and Environmental Protection</u></i>
CLIM	90.2003	<i>Marzio GALEOTTI: <u>Environment and Economic Growth: Is Technical Change the Key to Decoupling?</u></i>
CLIM	91.2003	<i>Marzio GALEOTTI and Barbara BUCHNER: <u>Climate Policy and Economic Growth in Developing Countries</u></i>
IEM	92.2003	<i>A. MARKANDYA, A. GOLUB and E. STRUKOVA: <u>The Influence of Climate Change Considerations on Energy Policy: The Case of Russia</u></i>
ETA	93.2003	<i>Andrea BELTRATTI: <u>Socially Responsible Investment in General Equilibrium</u></i>
CTN	94.2003	<i>Parkash CHANDER: <u>The γ-Core and Coalition Formation</u></i>
IEM	95.2003	<i>Matteo MANERA and Angelo MARZULLO: <u>Modelling the Load Curve of Aggregate Electricity Consumption Using Principal Components</u></i>
IEM	96.2003	<i>Alessandro LANZA, Matteo MANERA, Margherita GRASSO and Massimo GIOVANNINI: <u>Long-run Models of Oil Stock Prices</u></i>
CTN	97.2003	<i>Steven J. BRAMS, Michael A. JONES, and D. Marc KILGOUR: <u>Forming Stable Coalitions: The Process Matters</u></i>
KNOW	98.2003	<i>John CROWLEY, Marie-Cecile NAVES (Ixxiii): <u>Anti-Racist Policies in France. From Ideological and Historical Schemes to Socio-Political Realities</u></i>
KNOW	99.2003	<i>Richard THOMPSON FORD (Ixxiii): <u>Cultural Rights and Civic Virtue</u></i>
KNOW	100.2003	<i>Alaknanda PATEL (Ixxiii): <u>Cultural Diversity and Conflict in Multicultural Cities</u></i>
KNOW	101.2003	<i>David MAY (Ixxiii): <u>The Struggle of Becoming Established in a Deprived Inner-City Neighbourhood</u></i>
KNOW	102.2003	<i>Sébastien ARCAND, Danielle JUTEAU, Sirma BILGE, and Francine LEMIRE (Ixxiii) : <u>Municipal Reform on the Island of Montreal: Tensions Between Two Majority Groups in a Multicultural City</u></i>
CLIM	103.2003	<i>Barbara BUCHNER and Carlo CARRARO: <u>China and the Evolution of the Present Climate Regime</u></i>
CLIM	104.2003	<i>Barbara BUCHNER and Carlo CARRARO: <u>Emissions Trading Regimes and Incentives to Participate in International Climate Agreements</u></i>
CLIM	105.2003	<i>Anil MARKANDYA and Dirk T.G. RÜBBELKE: <u>Ancillary Benefits of Climate Policy</u></i>
NRM	106.2003	<i>Anne Sophie CRÉPIN (Ixiv): <u>Management Challenges for Multiple-Species Boreal Forests</u></i>
NRM	107.2003	<i>Anne Sophie CRÉPIN (Ixiv): <u>Threshold Effects in Coral Reef Fisheries</u></i>
SIEV	108.2003	<i>Sara ANIYAR (Ixiv): <u>Estimating the Value of Oil Capital in a Small Open Economy: The Venezuela's Example</u></i>
SIEV	109.2003	<i>Kenneth ARROW, Partha DASGUPTA and Karl-Göran MÄLER(Ixiv): <u>Evaluating Projects and Assessing Sustainable Development in Imperfect Economies</u></i>
NRM	110.2003	<i>Anastasios XEPAPADEAS and Catarina ROSETA-PALMA(Ixiv): <u>Instabilities and Robust Control in Fisheries</u></i>
NRM	111.2003	<i>Charles PERRINGS and Brian WALKER (Ixiv): <u>Conservation and Optimal Use of Rangelands</u></i>
ETA	112.2003	<i>Jack GOODY (Ixiv): <u>Globalisation, Population and Ecology</u></i>
CTN	113.2003	<i>Carlo CARRARO, Carmen MARCHIORI and Sonia OREFFICE: <u>Endogenous Minimum Participation in International Environmental Treaties</u></i>
CTN	114.2003	<i>Guillaume HAERINGER and Myrna WOODERS: <u>Decentralized Job Matching</u></i>
CTN	115.2003	<i>Hideo KONISHI and M. Utku UNVER: <u>Credible Group Stability in Multi-Partner Matching Problems</u></i>
CTN	116.2003	<i>Somdeb LAHIRI: <u>Stable Matchings for the Room-Mates Problem</u></i>
CTN	117.2003	<i>Somdeb LAHIRI: <u>Stable Matchings for a Generalized Marriage Problem</u></i>
CTN	118.2003	<i>Marita LAUKKANEN: <u>Transboundary Fisheries Management under Implementation Uncertainty</u></i>
CTN	119.2003	<i>Edward CARTWRIGHT and Myrna WOODERS: <u>Social Conformity and Bounded Rationality in Arbitrary Games with Incomplete Information: Some First Results</u></i>
CTN	120.2003	<i>Gianluigi VERNASCA: <u>Dynamic Price Competition with Price Adjustment Costs and Product Differentiation</u></i>
CTN	121.2003	<i>Myrna WOODERS, Edward CARTWRIGHT and Reinhard SELTEN: <u>Social Conformity in Games with Many Players</u></i>
CTN	122.2003	<i>Edward CARTWRIGHT and Myrna WOODERS: <u>On Equilibrium in Pure Strategies in Games with Many Players</u></i>
CTN	123.2003	<i>Edward CARTWRIGHT and Myrna WOODERS: <u>Conformity and Bounded Rationality in Games with Many Players</u></i>
	1000	Carlo CARRARO, Alessandro LANZA and Valeria PAPPONETTI: <u>One Thousand Working Papers</u>

