

Risk Belief, Producer Demand, and Valuation of Improved Irrigations: Results from Field Experiments in Mt. Kilimanjaro

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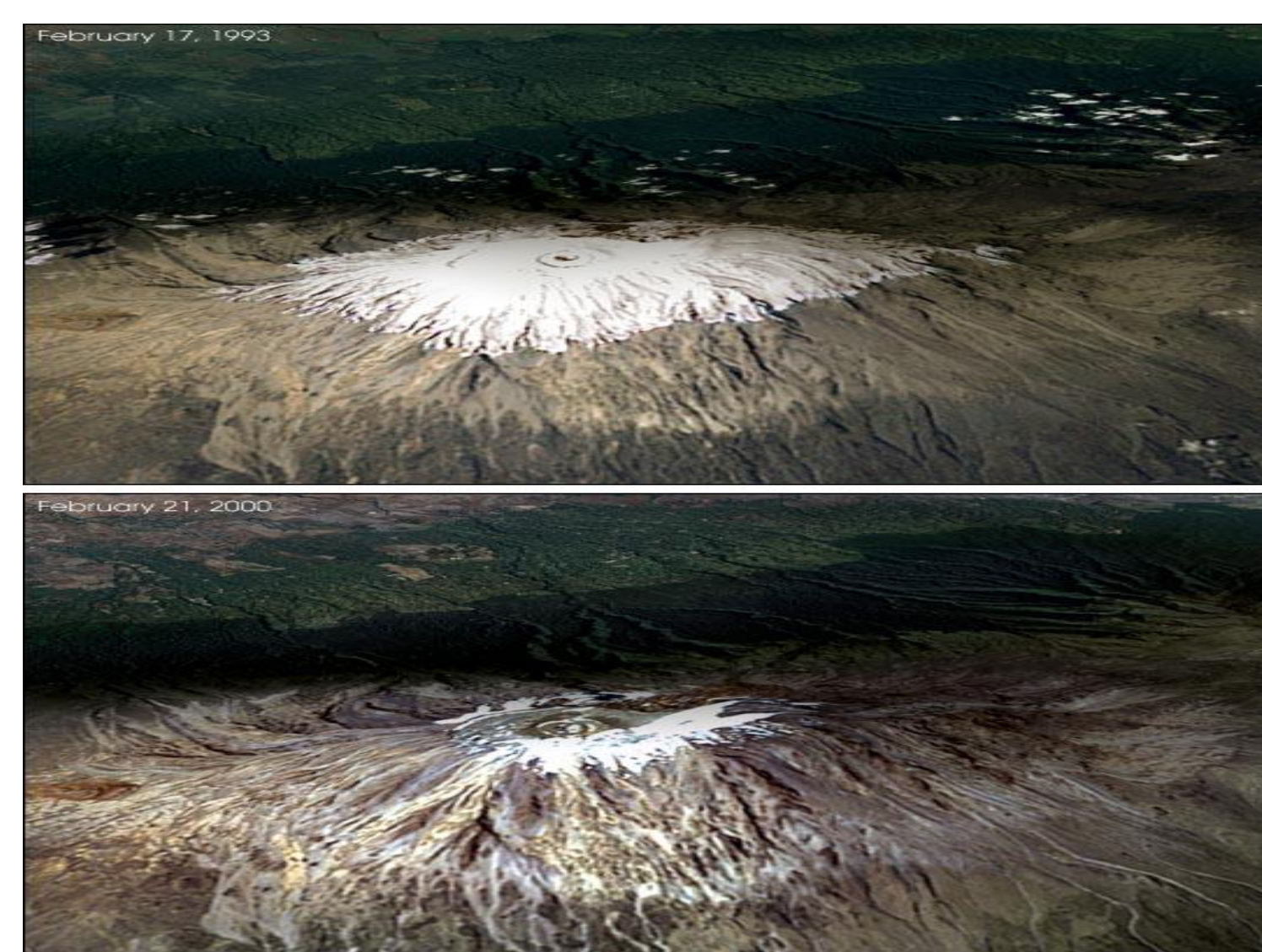
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Abstract

This paper systematically estimates the potential benefit of introducing improved irrigation schemes in Mt. Kilimanjaro to help rain dependent farmers cope with the risks of climate change. The study uses Contingent Valuation Method (CVM) to elicit farmers' Willingness to Pay (WTP) for eliminating the risks of crop loss by accessing improved irrigation schemes. Data for the analysis were gathered using a double bounded survey from over 200 randomly-sampled farmers in 15 villages. The study makes a contribution to the applied welfare literature and should also be useful for policymakers in Africa. The policy contribution consists of valuation of improved irrigation in the presence of climate change risks. The applied welfare contribution consists of empirical evidence about the impact of farmer's risk aversion on welfare valuation. The results show that farmers with lower expectations about future rainfall are willing to pay more for accessing the improved irrigation scheme. In addition, Mt. Kilimanjaro farmers are willing to pay up to 10% of their income to have access to improved irrigation canals.

