

# Does improved water quality increase the value of houses?

Comparison of revealed and stated preferences methods

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# Outline

- Introduction
- CE
- HP
- Comparison
- Conclusions and future research

# Introduction

- Implementation of the Water Framework Directive (WFD) in the Netherlands
- => huge interest in the costs of measures, but ...
- => What are the benefits?
- One of the benefits is the utility derived from living close to good quality surface water.
- How to measure this utility gain?
- => Increase of the values of houses.

# Introduction

- International literature on valuing water quality improvements:
  - Water quality and recreation (Adamowicz et al., 1994)
  - Reduced pollution as compensation (Burton et al. 2000; Heberling et al., 2000)
  - Ecology and tax increase (Georgiou et al., 2000; Hanley et al., 2006)
- Water quality and the value of houses: hedonic pricing
- For the Netherlands: Luttik (2000) hedonic pricing model

# Introduction

- Hedonic pricing analysis
- Choice experiment


























	<b>Hedonic analysis</b>	<b>Choice experiment</b>
Preferences	Revealed	Stated
Units	House transactions	House owners/house hunters
Regions	5 (Flevoland, Gelderse Poort, Maasplassen, Rijnmond, Vechtstreek)	3 (Flevoland, Maasplassen, Vechtstreek)

# CE - study design

- Internet survey
- Five choice questions with three alternatives
  - - Two changes with improved water quality
  - - One no-change option
- Design with as much variation as possible
  
- Two versions of ecological indicator
  - Presence of natural (river) banks
  - Ecological status (fish presence)













# CE - study design - attributes

<b>Attribute</b>	<b>Description</b>	<b>Levels</b>
$X_{distance}$	Distance to water	0; 50; 100;500;1500 meters
$X_{water\ type}$	Type of water	City canal, River, lake, wide rural canal, small rural canal, ditch
$X_{view}$	View on surface water	yes; no
$X_{transparency}$	Water transparency	turbid water (0-50cm); moderately turbid water (50-100 cm); pellucid water (100-200cm); very pellucid water (>200cm)
$X_{ecological\ status}$ (version 1)	Ecological status	poor; moderate; good
$X_{natural\ banks}$ (version 2)	Presence of natural bank	yes; no
$X_{house\ price}$	Additional house price	€1.000; €5.000; €10.000; €15.000; €25.000; €40.000

meerprijs	 + € 1.000	 + € 5.000	 + € 10.000	 + € 15.000	 + € 25.000	 + € 40.000
type water	 kanaal	 rivier	 meer	 gracht	 vaart/ brede sloot	
afstand tot water	 0 meter	 50 meter	 100 meter	 500 meter	 1.500 meter	
uitzicht op water	 ja	 nee				
helderheid	 troebel: 0-50 cm	 beetje troebel: 50-100 cm	 helder: 100-200 cm	 zeer helder: > 200 cm		
water-natuur	 slecht	 matig	 goed			



# CE - study design

	House A	House B	Neither
Additional house price	 + € 1.000	 + € 10.000	
Type of water	 Canal	 Lake	
Distance to water	 50 meters	 1500 meters	
View on water	 yes	 no	
Water transparency	 turbid: 0-50 cm	 pellucid: 100-200 cm	
Ecological status	 good	 moderate	

I want neither House A nor House B

Please select House A, House B, or Neither of both houses

# Data

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- Period: August-September 2007
- Respondents from 3 study areas in the NL
  - Different areas
  - Differences in surface water

# Data - survey

- Subscribers to on-line real estate agents (house owners and house hunters)
- Respondents with recent experience of the housing market
- 600 observations (10% response rate)
- Is it a representative survey for the Dutch population?  
No, sample statistics or respondents: older, higher educated, higher income, larger families (less single persons hh)

# Data – sample characteristics

Characteristics	Total sample	Flevo-land	Vecht river basin	Meuse lakes
Share of males (%)	56.5	62.3	48.6	63.8
Average age	43	45	40	43
Min-max age	18-83	22-77	18-71	24-70
Average household size	2.8	2.8	2.5	3.1
Share of single person hh (%)	15.2	13.5	20.6	7.7
Share of hh with children (%)	50.5	52.9	45.0	57.7
Share of highly educated persons (%)	62.6	58.9	74.1	52.1
Average monthly income (€)	3,160	3,200	3,200	3,000

