

Investigating WTP – WTA Asymmetry in Choice Experiments

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eftec



WTP – WTA asymmetry

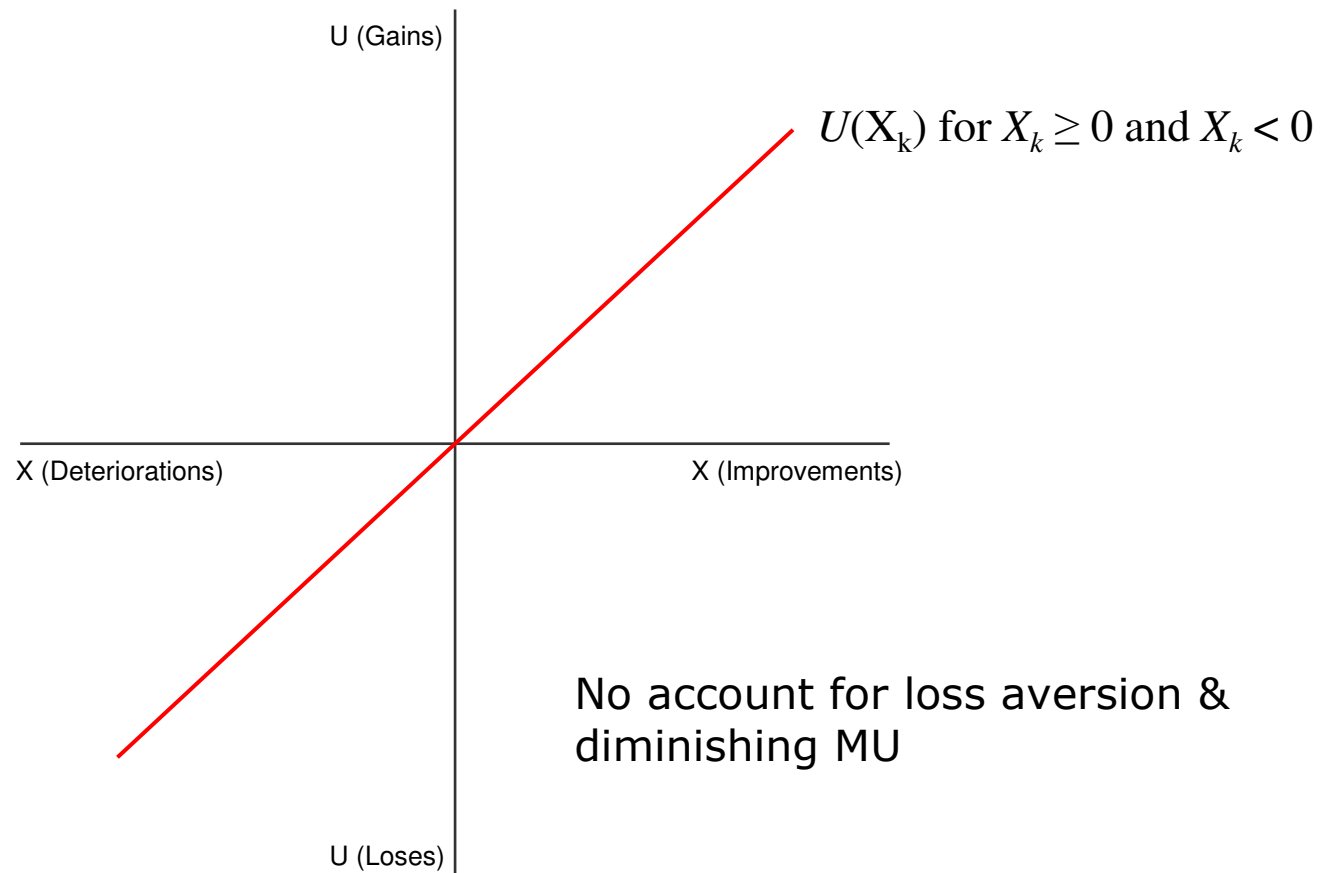
- Universally observed (and investigated...)
- Standard theory allows for a small difference between WTP for a unit gain and WTA for a unit loss in absolute terms
- Commonly observe that losses are valued significantly greater than gains of the same magnitude
- Apparent in real, hypothetical and experimental settings for market, non-market & public goods
- Possible explanations: income & substitution effects (standard theory); loss aversion (psychological literature)