Background

Over the past 90 years, the glaciers of Mt. Kilimanjaro have shrunk by 82% (Thompson et al, 2002). These melting glaciers are accompanied with delayed rainfall onset, which in turn extends the dry season and creates agricultural yield uncertainties and food insecurity in the region (Aggrawala et al., 2003).



To help local farmers cope with the risks of Climate Change, policy makers have become interested in introducing improved irrigation scheme. The present study uses Contingent Valuation Method (CVM) to elicit Mt. Kilimanjaro farmers' Willingness to Pay (WTP) for improved irrigation schemes while accounting for the effects of farmer's prior risk aversion.

Conceptual Framework

Let \tilde{z}_i be risks that farmer i faces when no irrigation

$\tilde{z}_i \sim (\tilde{z}, \sigma^2)$ and $\theta \tilde{z}_i$ is the pdf of \tilde{z}_i .

Let w_i be farmer wealth level and $u(\cdot)$ be the utility s.t.

$u(\cdot)' > 0$ and $u(\cdot)'' < 0$.

$$Eu(w + \tilde{z}_i) = u(w - \varphi_i(w, \theta \tilde{z}_i))$$

$$Eu(w + \tilde{z}_i) = E\{u(w) + u(w)' \tilde{z}_i + \frac{1}{2} u(w)'' \tilde{z}_i^2 + \dots\} \approx u(w) + \frac{1}{2} u(w)'' \tilde{z}_i^2$$

$$u(w - \varphi_i(w, \theta \tilde{z}_i)) = u(w) - u(w)' \varphi_i(w, \theta \tilde{z}_i)$$

$$WTP = \varphi_i(w, \theta \tilde{z}_i) = \frac{\sigma^2}{2} \left[-\frac{u(w)''}{u(w)'} \right]$$

