Cost benefit analysis – some practical examples

John Rolfe

Central Queensland University

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Cost Benefit Analysis

- Cost-benefit analysis is one of the main ways that economists analyse major development proposals and environmental problems
- Similar to Net Present Value technique commonly applied in finance
- Works by identifying all the costs and benefits that would result from a particular resource use
- These include non-money costs and benefits

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Applying Cost Benefit Analysis to NRM Investment Decisions

- Potential but often difficult to do very well
- A lot of the benefits are very difficult to quantify
- A lot of the costs are difficult to quantify
  - Particularly net production changes
- Not a lot of case studies to follow

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Stages in the application process

- Identify all costs and benefits
- Measure them
- Discount them back to common time period
- Assess whether benefits>costs
- Assess who bears the benefits and costs
- Perform sensitivity analysis
- Assess whether proposal is worth it

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CBA of tree clearing

Impacts	**Benefits**	**Costs**
Property level		
- direct, medium term	Income from improved pasture production	Cost of clearing trees, improving pasture, controlling regrowth
- indirect, longer term	Possible reduction in grazing pressure on rest of property	Reduced benefit of tree cover (eg shade, shelter, nutrient recycling)
	Improved access for mustering	Pastoralists own value for risk of salinity, erosion
		Pastoralists own value for biodiversity loss
External impacts		
- Social value of land quality	Possible reduction in land degradation on some properties	Possible increased risk of salinity/erosion above landholder expectations and on other properties
- Cost of greenhouse gases		Impact of land clearing on greenhouse gas emissions
- Social value of biodiversity		Effect of tree clearing on biodiversity
- Indirect effects of production	Social value of positive effects on rural communities	

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Identification of impacts

- Major problem in the past is that only financial costs and benefits were identified - many environmental and social ones ignored
- Not always easy to be sure what the outcomes will be of a project
- Not always agreement about what are important social and environmental impacts to include

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Valuing Costs and Benefits

- One of the key stages in Cost-Benefit Analysis was to measure all the costs and benefits
- Normally do this in terms of dollar values
- Not always easy, because some items (eg biodiversity protection) are not traded in markets
- Need special non-market valuation techniques to handle these cases

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Non-market valuation techniques

- Revealed preference techniques
  - Travel cost method
    - used for recreation impacts
  - Hedonic pricing
    - used for housing/lifestyle impacts
- Averted expenditure techniques
  - Often used to estimate the value of indirect use benefits
    - Storm protection benefits of mangroves

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Non-market valuation techniques 2

- Stated preference techniques
  - Contingent valuation
  - Choice modelling
- These are capable of estimating non-use values
- Key techniques to use in relation to values for biodiversity
- But often complex, expensive and time consuming to apply