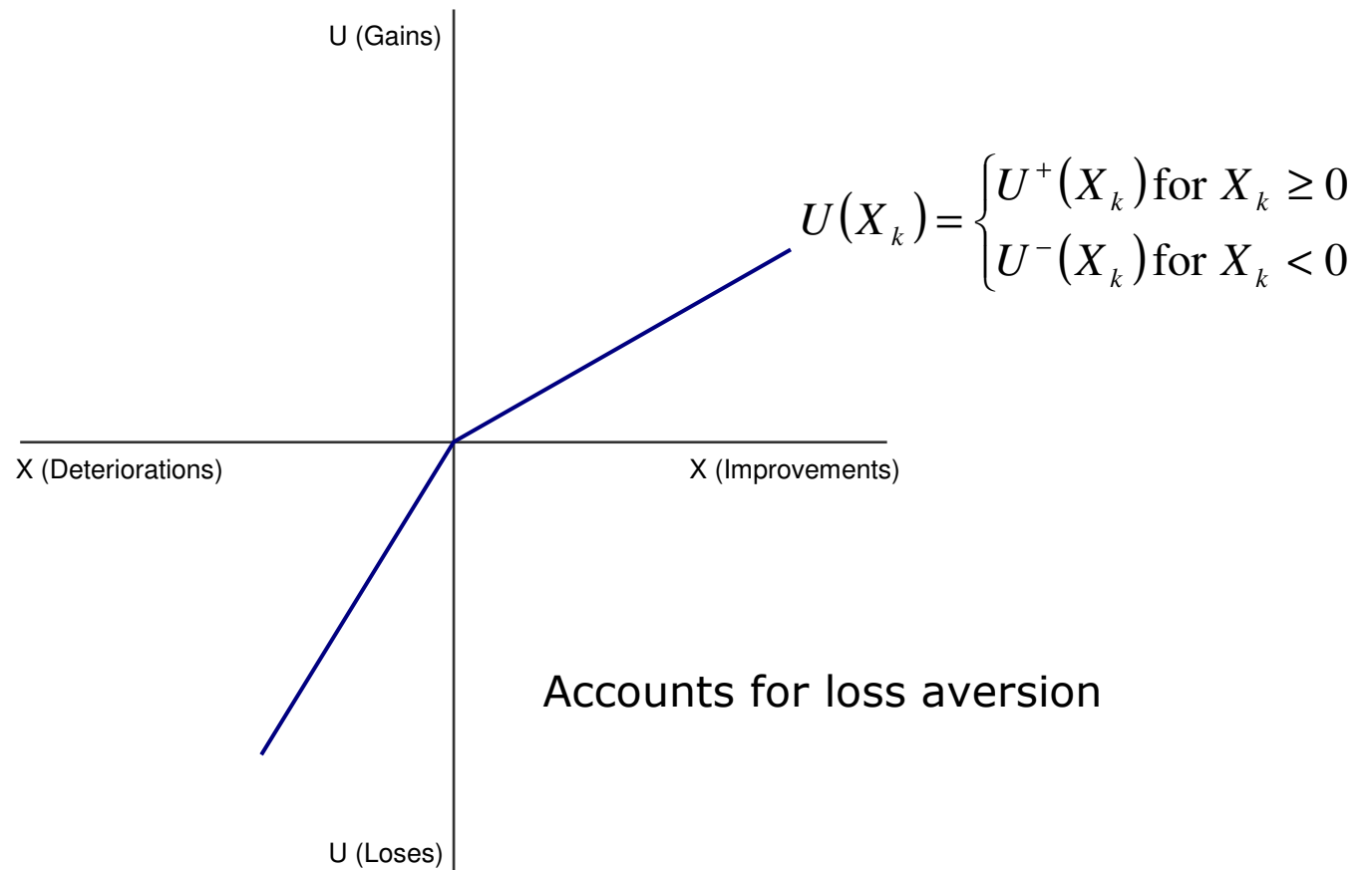
Choice experiment application

- A CE permits numerous discrete changes in the provision of a good to be evaluated for which marginal WTP and WTA values may be estimated
 - Respondents trade-off both improvements and deterioration in the levels of attributes against the status quo
 - Estimate different econometric model specifications which permit marginal utility (MU) to vary with the change in each attribute:
 - Diminishing MU for improvements; and
 - Account for potential loss aversion
- ⇒ *Linear, piecewise linear and s-shaped utility functions*