# Data – sample characteristics

Characteristics	Total sample	Flevo-land	Vecht river	Meuse lakes
Share of property owners (%)	85.1	87.9	79.5	90.8
Average age of the house	38	25	53	32
Average number of bed rooms	3.3	3.5	2.8	3.5
Share of houses with garden(%)	79.7	89.7	62.8	90.7
Type of dwelling (%)				
Non-detached and semi-detached single-family dwellings	49.3	54.1	49.1	47.9
Detached terraced dwellings for single families	9.9	9.7	2.7	21.1
Flat or apartment (First-floor apartment, upstairs apartment)	21.5	15	36.4	10.6
Mansion/villa/farmhouse	15.6	19.3	9.1	20.4
City canal house	1.1	0.5	2.3	0
Houseboat	0.5	1	0.5	0
Other types of dwellings	2.1	0.4	0	0
Average house price (€1,000)*	330	329	342	320

# CE - data - water bodies in pilot areas

Average distance (m) to surface water type per region (nobs between brackets)

Type of water	Flevoland		Vecht river basin		Meuse Lakes		$\chi^2$
City canal	98	(27)	215	(55)	107	(7)	1.67
River	1500	(2)	247	(22)	1869	(33)	<b>16.03</b>
Lake	1341	(82)	1627	(29)	1447	(30)	0.81
Brook	507	(3)	11	(3)	633	(14)	<b>5.51</b>
Pond	164	(5)	127	(10)	355	(11)	<b>7.70</b>
Wide canal (rural areas)	295	(10)	355	(28)	1372	(32)	<b>23.04</b>
Canal (rural areas)	451	(34)	286	(12)	-		1.91
Ditch	270	(41)	257	(60)	444	(12)	<b>21.19</b>

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# CE - results

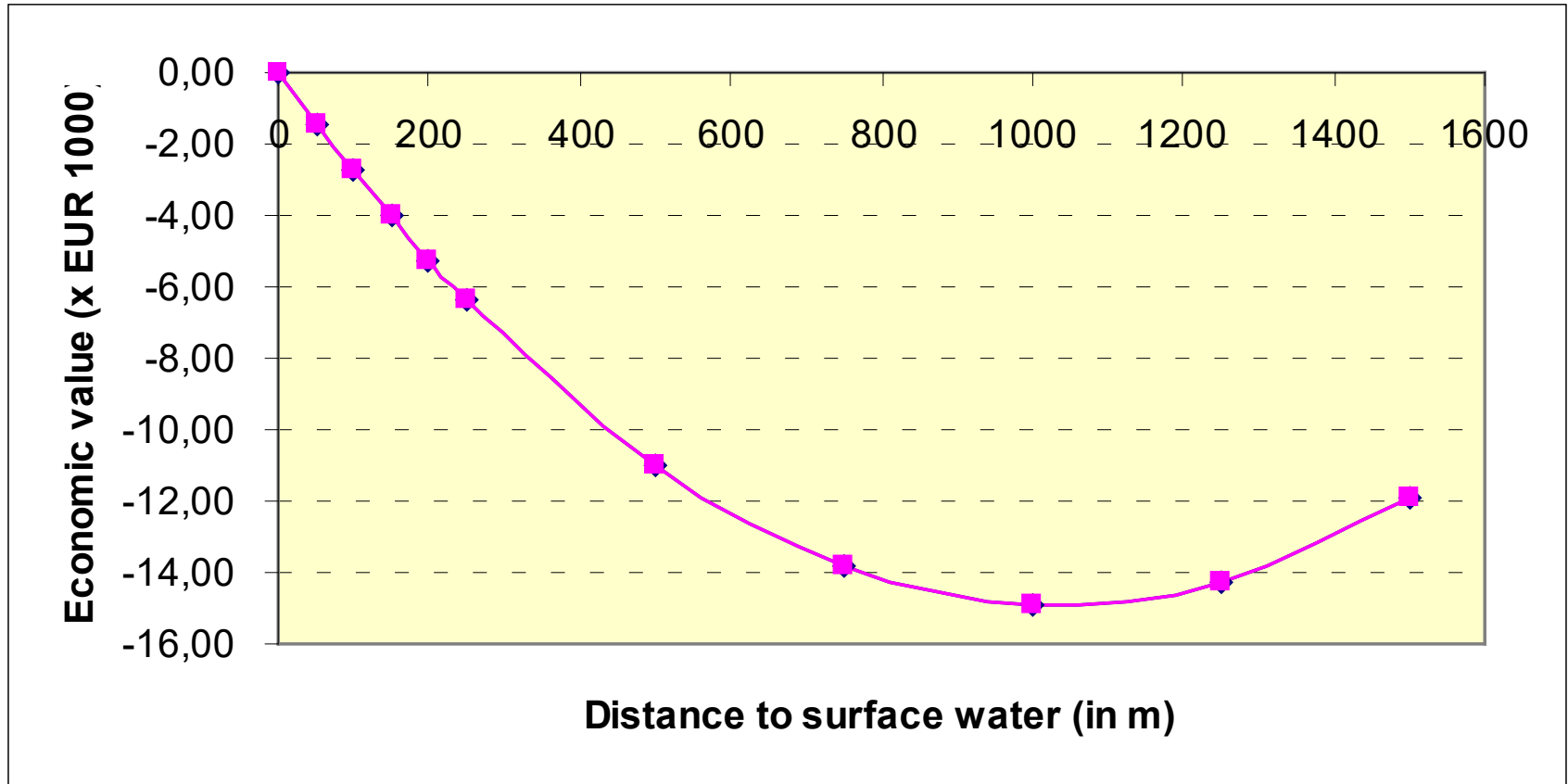
- Most coefficients are significant
- Most coefficients do not differ across both versions
- Distance and transparency have quadratic functions