NOTE DI LAVORO PUBLISHED IN 2004

IEM	1.2004	<i>Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB: <u>Empirical Analysis of National Income and So2 Emissions in Selected European Countries</u></i>
ETA	2.2004	<i>Masahisa FUJITA and Shlomo WEBER: <u>Strategic Immigration Policies and Welfare in Heterogeneous Countries</u></i>
PRA	3.2004	<i>Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI: <u>Do Privatizations Boost Household Shareholding? Evidence from Italy</u></i>
ETA	4.2004	<i>Victor GINSBURGH and Shlomo WEBER: <u>Languages Disenfranchisement in the European Union</u></i>
ETA	5.2004	<i>Romano PIRAS: <u>Growth, Congestion of Public Goods, and Second-Best Optimal Policy</u></i>
CCMP	6.2004	<i>Herman R.J. VOLLEBERGH: <u>Lessons from the Polder: Is Dutch CO2-Taxation Optimal</u></i>
PRA	7.2004	<i>Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN (lxv): <u>Merger Mechanisms</u></i>
PRA	8.2004	<i>Wolfgang AUSSENEGG, Pegaret PICHLER and Alex STOMPER (lxv): <u>IPO Pricing with Bookbuilding, and a When-Issued Market</u></i>
PRA	9.2004	<i>Pegaret PICHLER and Alex STOMPER (lxv): <u>Primary Market Design: Direct Mechanisms and Markets</u></i>
PRA	10.2004	<i>Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER (lxv): <u>The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions</u></i>
PRA	11.2004	<i>Bjarne BRENDSTRUP and Harry J. PAARSCH (lxv): <u>Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders</u></i>
PRA	12.2004	<i>Ohad KADAN (lxv): <u>Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values</u></i>
PRA	13.2004	<i>Maarten C.W. JANSSEN (lxv): <u>Auctions as Coordination Devices</u></i>
PRA	14.2004	<i>Gadi FIBICH, Arieh GAVIOUS and Aner SELA (lxv): <u>All-Pay Auctions with Weakly Risk-Averse Buyers</u></i>
PRA	15.2004	<i>Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER (lxv): <u>Competition and Cooperation in Divisible Good Auctions: An Experimental Examination</u></i>
PRA	16.2004	<i>Marta STRYSZOWSKA (lxv): <u>Late and Multiple Bidding in Competing Second Price Internet Auctions</u></i>
CCMP	17.2004	<i>Slim Ben YOUSSEF: <u>R&D in Cleaner Technology and International Trade</u></i>
NRM	18.2004	<i>Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU (lxvi): <u>Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics</u></i>
SIEV	19.2004	<i>Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA: <u>Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice</u></i>
NRM	20.2004	<i>Guido CANDELA and Roberto CELLINI (lxvii): <u>Investment in Tourism Market: A Dynamic Model of Differentiated Oligopoly</u></i>
NRM	21.2004	<i>Jacqueline M. HAMILTON (lxvii): <u>Climate and the Destination Choice of German Tourists</u></i>
NRM	22.2004	<i>Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ (lxvii): <u>Land, Environmental Externalities and Tourism Development</u></i>
NRM	23.2004	<i>Pius ODUNGA and Henk FOLMER (lxvii): <u>Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya</u></i>
NRM	24.2004	<i>Jean-Jacques NOWAK, Mondher SAHLI and Pasquale M. SGRO (lxvii): <u>Tourism, Trade and Domestic Welfare</u></i>
NRM	25.2004	<i>Riaz SHAREEF (lxvii): <u>Country Risk Ratings of Small Island Tourism Economies</u></i>
NRM	26.2004	<i>Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA (lxvii): <u>Tourism and Economic Growth in Latin American Countries: A Panel Data Approach</u></i>
NRM	27.2004	<i>Raúl Hernández MARTÍN (lxvii): <u>Impact of Tourism Consumption on GDP. The Role of Imports</u></i>
CSRM	28.2004	<i>Nicoletta FERRO: <u>Cross-Country Ethical Dilemmas in Business, a Descriptive Framework</u></i>
NRM	29.2004	<i>Marian WEBER (lxvi): <u>Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest</u></i>
NRM	30.2004	<i>Trond BJORN DAL, Phoebe KOUNDOURI and Sean PASCOE (lxvi): <u>Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting</u></i>
CCMP	31.2004	<i>Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI: <u>Weather Impacts on Natural, Social and Economic System (WISE) Part I: Sectoral Analysis of Climate Impacts in Italy</u></i>
CCMP	32.2004	<i>Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI: <u>Weather Impacts on Natural, Social and Economic System (WISE) Part II: Individual Perception of Climate Extremes in Italy</u></i>
CTN	33.2004	<i>Wilson PEREZ: <u>Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution</u></i>
KTHC	34.2004	<i>Gianmarco I.P. OTTAVIANO and Giovanni PERI (lxviii): <u>The Economic Value of Cultural Diversity: Evidence from US Cities</u></i>
KTHC	35.2004	<i>Linda CHAIB (lxviii): <u>Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison</u></i>
KTHC	36.2004	<i>Franca ECKERT COEN and Claudio ROSSI (lxviii): <u>Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context</u></i>
KTHC	37.2004	<i>Kristine CRANE (lxviii): <u>Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari</u></i>
KTHC	38.2004	<i>Kiflemariam Hamde (lxviii): <u>Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm</u></i>
ETA	39.2004	<i>Alberto CAVALIERE: <u>Price Competition with Information Disparities in a Vertically Differentiated Duopoly</u></i>
PRA	40.2004	<i>Andrea BIGANO and Stef PROOST: <u>The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?</u></i>
CCMP	41.2004	<i>Micheal FINUS (lxix): <u>International Cooperation to Resolve International Pollution Problems</u></i>

