

Assessing non-market values for keeping unallocated water flows in reserve

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The case study area

- Fitzroy Basin in central Queensland
- 2nd largest river system in Australia after the Murray Darling
- Largest draining into the Great Barrier Reef lagoon
- Approx area: 143 sq kms
- Water used for irrigation (74%), industry, urban



The case study problem

- Currently 50% of flows allocated to the environment
- 35% already allocated to current users
- 15% remains unallocated
- What are the options for the unallocated
- Can be used now – irrigation development
- Can be kept in reserve for the future – keeping option open as it can still be used in the future – option value

Water resource development

Economic considerations:

- Little water available in cotton growing areas – still substantial surplus in the lower Fitzroy
- Further development provides economic benefits







Environmental considerations:

- Some scientific uncertainty about the level set for environmental flows
- Allocating more water to irrigation development has potential environmental impacts
- Should more water be kept in reserve as insurance?

The aims and methodology

- Purpose was to assess the tradeoffs between economic development and environmental protection
- Choice Modelling an economic valuation technique used to assess community values (non-market /non use)
- Elicited values for social and environmental impacts of further water development
- In particular, values for the unallocated water reserve
- 3 main groups of surveys run in 2000, 2001 and 2002 – included Brisbane (capital city - non-use) and Rockhampton households (regional centre)

Choice Modelling – example choice set

<div style="font-size: 48px; text-align: center;">X</div>	Question X: Options A, B and C.					
	Please choose the option you prefer most by ticking ONE box.					
	<div style="border: 1px solid red; border-radius: 50%; padding: 5px; display: inline-block;"> Fifteen-year effects </div>					
How much I pay each year	Healthy vegetation left in floodplains	Kilometres of waterways in good health	Protection of Aboriginal Cultural sites	Unallocated water	I would choose	
						
Option A						
\$0	20%	1500	25%	<div style="border: 1px solid red; border-radius: 50%; padding: 5px; display: inline-block;"> 0% </div>	<input type="checkbox"/>	
Option B						
\$20	30%	1800	35%	5%	<input type="checkbox"/>	
Option C						
\$50	40%	2100	45%	10%	<input type="checkbox"/>	

Multinomial logit model – Brisbane 2002

	Coefficient	Standard.Error
Cost	-0.016***	0.002
Vegetation	0.054***	0.015
Waterways	0.001**	0.000
People leaving	-0.013*	0.007
Reserve	0.101***	0.019
Constant	-3.330***	0.548
Age	0.011*	0.006
Education	0.218***	0.071
Income	0.000***	0.000

Model Statistics

N (Choice Sets)	864
Log L	-813.12
Adj. rho-square	0.26314
Chi-square (DoF=23)	469.42

**Value for a one unit (1%) change
in water reserve = $0.101/0.016$
= \$6.33**

*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

part-worth values (\$) for water reserve

	Population	Fitzroy	CNM	Dawson
Survey 1 2000	Brisbane	\$1.52 (0.22–2.81)	\$ 9.36 (5.15–15.65)	\$ 2.24 (1.49–3.17)
	Rockhampton	\$ 1.43 (not significant)	<ul style="list-style-type: none"> • Values significant in 8 out of 9 split-samples • uniform across most populations and sites (confidence intervals (in parenthesis) overlap) 	
	Emerald	\$ 2.20 (0.71–3.71)		
Survey 2 2001	Brisbane	\$ 3.19 (1.79–5.32)		
	Rockhampton	\$ 2.95 (1.93–4.35)		
	Rockhampton Aboriginal	\$ 3.86 (2.02–6.73)		
Survey 3 2002	Brisbane	\$5.77 (3.20–8.85)		