Fieldwork and Data Collection



Results

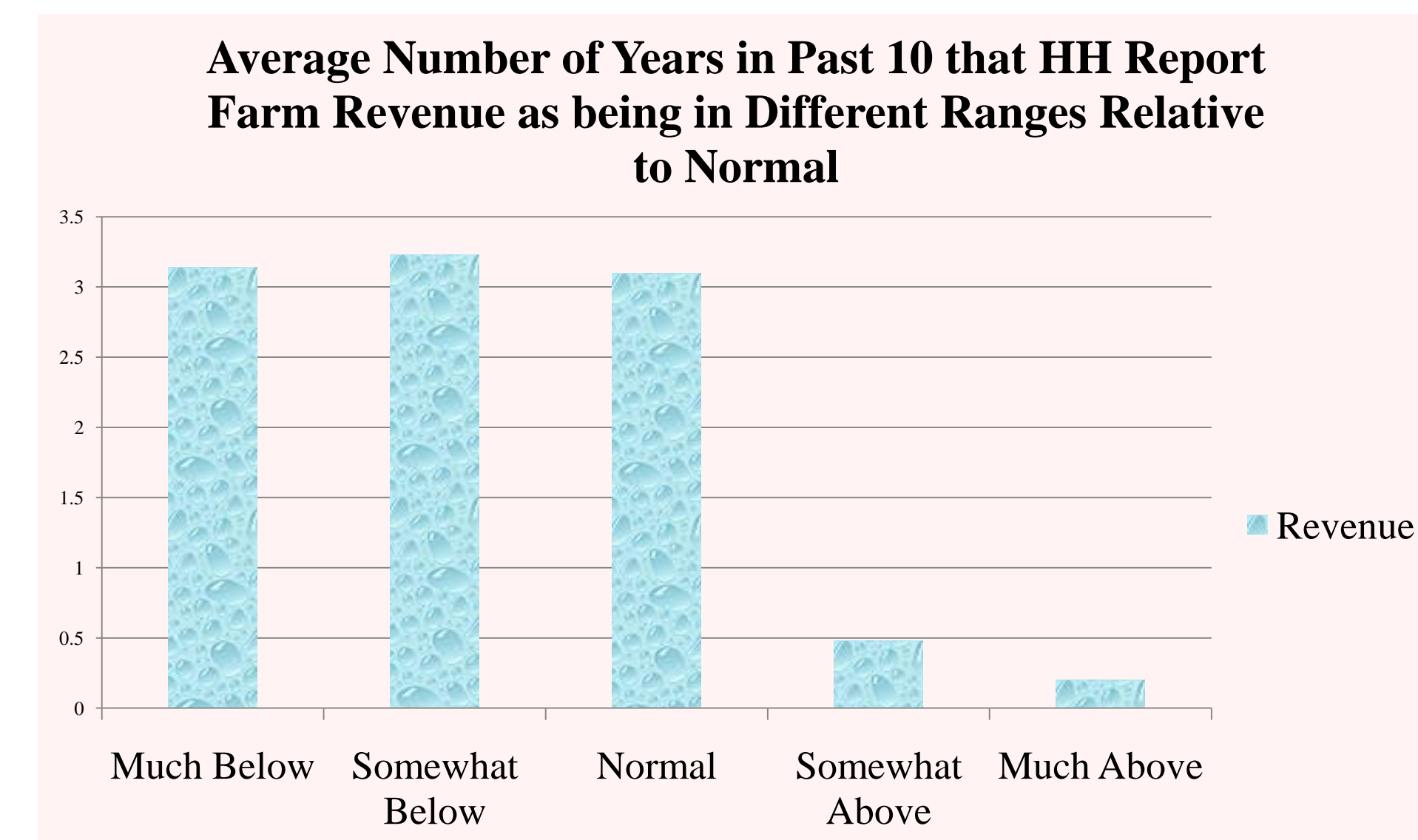
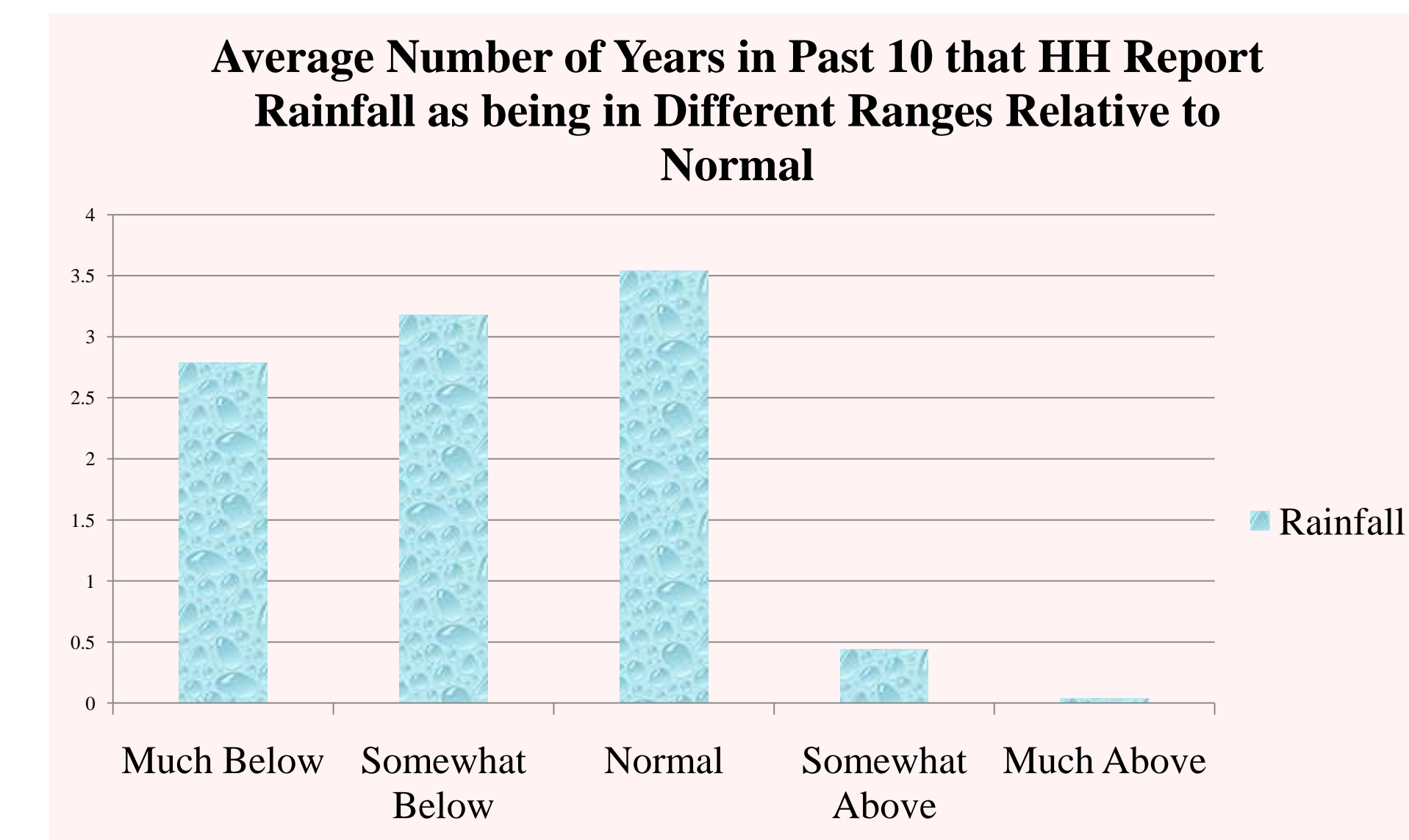