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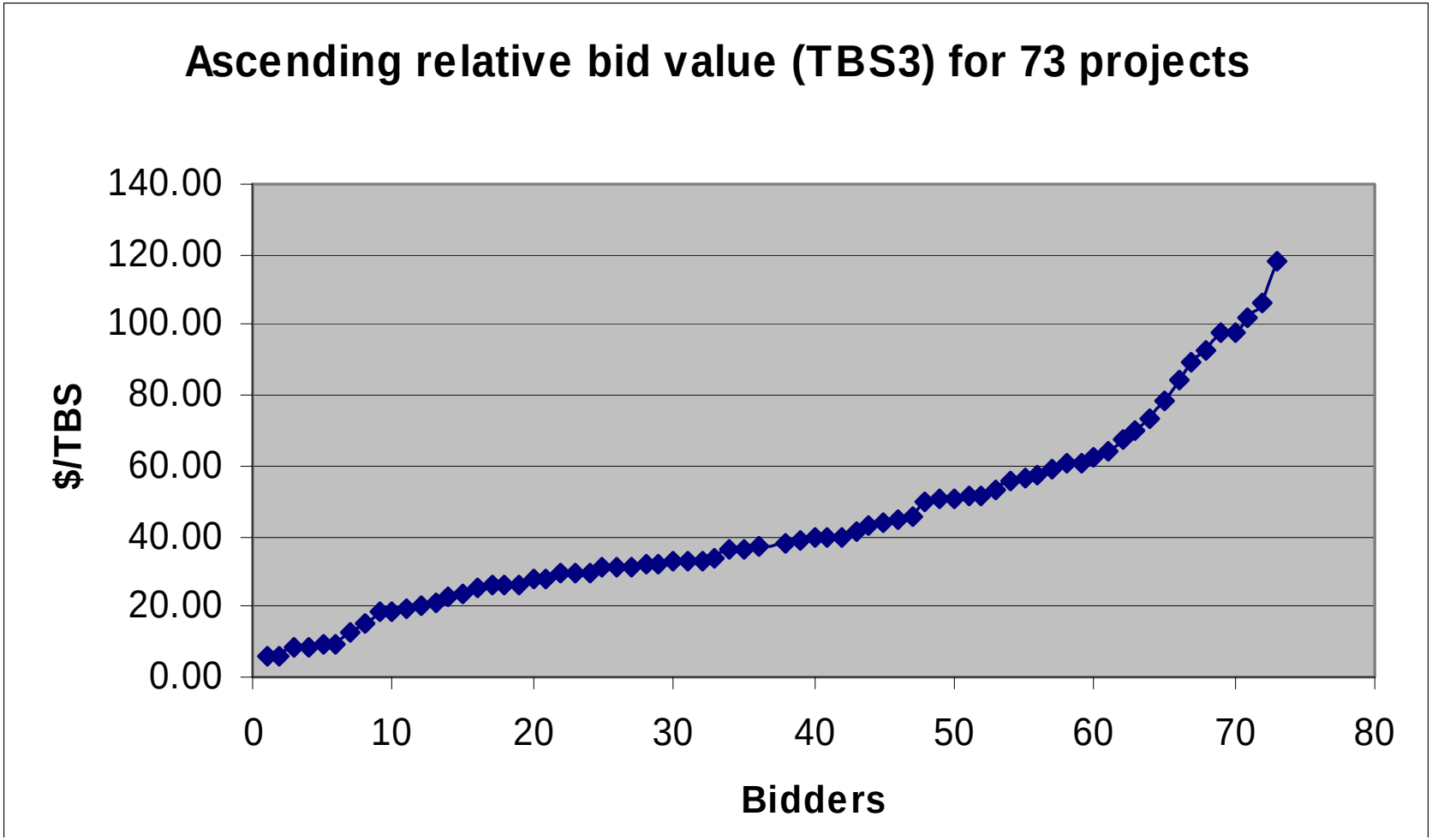
Estimating costs

- One of the benefits of using competitive tenders is that they provide some estimates of landholder costs
- Landholders identify the level of incentive required for them to change management

Landholder costs to improve water quality in Mackay



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Benefit transfer

- Instead of doing a separate valuation study each time, possible to ‘borrow’ values from other, previous studies
- Most studies focused on particular issues, and are not designed to transfer to other situations
- Values may be sensitive to characteristics
  - Populations involved
  - The way the tradeoffs are framed
  - The scope at which the issue is pitched
  - The scale of the tradeoffs

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Three main approaches to Benefit Transfer

- ‘The Prospector’ – searches for suitable previous studies and transfers results across
- ‘The Systematic’ – designs a database of values suitable for benefit transfer
- ‘The Bayesian’ – combines both a review of previous studies with potential data gathering

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Multi-criteria analysis

- A bit similar in performance to CBA
- Impacts are identified, and then rated by a group of stakeholders and experts
- Weightings are ‘summed’ to give answer
- Commonly used in the political process because it is
  - Relatively quick and easy
  - Engages stakeholders and experts

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Some issues with MCA

- There are several key issues to consider
  - There is no definitive basis for setting the weightings
    - Some potential to be arbitrary
  - Process open to influence by different stakeholders and interest groups
  - Does not allow effective comparison between projects
  - May be difficult to validate after the event (in comparison to CBA)