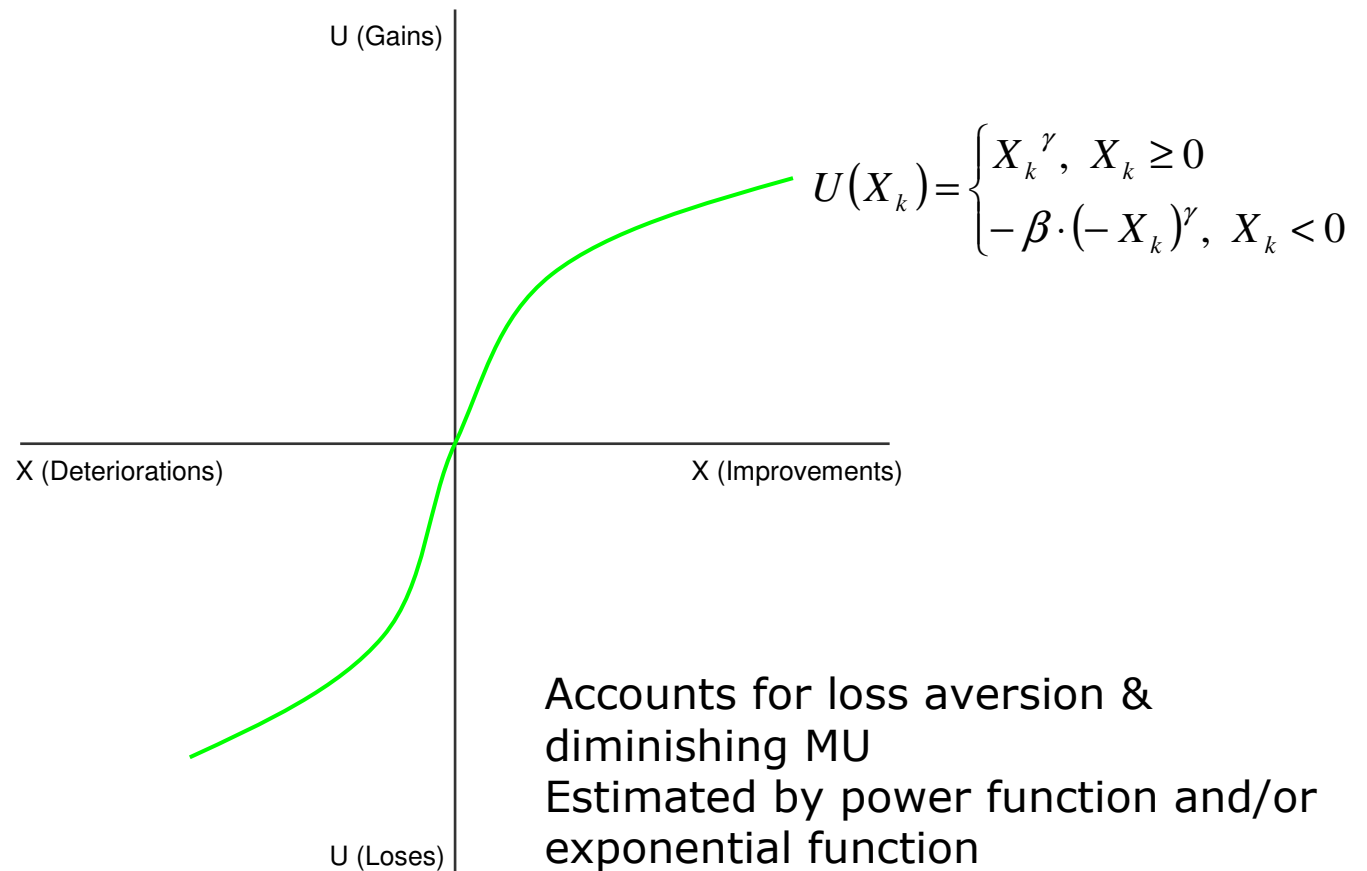
Linear utility specification



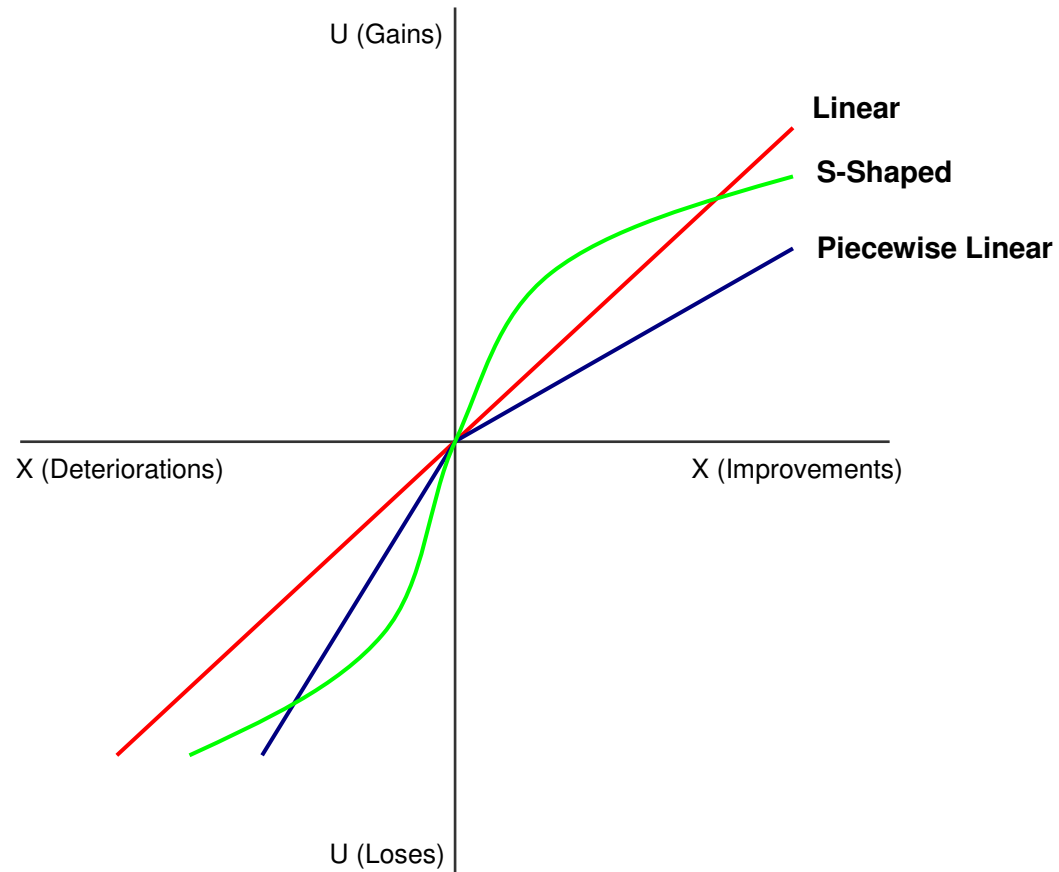
Piecewise linear utility specification



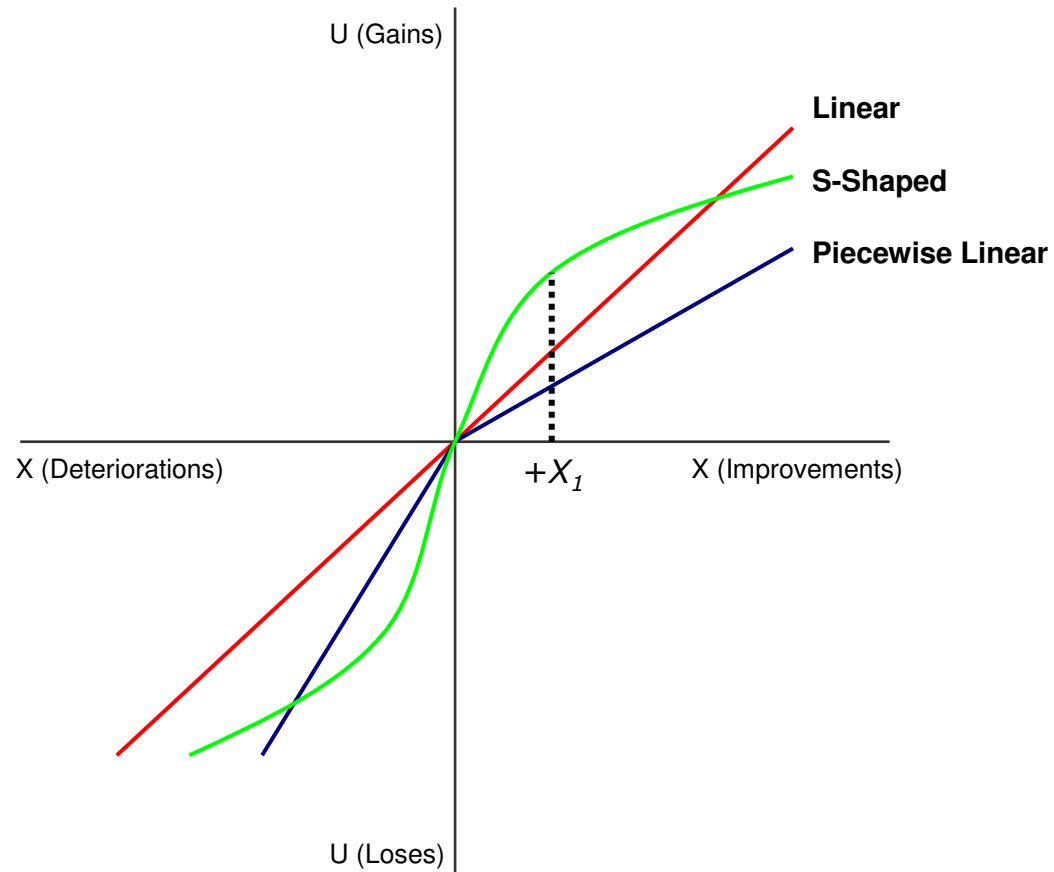
S-shaped utility specification



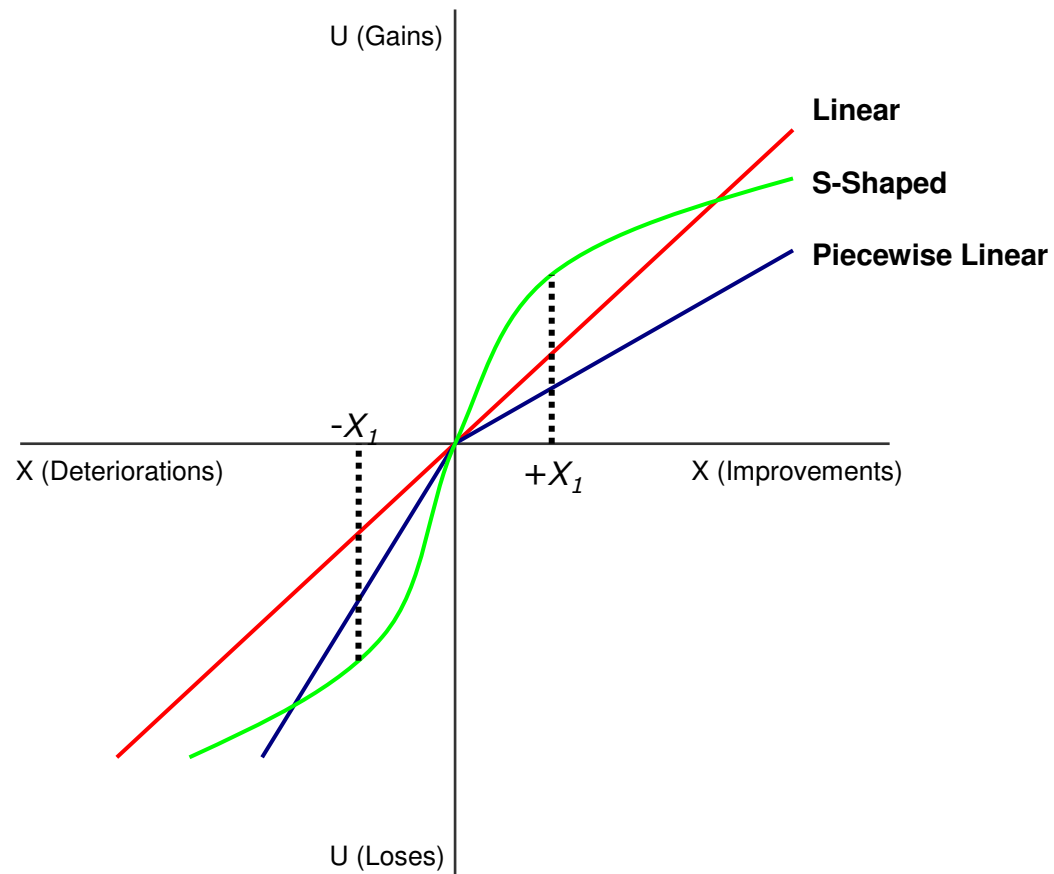
Implications of specifications



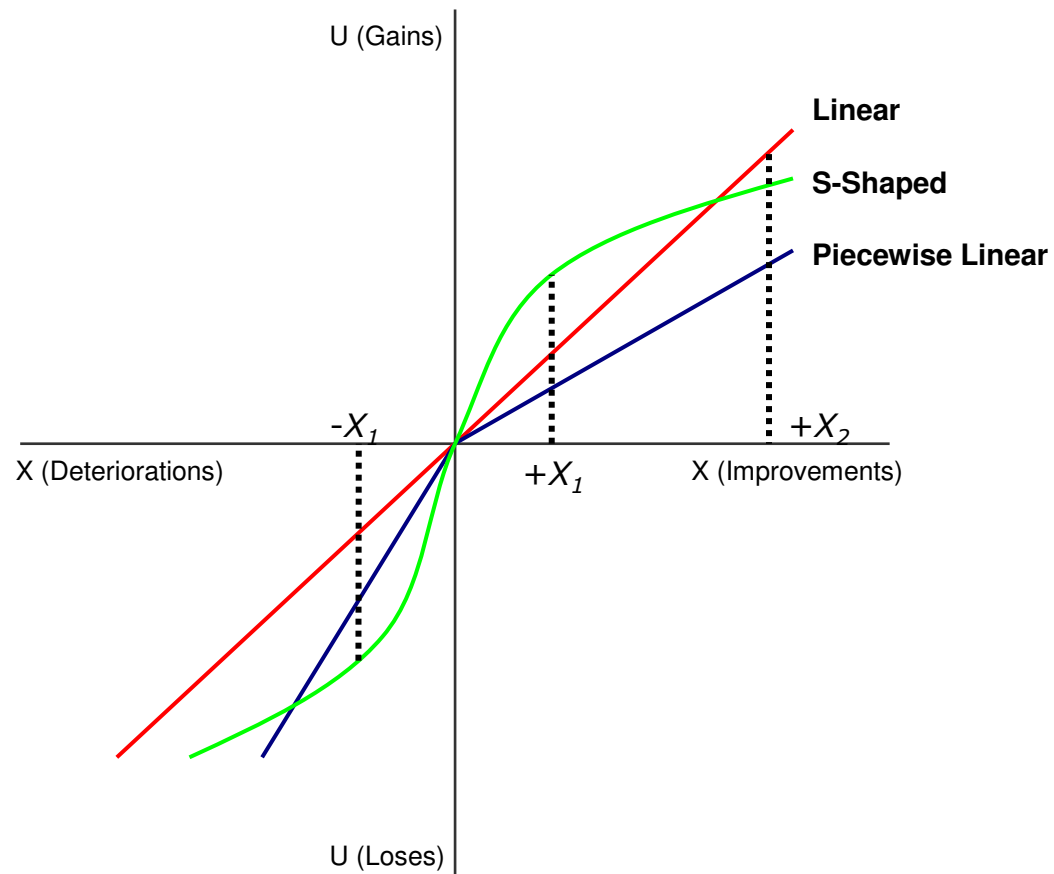
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Study details

- Policy context
 - Investment planning in water industry - 2009 Price Review
 - Customer preferences for changes in water, wastewater & environmental services
 - Application of cost-benefit analysis (CBA)
- CE for United Utilities Water
