

The Cost of Reduced Life Expectancy Due to Air Pollution

Assessing the Value of a Life Year (VOLY) Using Contingent Valuation

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Within the European project **NEEDS**

This project was conducted by an international team from nine European countries. The questionnaire is a joint product of the research team and the data collected in the participating countries was pooled to compute a EU16 VOLY (EU 15 plus Switzerland). See Rabl Ari et al. 2007.

Aim of the study

The aim of the study is to assess the **value of a life year (VOLY)** lost as a consequence of air pollution. Epidemiological studies suggest that air pollution results in small loss of life expectancy (LE) – from one month to a few months – which makes air pollution a very different case from the standard one, traffic accidents. The usual metric to assess mortality costs – the value of a statistical life - VSL - is here not suitable.

Air pollution has many adverse effects: increased risk of mortality and morbidity, damage to the ecosystem, climate change.... The good to be assessed is **the sole value of the life lost** (mortality cost), not the reduced HRQoL due to air pollution (morbidity cost), nor the damage to the environment, nor the economic implications of morbidity and mortality (work impairment, health care cost).

Higher mortality due to air pollution does not mean that people will loose a few months of life in poor health. The increased mortality risk is spread over many years: acute exposure to air pollution can lead to sudden death, whereas chronic exposure can lead to premature death by accelerating the aging process. Living in an air-polluted area thus entails a small increase in the probability of death throughout life.

Method

The usual procedure to compute the value of a life year (VOLY) is to assume that the value of a statistical life (VSL) is the discounted sum of annual VOLYs. A different approach was adopted here by assessing the VOLY directly using a CV survey.

Within the traditional approach, the VSL estimate is extracted from the respondents' WTP for a small change in the probability of dying. However, respondents encounter difficulties when dealing with small probabilities. The alternative approach consists in expressing the health implications of air pollution as a change in LE. Respondents supposedly understand this more easily.

CV survey is used to value the change in mortality risk (and in LE) only. With this so-called **restricted perspective**, the scenario must be carefully designed to limit the risk of an embedding effect.

Lastly, the personal perspective is considered by asking the respondent to express his/her personal preferences about his/her own health (Dolan et al. 2003).

CV survey

The CV survey was conducted in Western Switzerland from December 2005 to January 2006. The administration of the questionnaire took about 50 minutes. The feedback by interviewers shows that respondents had a good understanding of the questions (91.6% good or very good understanding). Quota sampling method was used to select respondents. 179 of the 192 questionnaires were used to estimate the WTP.

Contingent valuation survey

Initial sample	192
Respondents	179
"No" response to the elicitation question	52
False zero	27
Implausible observations	4
Final sample	96

Characteristics of the respondents

	Sample	Population
Gender		
Male	48.2%	48.8%
Female	50.8%	51.1%
Age group		
30-39	21.3%	28.4%
40-49	28.5%	28.8%
50-59	22.3%	24.2%
60-69	17.8%	17.8%
Socio-professional category		
Unskilled workers	14%	15.7%
Skilled workers and employees	57.4%	55.7%
Middle ranking executives	20.7%	21.5%
Self-employed and top management	87.9%	87.1%

Source: Federal census of the population 2000 (OFS 2003)

Scenario and WTP elicitation

Respondents had to express their WTP for a 3 and 6 month gain in LE due to stricter environmental regulation. The aim is to value the change in LE, but not other private (reduce morbidity risk) and public benefits (health of others, ecosystem).

The way benefits of pollution control were described made the respondents aware of the fact that increased risk of death results both from acute fatalities ("acute death") as well as from chronic effect resulting from long term exposure to pollutants ("chronic death").

Respondents are told to consider only their personal benefit:

"Please consider only your personal gain of life expectancy; What is the maximum amount you are willing to pay in the form of higher expenses to gain an average of 6 months in your life expectancy?"

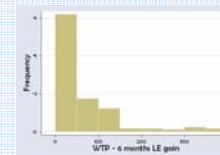
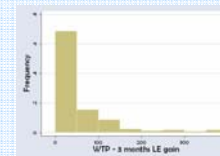
The payment vehicle is an increase in the cost of living due to pollution control policy (the usual way to pay for air pollution control). It was well accepted and does not seem to have induced protest responses.

Results

The mean WTP is CHF 57.2 (EUR 35.9) for six months gain in life expectancy and CHF 47.9 (EUR 30.0) for three months.

The payment is to be made on a lifelong basis, on average 36.7 years (respondents' average life expectancy).

	Monthly WTP (CHF)	
	3 months LE gain	6 months LE gain
Mean	47.8	57.2
Median	20	20
Std.	87.2	75.6



If based on a six months gain in LE, the implicit extracted value of a life year (VOLY) is CHF 50,000 (€30,000 or PPP adjusted €25'000) and if based on a three months gain in LE it is CHF 84,000 (€51,000 or PPP adjusted €42'000).

The lower value (six months gain) is very close to the air pollution related VOLY (CHF 53,000) estimated in Switzerland by Soguel and van Griethuysen (2000).

Internal validity test

The internal validity of the CV survey is checked using a multiple regression model. WTP is positively related to income. Respondents with poor subjective health state (HEALTH) accept to pay more in order to benefit from reduced air pollution. Respondents who are concerned about air pollution pay more (CONCERN). When respondents value a broader set of goods, the WTP is higher (BROAD).

Variable	Coefficient	t-value
CONSTANT	-35.22	-2.148*
INCOME	0.010	2.107**
EDUCATION	0.008	1.082*
HEALTH	0.030	2.123**
CONCERN	01.10	1.742*
BROAD	00.70	1.012*
R ²	0.220	
Adj. R ²	0.188	
F-stat.	0.000	

Discussion

Respondents should have valued only their own benefit in terms of increased life expectancy. However, answers to debriefing question show that they also have considered gain in LE for relatives (17.9%), change in morbidity (28.7%), benefit for the ecosystem (12.4), or even all sorts of benefits of a reduced concentration of air pollutants (32.2). Clearly, the CV survey did not succeed in avoiding the embedding effect.

We observe a higher WTP on average when respondents considered multiple benefits instead of their exclusive LE benefit. Using a simple model to take into account that some respondents are not expressing specific preferences for good "life expectancy", we show that the WTP for LE and the VOLY estimate is significantly reduced.

The results reveal scope insensitivity: the WTP does not vary proportionally to the gain in LE. One would expect the expressed WTP to be twice as high for six months as it is for three months ("strict proportionality", Pearce 2004). Here the WTP for six months is only 20% higher than WTP for 3 months' additional life. If used for policy purposes, the VOLY should be based on the six months' estimate, which provides a lower, more conservative value.

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