KTHC	42.2004	<i>Francesco CRESPI</i> : <u>Notes on the Determinants of Innovation: A Multi-Perspective Analysis</u>
CTN	43.2004	<i>Sergio CURRARINI and Marco MARINI</i> : <u>Coalition Formation in Games without Synergies</u>
CTN	44.2004	<i>Marc ESCRIHUELA-VILLAR</i> : <u>Cartel Sustainability and Cartel Stability</u>
NRM	45.2004	<i>Sebastian BERVOETS and Nicolas GRAVEL</i> (lxvi): <u>Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach</u>
NRM	46.2004	<i>Signe ANTHON and Bo JELLESMARK THORSEN</i> (lxvi): <u>Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits</u>
NRM	47.2004	<i>John MBURU</i> (lxvi): <u>Wildlife Conservation and Management in Kenya: Towards a Co-management Approach</u>
NRM	48.2004	<i>Ekin BIROL, Ágnes GYOVAI and Melinda SMALE</i> (lxvi): <u>Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transitional Economy</u>
CCMP	49.2004	<i>Gernot KLEPPER and Sonja PETERSON</i> : <u>The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects</u>
GG	50.2004	<i>Scott BARRETT and Michael HOEL</i> : <u>Optimal Disease Eradication</u>
CTN	51.2004	<i>Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG</i> : <u>Simple Priorities and Core Stability in Hedonic Games</u>
SIEV	52.2004	<i>Francesco RICCI</i> : <u>Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory</u>
SIEV	53.2004	<i>Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON</i> : <u>Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?</u>

- (lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
- (lx) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002
- (lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
- (lxii) This paper was presented at the ENGIME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002
- (lxiii) This paper was presented at the ENGIME Workshop on “Social dynamics and conflicts in multicultural cities”, Milan, March 20-21, 2003
- (lxiv) This paper was presented at the International Conference on “Theoretical Topics in Ecological Economics”, organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM Trieste, February 10-21, 2003
- (lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
- (lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL), Venice, August 28-29, 2003
- (lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
- (lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003
- (lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003

2003 SERIES

CLIM	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
GG	<i>Global Governance</i> (Editor: Carlo Carraro)
SIEV	<i>Sustainability Indicators and Environmental Valuation</i> (Editor: Anna Alberini)
NRM	<i>Natural Resources Management</i> (Editor: Carlo Giupponi)
KNOW	<i>Knowledge, Technology, Human Capital</i> (Editor: Gianmarco Ottaviano)
IEM	<i>International Energy Markets</i> (Editor: Anil Markandya)
CSR	<i>Corporate Social Responsibility and Management</i> (Editor: Sabina Ratti)
PRIV	<i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)
CTN	<i>Coalition Theory Network</i>

2004 SERIES

CCMP	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
GG	<i>Global Governance</i> (Editor: Carlo Carraro)
SIEV	<i>Sustainability Indicators and Environmental Valuation</i> (Editor: Anna Alberini)
NRM	<i>Natural Resources Management</i> (Editor: Carlo Giupponi)
KTHC	<i>Knowledge, Technology, Human Capital</i> (Editor: Gianmarco Ottaviano)
IEM	<i>International Energy Markets</i> (Editor: Anil Markandya)
CSR	<i>Corporate Social Responsibility and Management</i> (Editor: Sabina Ratti)
PRA	<i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)
CTN	<i>Coalition Theory Network</i>