 - 14 service attributes; split into 4 'blocks'
 - Improvements & deteriorations in service
 - Sample >2,000 households; ~1,000 observations/block; ~8,000 choices/block
 - D-efficient experimental design

⇒ *Analysis: location and severity of sewer flooding*

Attributes & levels

<i>Sewer flooding attribute</i>		<i>Level</i>						
		L-2	L-1	SQ	L1	L2	L3	L4
External – remote [EX1]	No. incidents	-	1,875	1,500	750	375	-	-
External – adjacent [EX2]	No. incidents	-	2,500	2,000	1,000	500	-	-
Internal - below ground [IN1]	No. properties	-	800	400	200	100	-	-
Internal - ground [IN2]	No. properties	-	875	700	350	175	-	-
Water bill [BIL]	Change in bill	-£15	-£5	£0	+£5	+£10	+£15	+£25



Estimation

- Compare linear model: $v(\cdot) = \beta_k X_k$ to non-linear specifications (piecewise linear, power and exponential models).
- Observe 4 points on utility function for service attributes (Level -1 to Level +2); 7 points for the price attribute:
 - ⇒ Estimate β 's for gains and losses
 - ⇒ Estimate γ 's for power and exponent functions for gains only
- Estimate a non-parametric utility function using a multinomial logit model (MNL); each attribute level entered as a dummy variable
 - ⇒ Compute approximation of curvature coefficient (the γ 's)
- Fit non-linear specifications with a mixed logit model (MXL) via simulated maximum likelihood