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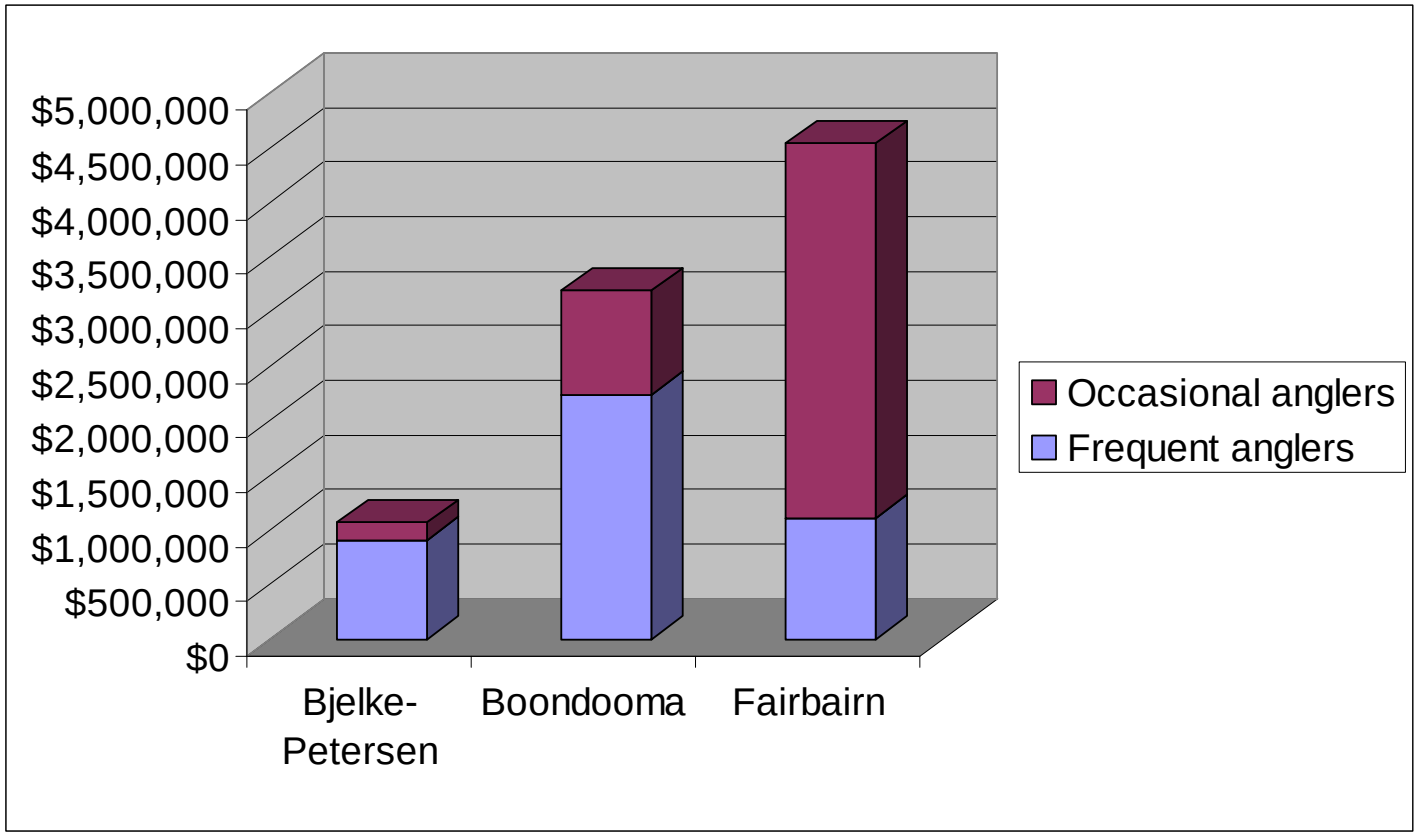
Valuing recreation benefits of freshwater dams

- Recreational benefits of dams often unknown – not priced in markets
- Sometimes tradeoffs between use of water for irrigation and reserving it for recreation
- Assessed value of recreation for 3 dams
- Surveyed visitors and identified value of their travel time and travel costs to access the dams

Recreational fishing values



Valuing tradeoffs with water reserves

- Used choice modelling studies to identify values community had for being cautious with water allocations
- Surveys conducted in Brisbane and Rockhampton in 2000 - 2002

