

# An Empirical Study on the Role of Altruism in the Valuation of Municipal Drinking Water Risk Reductions

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# Background

- To answer a basic policy question: what are Canadians' preferences for alternative water treatment programs that differ in their effectiveness in reducing microbial risks versus cancer risks from drinking water?
  - The chlorine based treatments: lower microbial risks, higher cancer risks and lower costs.
  - Treatments relying less on the use of chlorine: higher microbial risks, lower cancer risks and higher costs.

Adamowicz, W., D. Dupont, A. Krupnick, and J. Zhang. 2007. Valuation of Cancer and Microbial Disease Risk Reductions in Municipal Drinking Water: An Analysis of Risk Context using Multiple Valuation Methods. *Discussion Paper*. Resources for the Future, 07-39.

## However, Empirical Questions are

- How significant is altruism in the public health values
- How should public health risk reduction valuation be conducted when altruism is present and is likely to affect the optimal provision of the public good.

# Previous Studies of the Role of Altruism in the Demand for Public Goods

- McConnell (1997)
- Strand (2004)

However, little empirical work has been done to measure the magnitude of altruistic value versus self-interested value.

McConnell, K. E. 1997. Does Altruism Undermine Existence Value?" *Journal of Environmental Economics and Management* 32: 22-37.

Strand, J. 2004. Public and Private-good Values of Statistical Lives: Results from a Combined Choice-experiment and Contingent Valuation Survey. Department of Economics, University of Oslo.

## Decomposition of Willingness to Pay by Motivation

$$WTP_{\text{Total}_i} = e(q_i^0, G^0, U^0) - e(q_i^1, G^1, U^0)$$

$$WTP_{\text{Total}_i} = e(q_i^0, G^0, U^0) - e(q_i^1, G^0, U^0) \\ + e(q_i^1, G^0, U^0) - e(q_i^1, G^1, U^0)$$

$$WTP_{\text{Total}_i} = WTP_{\text{Self}_i} + WTP_{\text{Altrm}_i}$$

Flores, N. E. 2002. Non-paternalistic Altruism and Welfare Economics. *Journal of Public Economics* 83: 293-305.

# Types of Altruism and their Impacts on Total Benefits (TB) in Cost-Benefit Analysis

## ➤ Paternalistic altruism

$$TB |_{\text{paternalistic altruism}} = \sum_{i=1}^n WTP_{\text{Total}_i}$$

## ➤ Non-paternalistic altruism

$$TB |_{\text{non-paternalistic altruism}} = \sum_{i=1}^n WTP_{\text{Self}_i}$$

- One difficulty in accounting for altruism in the demand for a public good is to identify the demand with different motives empirically.
  
- Our hypothesis: self-protection against the health risks decreases one's willingness-to-pay for the public program that aims to reduce these risks.
  - Data on water filter expenditure (FEXP) and expenditure on bottled water purchases (WPHS) at home.

# An Internet-Based Stated Preference Survey

- The survey was conducted during the spring and summer of 2004 across Canada (two waves).
- A total of 1633 Canadians participated the survey.
- The survey included questions about water consumption (filter use, bottled water purchases, etc.) and stated preference valuation of water treatment programs.
- Attributes used to describe a water treatment program are: microbial illnesses (MICI) , microbial deaths (MICD), cancer illnesses (CANI), cancer deaths (CAND), and annual increase in the current water bill (BILL).