# CE - results: Best fit model

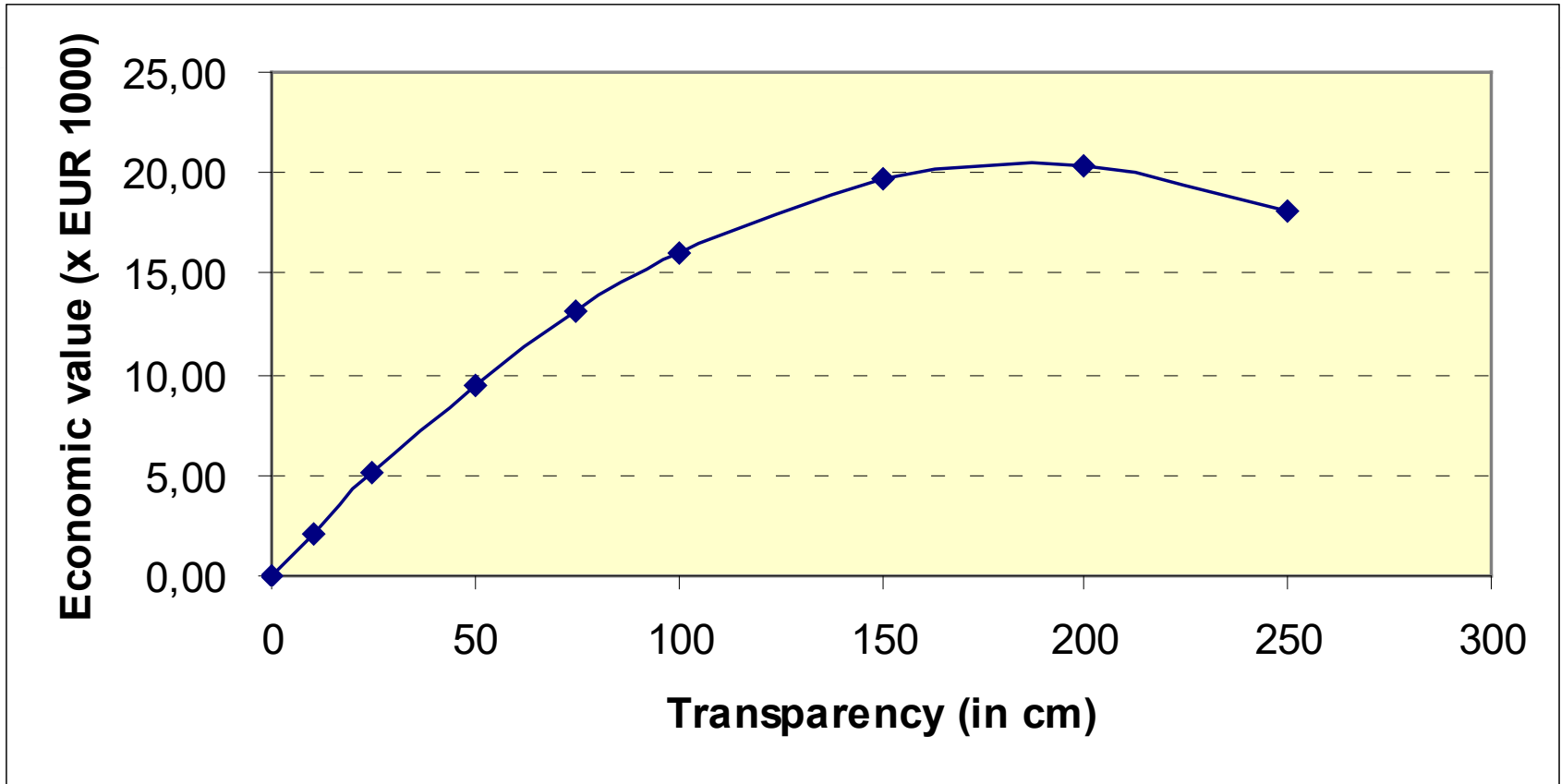
- Allows for heterogeneous preferences
- Main effects are the same except for
  - City canal dummy
  - => Particular effect in Vecht river basin (version 1: ecological status)
  - => Interacts with view on surface water (version 2: natural banks)