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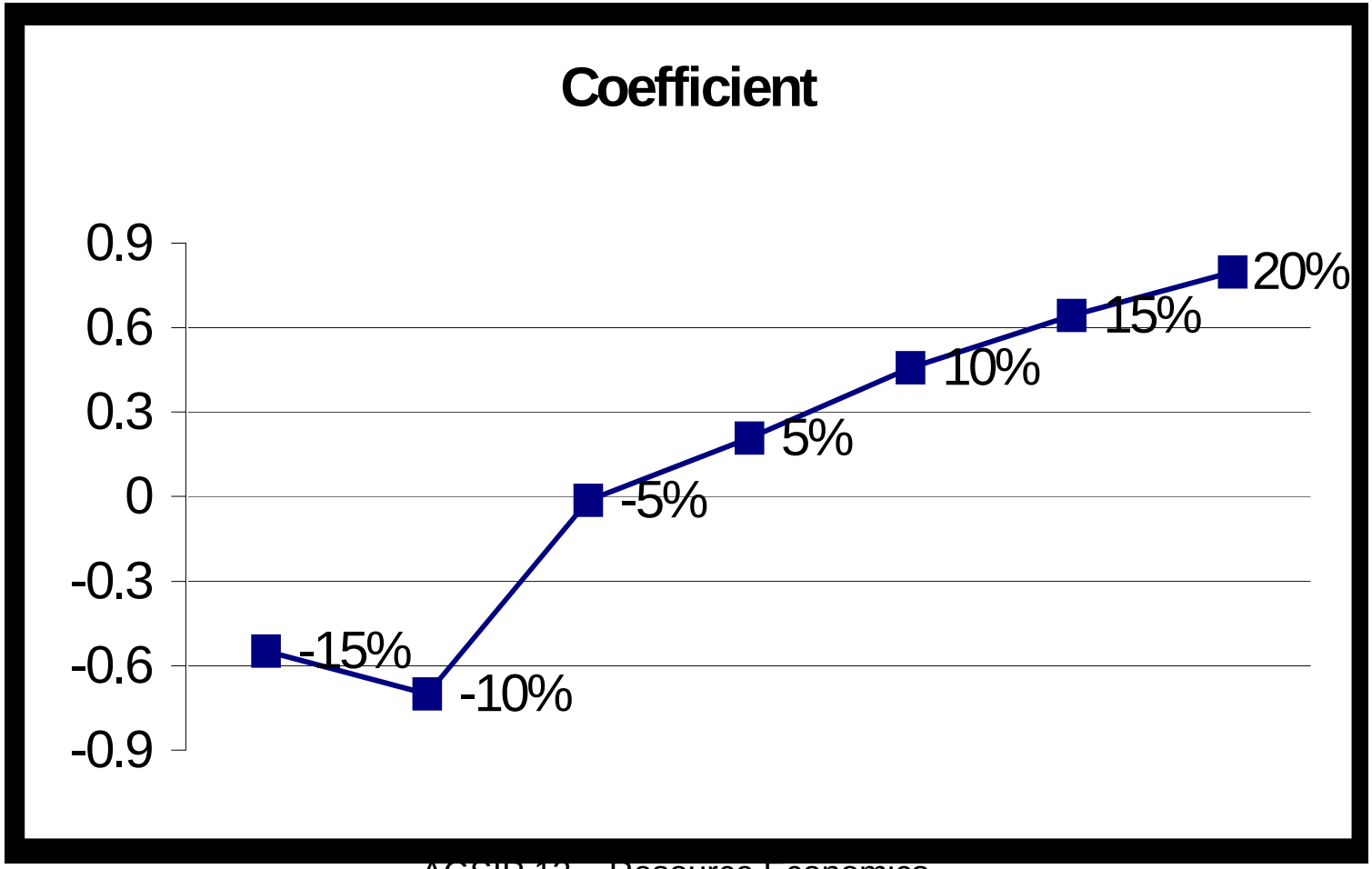
Choice Modelling Valuation Technique – example choice set

X	**Question X: Options A, B and C.** Please choose the option you prefer most by ticking ONE box.				
	Fifteen-year effects				
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%**	**0%**	☐
Option B					
$20	**30%**	**1800**	**35%**	**5%**	☐
Option C					
$50	**40%**	**2100**	**45%**	**10%**	☐

Coefficient Values for separate reserve levels



Applying the results in the Comet-Nogoa-Mackenzie (CNM) system

- Brisbane households would pay $6.59 annually to reserve each 1% of water in the CNM system
- There was 4% currently unallocated
- Over 20 years and 300,000 households, present value is **$78M** with discount rate of 8% or **$59M** with 12% discount rate
- Approximately double if count rest of Qld
- If 4% were to be allocated = 40,000 ML
- At value of $300/ML, total value = **$12M**

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Applying the results in the Dawson system