# Two Approaches....

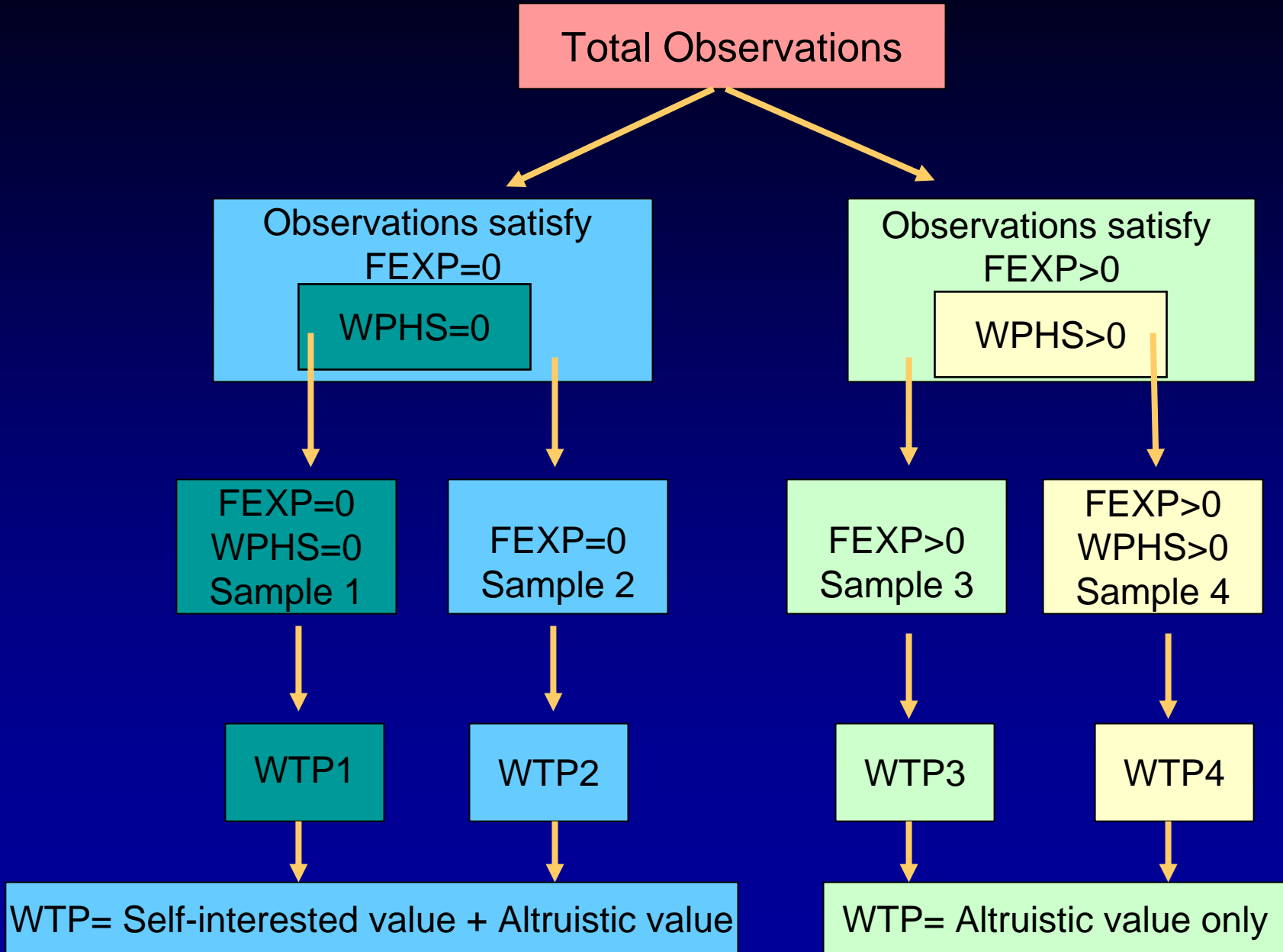
- The sample segmentation method

Split the entire sample into sub-groups based on self-protection behaviour and estimate demand for sub-groups separately.

- The interaction method

The interaction method accounts for differences in motives for risk reductions based on levels of expenditure on self-protection while controlling for endogeneity between the self-protection decision and the demand decision for the public good.

# A Sample Segmentation Approach



# Models Estimated using Sub-samples and Hypothesis

Model 1	Model 2	Model 3	Model 4
Sample 1 FEXP=0 & WPHS =0 (432 obs.)	Sample 2 FEXP=0 (828 obs.)	Sample 3 FEXP>0 (636 obs.)	Sample 4 FEXP>0 & WPHS>0 (292 obs.)
<b>WTP1</b> ( $WTP_{Self} + WTP_{Altrm}$ )	<b>WTP2</b> ( $WTP_{Self} + WTP_{Altrm}$ )	<b>WTP3</b> ( $WTP_{Altrm}$ )	<b>WTP4</b> ( $WTP_{Altrm}$ )

**Hypothesis:  $WTP1 > WTP2 > WTP3 > WTP4$**

Recovering self-interested WTP by subtracting altruistic WTP from total WTP.

$$WTP1_{Self} = WTP1 - WTP4$$

$$WTP2_{Self} = WTP2 - WTP3$$

# The Interaction Method

- Hypothesizing a dose-response relationship between levels of filter expenditure and probability of choosing the proposed public program.
  - $V_{ij} = X_{ij}\beta + FEXP * X_{ij}\gamma$
- Control for endogeneity between risk preferences and demand decision for the public program.
  - Construct an instrumental variable Z for FEXP using tobit regression of FEXP on socio-demographic variables.

$$V_{ij} = X_{ij}\beta + Z * X_{ij}\gamma$$

$$WTP5_{Total} = WTP5 \Big|_{\bar{Z}|FEXP=0} \quad WTP5_{Altrm} = WTP5 \Big|_{\bar{Z}|FEXP>0}$$