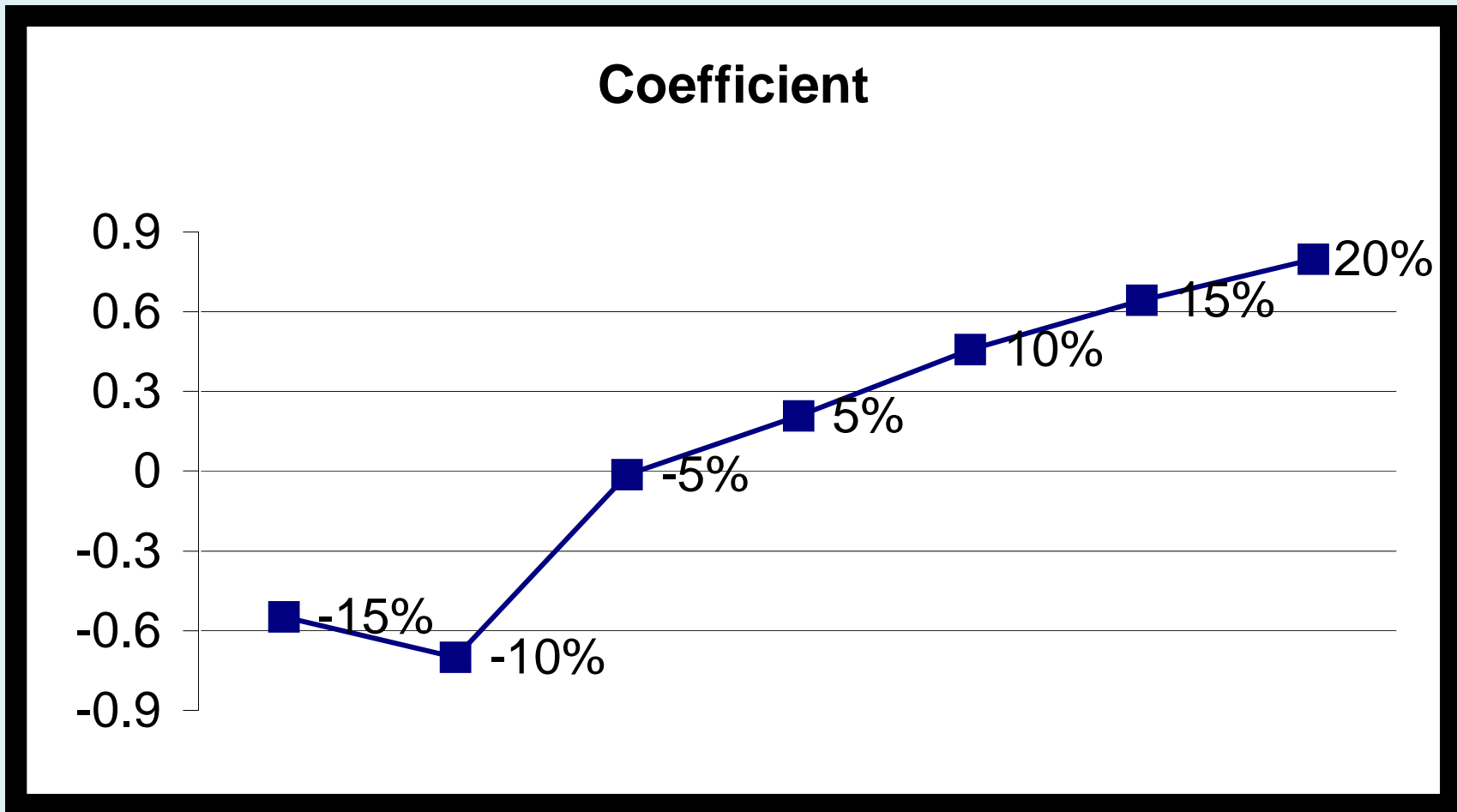
Are values sensitive to the levels used?

- This issue was tested in the 2nd survey - 2001
- Eight levels were used for the Reserve attribute (-15, -10, -5, 0, 5, 10, 15, 20)
- Negative values could occur if some water for the environment was allocated for use
- Could test if significant difference between +ve and -ve

Values for difference reserve levels

Variable	Model with +ve and -ve <i>Water Reserve</i> levels		Model with separated <i>Water Reserve</i> levels	
	Coefficient	Std. Error	Coefficient	Std. Error
Cost	-0.0115***	0.0013	-0.0110***	0.0013
Vegetation	0.0255***	0.0039	0.0248***	0.0039
Waterways	0.0005***	0.0002	0.0005***	0.0002
Cultural Heritage	-0.0191***	0.0041	-0.0186***	0.0042
Water Reserve - positive	0.0414***	0.0091		
Water Reserve - negative	0.0459***	0.0140		
W Reserve negative 15%			-0.5469**	0.2394
W Reserve negative 10%			-0.6994***	0.2359
W Reserve negative 5%			-0.0142	0.2093
W Reserve positive 5%			0.2084	0.2199
W Reserve positive 10%			0.4569**	0.1970
W Reserve positive 15%			0.6437***	0.2051
W Reserve positive 20%			0.7975***	0.2056
ASC	0.2090	0.1479	-0.0286	0.1239
Misunderstood Income	0.4067*	0.2244		
	-0.68 E-05***			
Model statistics				
No of Choice Sets	1232		1232	
Log Likelihood	-1213.16		-1237.77	
Adjusted R squared	0.0885		0.081	

Coefficient values for separate Reserve levels



Extrapolating the results

- No statistical difference between Brisbane and Rockhampton household values
- 50% survey response rate
- Assume 30% of non responses hold the same values
- Total = 255,450 households

Applying the results in the Fitzroy

- 2000- Brisbane households would pay \$1.52/year to reserve each 1% of water in the Fitzroy system
- The Fitzroy Water Resources Plan identified 544,800 ML or 15% as unallocated
- Brisbane households would pay \$22.80/year
- Over 20 years and 255,450 households
- **Present value is \$66.80M (if $r = .06$) or \$57.18M (if $r = .08$)** to keep the water in reserve
- Production value of \$468/ML
- **Present value production = approx \$254M**
- **Opportunity for further development**

Applying the results in the Comet-Nogoa-Mackenzie sub catchment

- Brisbane households would pay \$9.36 annually to reserve each 1% of water in the CNM system
- There was 40,000 ML identified in the Fitzroy Water Resources Plan as unallocated = 4%
- Brisbane households would pay \$37.44 /year
- Over 20 years and 255,450 households
- **Present value is \$109.70M (if $r = .06$) or \$93.90M (if $r = .08$) to keep the water in reserve**
- Production value of \$623/ML
- **Total production present value = \$25M**
- **Environmental costs outweigh development benefits**

Caution – values maybe overestimated

- Water trading may make it easy to reallocate water to the environment in the future – allocations for development may not be irreversible
- Option values are probably for the environmental assets (not water reserve). If other measures to insure environmental protection can be found, then real values for reserve water may be lower

Conclusions

- Important to begin exploring values associated with uncertainty
- Results of choice experiments suggest non – use /option values can be estimated
- Values appeared stable across experiments
- Total values are lower than development returns in the whole Fitzroy system
- Total values high compared to development returns in the CNM sub catchment
- Reserve values may have been over-estimated for a number of reasons