- Brisbane households would pay $2.53 annually to reserve each 1% of water in the Dawson system
- There was 10% currently unallocated
- Over 20 years and 300,000 households, present value is **$75M** if 8% discount rate
  or **$57M** if 12% discount rate
- Approximately double if count rest of Qld
- If 10% were to be allocated = 201,000 ML
- At value of $300/ML, total value = **$60M**

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Applying the results in the whole Fitzroy system

- Brisbane households would pay $5.31 annually to reserve each 1% of water in the Fitzroy system
- There was 15% currently unallocated
- Over 20 years and 300,000 households, present value is **$235M** if 8% discount rate
  or **$178M** if 12% discount rate
- Approximately double if count rest of Qld
- If 15% were to be allocated = 544,800 ML
- At value of $300/ML, total value = **$163M**

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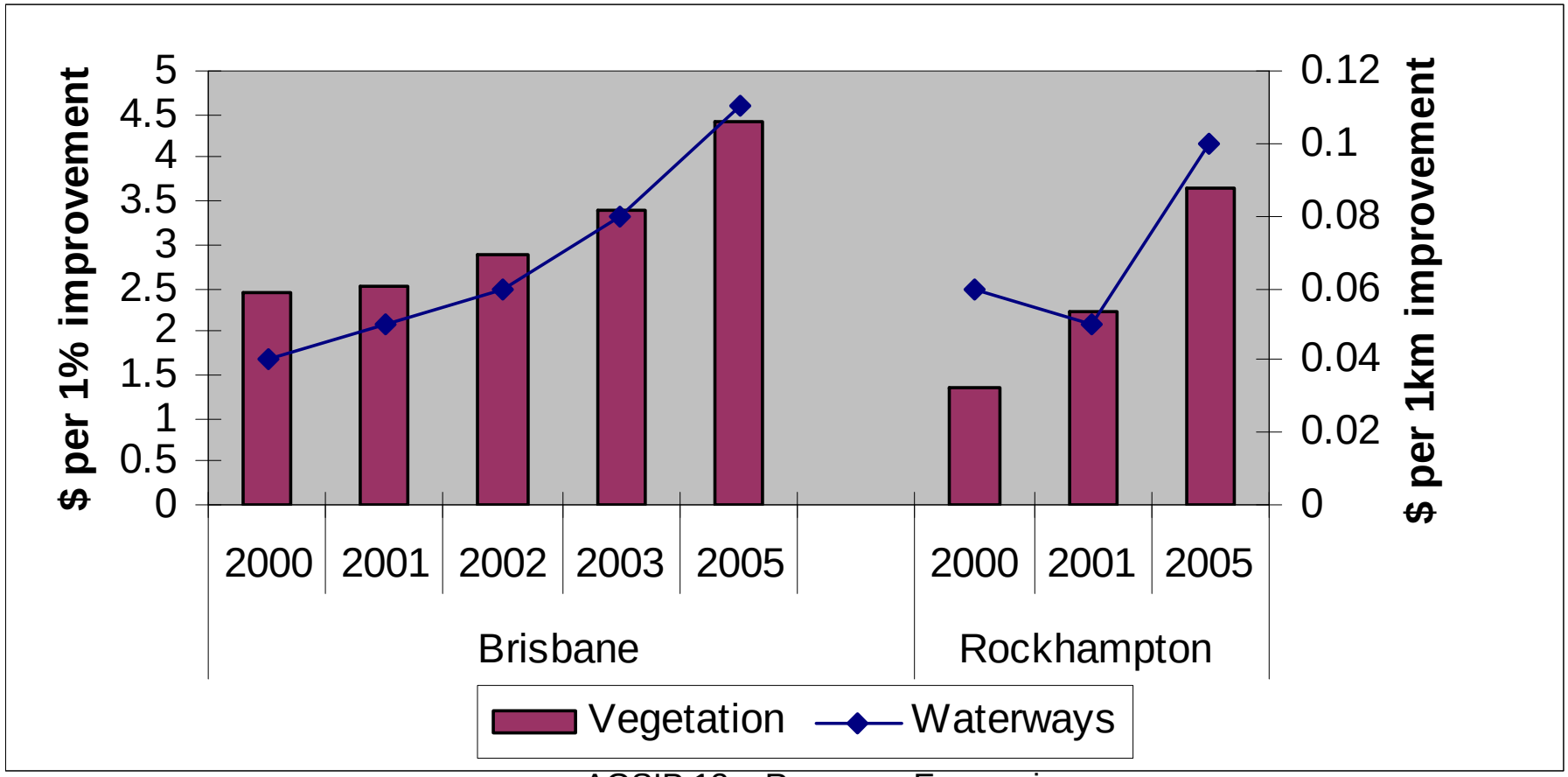
Values for vegetation and waterways over time