Hypothesis:  $WTP5_{Total} > WTP5_{Altrm}$

# WTP Estimates from a With-covariate CL Specification

	The Sample Segmentation Method				The Interaction Method	
	Model 1 (432 obs.)	Model 2 (828 obs.)	Model3 (636 obs.)	Model4 (292 obs.)	Model 5 (1464 obs.)	
	WTP1	WTP2	WTP3	WTP4	WTP5 <sub>Total</sub>	WTP5 <sub>Altrm</sub>
<b>MICI</b>	<b>0.023**</b>	<b>0.01634**</b>	<b>0.01629**</b>	<b>0.015**</b>	<b>0.017**</b>	<b>0.015**</b>
<b>MICD</b>	<b>19.875**</b>	<b>15.670**</b>	<b>10.005**</b>	<b>9.753**</b>	<b>14.157**</b>	<b>10.680**</b>
<b>CANI</b>	<b>4.875**</b>	<b>2.983**</b>	<b>2.079**</b>	<b>1.756**</b>	<b>2.639**</b>	<b>2.325**</b>
<b>CAND</b>	<b>16.731**</b>	<b>12.238**</b>	<b>8.549**</b>	<b>6.768**</b>	<b>10.714**</b>	<b>9.578**</b>

Notes: Results from a random parameters logit (RPL) specification are consistent with the CL results. The RPL results are available upon request.

# Self-interested WTP versus Altruistic WTP

	<u>The Sample Segmentation Method</u>				<u>The Interaction Method</u>	
	Self-interested WTP (% total)	Altruistic WTP (WTP4)	Self-interested WTP (% total)	Altruistic WTP (WTP3)	Self-interested WTP (% total)	Altruistic WTP (WTP5 <sub>Altrm</sub> )
	WTP1 <sub>Self</sub>	WTP1 <sub>Altrm</sub>	WTP2 <sub>Self</sub>	WTP2 <sub>Altrm</sub>	WTP5 <sub>Self</sub>	WTP5 <sub>Altrm</sub>
<b>MICI</b>	0.008 (35%)	0.015	0.00002 (0.10%)	0.016	0.002 (12%)	0.015
<b>MICD</b>	9.663 (49%)	9.753	5.455 (35%)	10.005	3.331 (24%)	10.68
<b>CANI</b>	3.106 (64%)	1.756	0.902 (30%)	2.079	0.313 (12%)	2.325
<b>CAND</b>	9.827 (59%)	6.768	3.615 (30%)	8.549	1.083 (10%)	9.578

# Value of Statistical Life (VSL) Estimates and Value of Statistical Case of Illnesses (VSI) (2004 Canadian Dollars)

	<u>The Sample Segmentation Method</u>				<u>The Interaction Method</u>	
	PA: WTP1 <sub>Total</sub>	NPA: WTP1 <sub>Self</sub>	PA: WTP2 <sub>Total</sub>	NPA: WTP2 <sub>Self</sub>	PA: WTP5 <sub>Total</sub>	NPA: WTP5 <sub>Self</sub>
<b>MICI (Unit)</b>	<b>30,962</b>	<b>10,769</b>	<b>21,966</b>	<b>67</b>	<b>22,885</b>	<b>2,692</b>
<b>MICD (Million)</b>	<b>26.7</b>	<b>13.6</b>	<b>21.1</b>	<b>7.6</b>	<b>19.1</b>	<b>4.7</b>
<b>CANI (Million)</b>	<b>6.5</b>	<b>4.2</b>	<b>4.0</b>	<b>1.2</b>	<b>3.6</b>	<b>0.4</b>
<b>CAND (Million)</b>	<b>22.5</b>	<b>13.4</b>	<b>16.5</b>	<b>5.0</b>	<b>14.4</b>	<b>1.5</b>

Note: PA—paternalistic altruism; NPA—non-paternalistic altruism

# Conclusions

- Demand for community health risk reductions from drinking water motivated by different interests can be identified using self-protection data.
- Total WTP can be decomposed into WTP for self interest and WTP for others.
- It is important to control for endogeneity between risk preference and self-protection decision when modelling choice decisions for risk reductions.
- It is found that altruism plays an important role in the valuation of community health risk reduction. 40% to 90% of an individual's total WTP for a marginal risk reduction appears to be from altruism.

# Study Limitations and Future Research

- Strong assumptions were imposed on the nature of self-protection to facilitate the empirical study.
  - Joint production problem (health risk, taste, odor, color).
  - Ignoring benefits of future cost saving for those who installed filter systems at home.
  - Ignoring benefits outside home.
- The magnitude of WTP and VSL estimates heavily hinged on the assumption about the nature of altruism and yet the nature of altruism is not clear.

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Thank You!