MXL Linear & Non-linear models

		Linear function	Piecewise linear function		Power function		Exponential function	
No. observations		8328	8328		8328		8328	
No. respondents		1041	1041		1041		1041	
Log-likelihood		-7101.23	-7025.93		-7013.84		-7010.95	
AIC		14226.47	14095.86		14071.67		14065.90	
Adj. pseudo R ²		0.223	0.230		0.231		0.231	
Attribute		Coef.	Loss	Gain	Loss	Gain	Loss	Gain
EX1	Mean	0.00046*** (0.00006)	0.00159*** (0.00028)	0.00020*** (0.00008)	0.03987*** (0.00742)	0.00947** (0.00371)	0.21252*** (0.03785)	0.04056** (0.01646)
	S-D	0.00034** (0.00017)	0.00196*** (0.00057)	0.00029 (0.00018)	0.04502** (0.02213)	0.00470 (0.01787)	0.24013** (0.10605)	0.05410 (0.05209)
EX2	Mean	0.00045*** (0.000049)	0.00162*** (0.00022)	0.00031*** (0.00006)	0.42801*** (0.05897)	0.22210*** (0.04006)	0.28996*** (0.03941)	0.11998*** (0.02187)
	S-D	0.00053*** (0.00008)	0.00177*** (0.00037)	0.00034** (0.00016)	0.52334*** (0.11043)	0.26451** (0.12946)	0.35697*** (0.06140)	0.16896*** (0.04946)
IN1	Mean	0.00156*** (0.00010)	0.00174*** (0.00028)	0.00160*** (0.00028)	0.03817*** (0.00726)	0.03891*** (0.00589)	0.03607*** (0.00649)	0.03438*** (0.00506)
	S-D	0.00138*** (0.00015)	0.00222*** (0.00036)	0.00177*** (0.00050)	0.04544*** (0.01142)	0.04856*** (0.00824)	0.04982*** (0.00936)	0.03286*** (0.00994)
IN2	Mean	0.00121*** (0.00008)	0.00385*** (0.00060)	0.00074*** (0.00015)	0.39464*** (0.06068)	0.19471*** (0.03487)	0.05851*** (0.00900)	0.01977*** (0.00365)
	S-D	0.00119*** (0.00013)	0.00402*** (0.00073)	0.00143*** (0.00017)	0.42961*** (0.08865)	0.30984*** (0.05062)	0.06354*** (0.01413)	0.03419*** (0.00448)
Bill	Mean	-0.04753*** (0.00327)	-0.00739 (0.00684)	-0.09341*** (0.00740)	-0.00133 (0.03869)	-0.23230*** (0.01737)	-0.00084 (0.02141)	-0.16582*** (0.01201)
	S-D	0.06053*** (0.00394)	0.08415*** (0.01354)	0.09019*** (0.00686)	0.41223*** (0.07739)	0.22273*** (0.01774)	0.24852*** (0.03654)	0.15845*** (0.01141)
SQ	Mean	1.62298*** (0.07299)	0.61753*** (0.11992)		0.60512*** (0.13042)		0.58207*** (0.13093)	
	S-D	1.64420*** (0.06629)	1.50382*** (0.07447)		1.44890*** (0.08923)		1.47929*** (0.08400)	

Notes: Standard-errors in parenthesis; Stat. significance: *p<0.1; **p<0.05; ***p<0.01.