Table 6: Multivariate Probit Using Simulated Maximum Likelihood (SML)

Variable	First Bid		Second Bid		Protection	
	Coeff	t-val	Coeff	t-val	Coeff	t-val
bid1	-1.13***	-2.76				
education	0.04	0.87	-0.01	-0.28		
Age	0.004	0.05	-0.01	-0.18	-0.10*	-1.94
Age Sq	-0.0001	-0.37	-0.000	-0.14	0.01**	1.99
hhsz	0.04	0.78	0.03	0.67		
Income	0.003	0.73	-0.010**	-2.31		
land size	0.12	1.25	0.15*	1.71	0.02	0.36
livestock	-0.30	-0.67	-0.29	-0.53	0.67*	1.75
irrigation	0.075	0.31	0.65**	2.03		
maize	0.30	0.97	0.43	1.41	0.60**	2.18
banana	-0.04	-0.11	0.57	1.27	0.66**	2.30
coffee	-0.36	-1.27	-0.52*	-1.71	-0.42*	-1.71
fertilizer	0.41	1.16	0.59	1.52		
Expected	-0.0009*	-1.75	-0.000	-0.26	-0.00	-0.63
Rain						
altitude	-0.00	-0.14	0.000	0.03	0.001	1.48
mulch	0.82*	1.66	-0.54	-0.69		
bid2			-1.77***	-5.45		
Dummy1			2.31*	1.72		
extension			0.21	0.82		
gender			0.51	1.28		
Beans					-0.48*	-1.70
Constant	12.34***	2.77	16.66***	4.59	0.64	0.46
Fixed Effect	Yes		Yes		Yes	

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

Measuring WTP

Table 7: Mean WTP for Improved Irrigation (in US \$)

	Mean WTP	Lower Bound	Upper Bound	p-value
First Bid	28.71***	21.62	62.62	0.000
Second Bid	33.14***	27.15	40.08	0.000

Conclusions

The results show that farmers with lower expectations about future rainfall are willing to pay more for accessing the improved irrigation scheme. In addition, Mt. Kilimanjaro farmers are willing to pay up to 10% of their income to have access to improved irrigation canals. Assuming a 5% discount rate, the study found that farmers will reimburse the cost of building the irrigation scheme after 7 to 9 years.

Selected References

Aggrawala S, Möhner A, Hemp A, van Aalst M, Hitz S, Smith J, Meena H, Mwakifwamba SM, Hyera T, Mwaipopo OU. 2003. "Development and Climate Change in Tanzania: Focus on Mount Kilimanjaro". COM/ENV/EPOC/DCD/DAC (2003)5/FINAL. Organization for Economic Cooperation and Development Paris, France (72 pp)

Haab, TC., McConnell, K., 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Northampton, MA: Edward Elgar Publishing.

Konishi, Y., and J.S. Coggins 2008. "Environmental risk and welfare valuation under imperfect information." *Resource and Energy Economics* 30:150-69.

Pratt J and Zeckhauser R. (1996). "Willingness to Pay and the Distribution of Risk and Wealth" *Journal of Political Economy*, Vol 104 n 4.

Young R.A., 2005. Determining the Economic Value of Water: Concepts and Methods. RFF Press. Washington

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For further information

Please contact the author at muamba.2@osu.edu. More information on this and related projects can be obtained at <http://digitalunion.osu.edu/R2/summer09/yoona/>.