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Dealing with the risk and uncertainty issues

- Issues of risk and uncertainty often ignored in stated preference studies
  - Very difficult to communicate these alongside information about attributes and alternatives in choice sets
- But two key non-use values are related to these issues
  - Option Value
  - Quasi-option value

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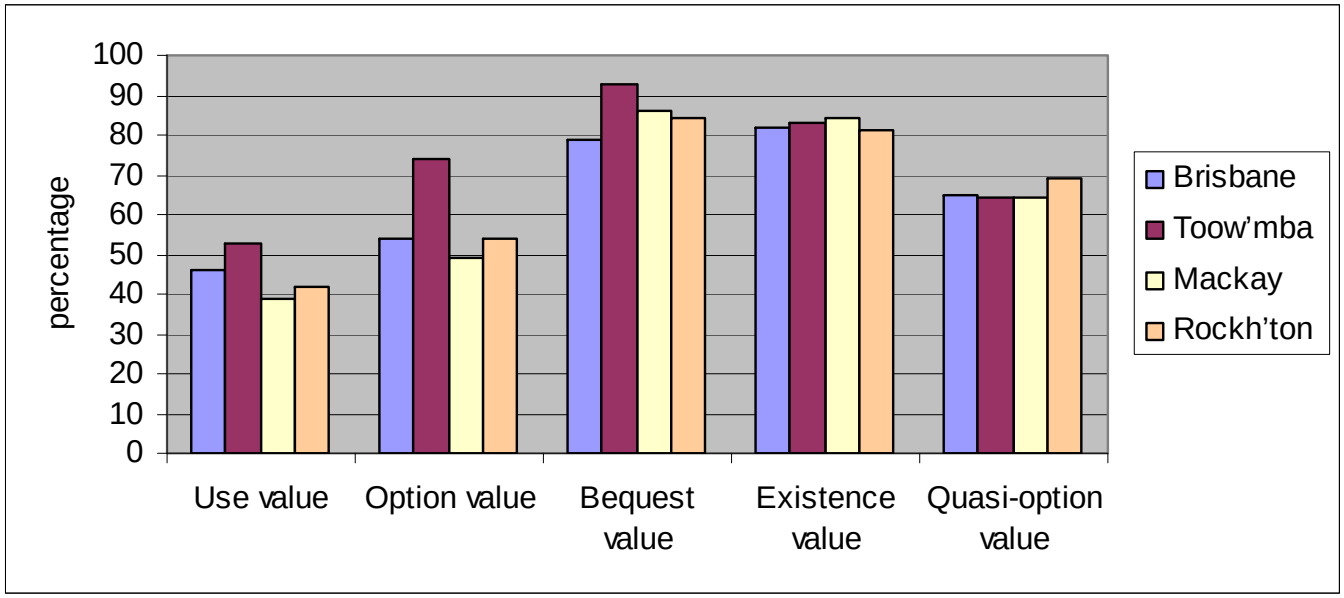
Some evidence of larger option values



- Qld surveys for BT database on soils, waterways, veg.
  - Asked to rated a series of questions representing use and non-use values - From 1 most to 5 (least important)
  - Percentage of respondents scoring values with a “1” or”2”

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Evidence for quasi-option values

- Donaghy et al (2004) asked households about WTP for a 5 year moratorium on release of GMOs
- Significant values estimated
  - Median and mean WTP estimates of $220 and $386 per household
  - Respondents did value opportunity to delay introduction of GMO's
  - Positive and significant income variable suggests that as income increases so does quasi-option values
- Confirms that community has values for being cautious with GMO's

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Some policy implications

- Important to assess non-use values for biodiversity impacts in same context as agricultural ones
  - Stated preference techniques can be used for this
  - Benefit transfer provides a way of getting rough estimates
- These tools make it more feasible to do cost-benefit analysis
- Allows priority setting and investment evaluation to be more rigorous.