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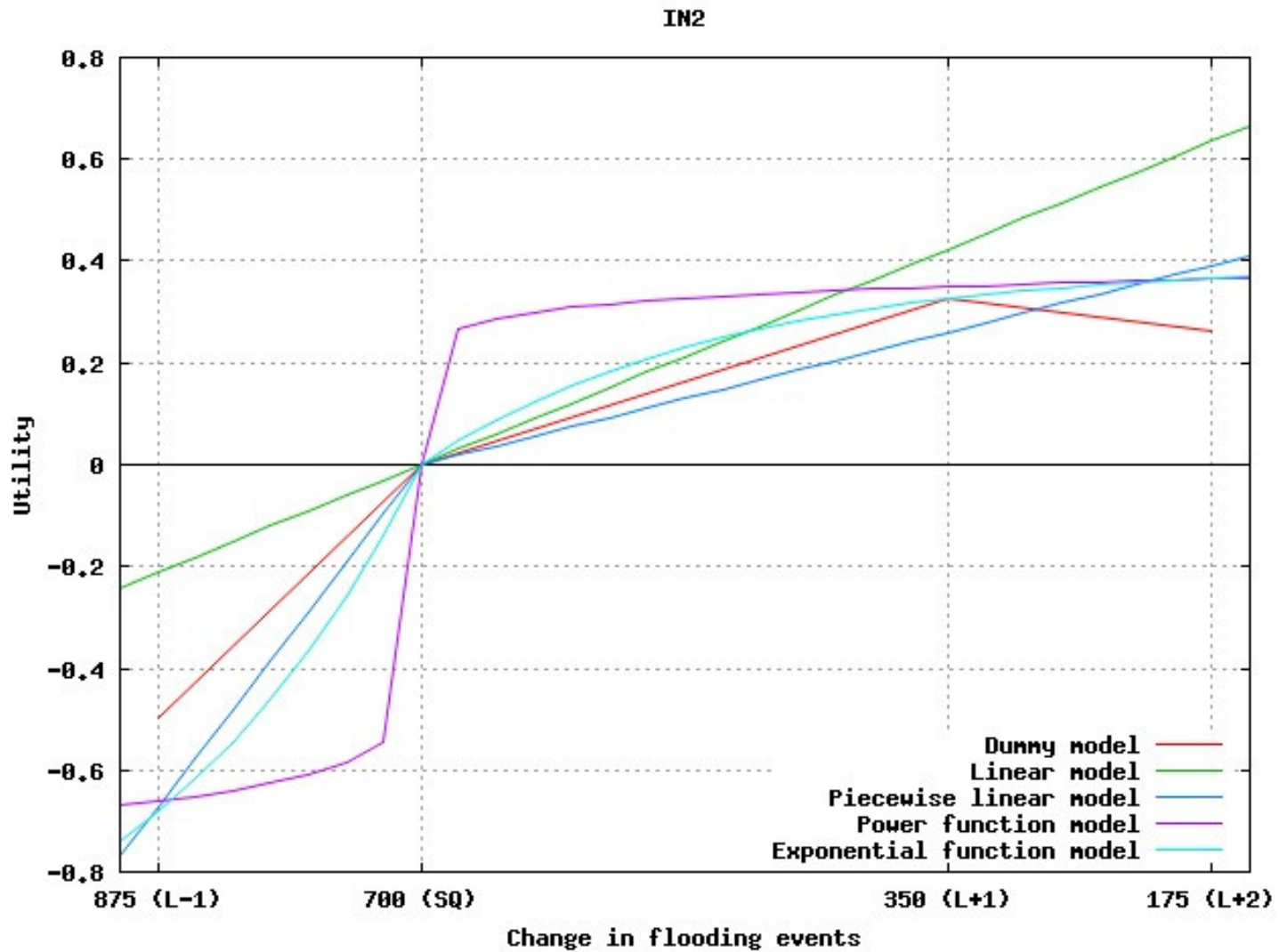
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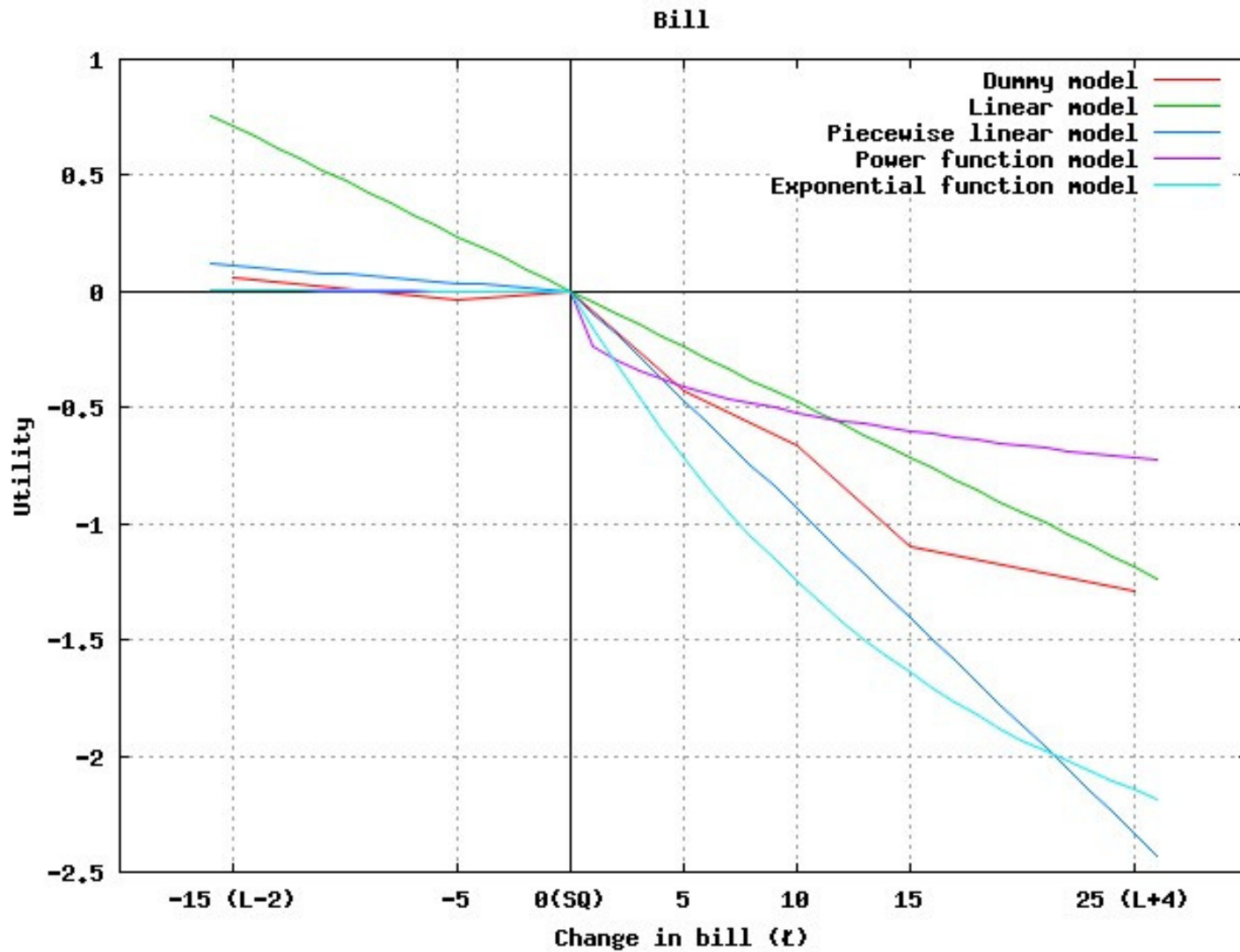
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EX1	Mean	0.00046*** (0.00006)	0.00159*** (0.00028)	0.00020*** (0.00008)	0.03987*** (0.00742)	0.00947** (0.00371)	0.21252*** (0.03785)	0.04056** (0.01646)
	S-D	0.00034** (0.00017)	0.00196*** (0.00057)	0.00029 (0.00018)	0.04502** (0.02213)	0.00470 (0.01787)	0.24013** (0.10605)	0.05410 (0.05209)
Bill	Mean	-0.04753*** (0.00327)	-0.00739 (0.00684)	-0.09341*** (0.00740)	-0.00133 (0.03869)	-0.23230*** (0.01737)	-0.00084 (0.02141)	-0.16582*** (0.01201)
	S-D	0.06053*** (0.00394)	0.08415*** (0.01354)	0.09019*** (0.00686)	0.41223*** (0.07739)	0.22273*** (0.01774)	0.24852*** (0.03654)	0.15845*** (0.01141)
SQ	Mean	1.62298*** (0.07299)	0.61753*** (0.11992)		0.60512*** (0.13042)		0.58207*** (0.13093)	
	S-D	1.64420*** (0.06629)	1.50382*** (0.07447)		1.44890*** (0.08923)		1.47929*** (0.08400)	

Notes: Standard-errors in parenthesis; Stat. significance: *p<0.1; **p<0.05; ***p<0.01.