# Results: distance to water



# Results: transparency



# CE - Results

	Ecological status (version 1)			Presence of natural banks (Version 2)		
	MEV	Standard error	Share of house price	MEV	Standard error	Share of house price
A lake versus a wide rural canal	23,012	3,974	7.0	27,184	4,382	8.2
A river versus a wide rural canal	13,312	3,742	4.0	16,727	3,980	5.1
A city canal over a wide rural canal	7,935	3,652	2.4	9,544	3,908	2.9
A small over a wide rural canal	-			-		
View on surface water (no view is reference)	23,640	2,523	7.2	24,653	2,667	7.5
Moderate versus poor ecological quality	17,892	3,160	5.4			
Good versus poor ecological quality	25,317	3,501	7.7			
Natural banks (no natural banks is reference)				9,986	2,303	3.0

# Ce - conclusions

- The estimated marginal economic value of natural banks amounts almost 3 percent of the average house price in the sample. For a good ecological status of the surface water, the marginal economic value is even 8 percent of the house price.
- However, the marginal economic value decreases with distance to water (up to 1.000 meters)
- And increases with transparency (up to 1.80 m)

# HP - approach

- Price is explained by characteristics (Lancaster, 1966)
- Example in the literature:
  - durable goods like refrigerators, deep freezers, washing machines and dish washers (Linderhof 2001)
  - wine
  - housing prices (Luttik 2000)
  - proximity of surface water (Rouwendal et al. 2017)

# HP – stepwise approach

Five models

House characteristics

+Environment: demographic and economic characteristics

+Environment: green areas

+Environment: proximity of surface water

+Environment: quality of surface water

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# HP - approach

- Maasplassen – Gelderse Poort comparison
- Proximity to large river, no proximity to large lakes
  
- Vechtstreek – Rijnmond comparison
- Proximity to both large river and lake
  
- Transferability of relationship

# HP - data

- Netherlands Association of Real Estators
- Actual house transactions 1995-2005
- Housing characteristics (year of construction, number of rooms, presence of garden, area in m<sup>2</sup>, etc.)
- Location (geo-referenced)



# HP - data

- Data on environment linked through location
  - Population density of neighbourhood or municipality
  - Distance to high-way (or railway station)
- Distance to local green area
- Proximity to water
  - Small waters (ponds)
  - Large rivers (Maasplassen and Gelderse Poort)
  - Large lakes (Vechtstreek and Rijnmond)

# HP - data

- Water quality
- Transparency (+)
- Oxygen concentration (+)
- Phosphorus concentration (-)
- Chl concentration (-)
- Heavy metals concentration (-)

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# HP - results

- Comparison

# Thank you!

## Questions?

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