MXL Linear & Non-linear models



MXL Linear & Non-linear models



WTP & WTA estimates

Comparison of WTP to WTA for internal sewer flooding (IN2)¹

Change from SQ ^{2,3}	Linear function	Piecewise linear function	Power function	Exponential function
175 fewer (WTP)	4.46	1.40	1.63	1.34
175 more (WTA)	-4.46	-91.18	-1293.17	-25.49
Ratio (WTA: WTP)	1.00	65.36	795.67	19.09
350 fewer (WTP)	8.91	2.79	1.79	1.86
350 more (WTA)	-8.91	-182.35	-1576.39	-27.22
Ratio (WTA: WTP)	1.00	65.36	878.49	14.62
525 fewer (WTP)	13.37	4.19	1.90	2.08
525 more (WTA)	-13.37	-273.53	-1770.01	-27.80
Ratio (WTA: WTP)	1.00	65.36	930.88	13.39

Notes: ¹ £ per household per year; ² Units = expected number of properties flooded per year; ³ Change from status quo and corresponding attribute levels from Table 1: SQ to L-1 = +175; SQ to L1 = -350; and SQ to L2 = -525.

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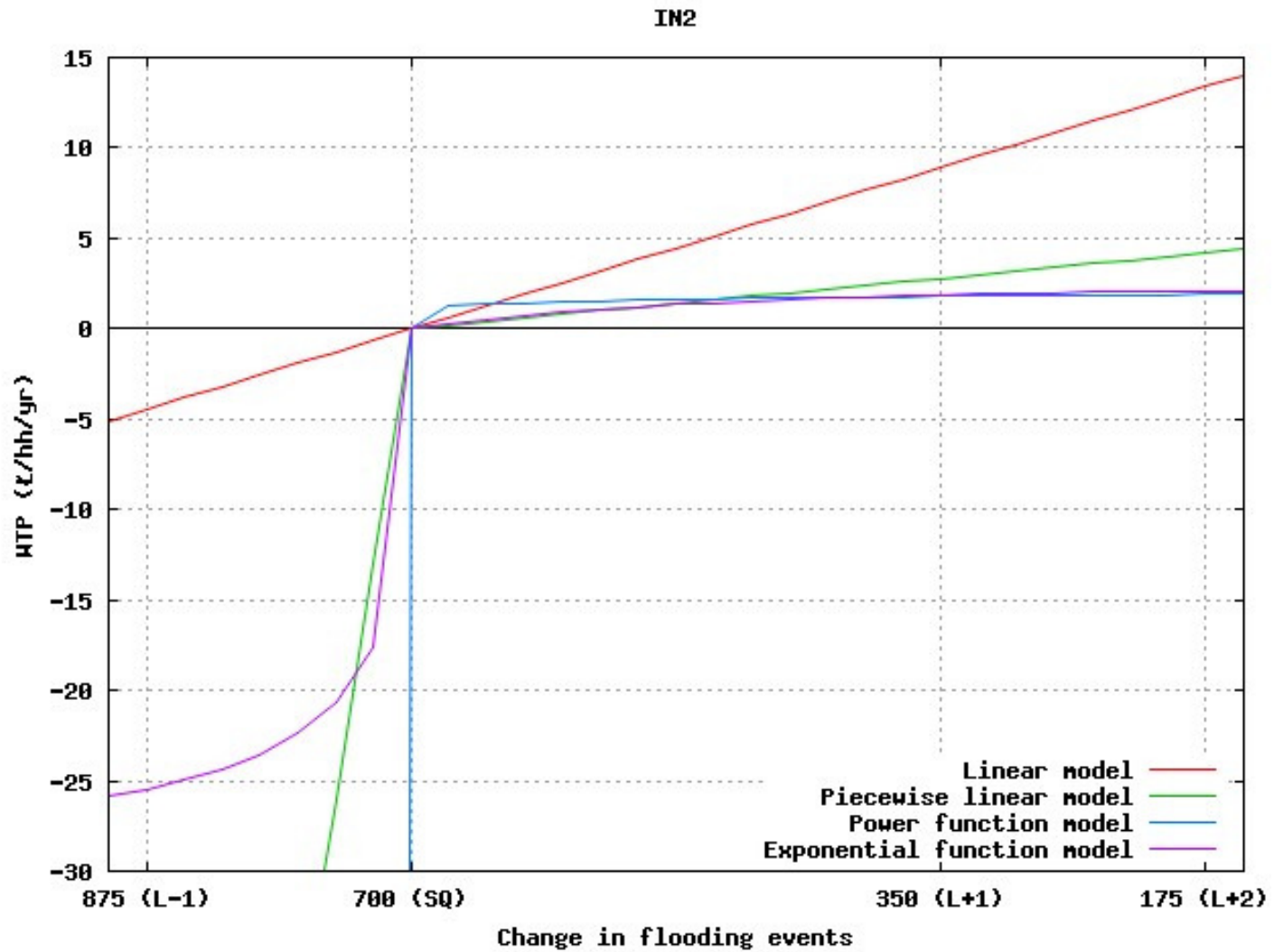
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WTP & WTA estimates





Conclusions

- Preferences for changes in provision are subject to both diminishing marginal utility and loss aversion
 - ⇒ Models that accommodate non-linearity have higher explanatory power
- Evidence of non-linearity in price attribute, both in terms of loss aversion and declining sensitivity
 - ⇒ Monetary outlays are perceived as losses rather than foregone gains
- Establish that WTP-WTA ratio varies according to the provision change under consideration
 - ⇒ Appealing property of choice experiment approach
- Use of WTP/WTA estimates in CBA should account for non-linearity
 - ⇒ Linear model 'averages' signals for gains and losses, implying over-estimate of WTP for gains & under-estimate of WTA for losses



Thank-you

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