

## Debating climate economics: a response to Ackerman's critique of climate damage modeling

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Abstract: Ackerman and Munitz (2016) offer a critique of estimates of the economic impact of climate change and the social cost of carbon, and the FUND model in particular. I am grateful for the opportunity to reply. I note that (1) their concerns are not new; (2) they highlight strengths of FUND rather than its weaknesses; and (3) they revisit their old mistakes. I conclude with a few improvements to FUND prompted by Messrs Ackerman and Munitz.

DEBATING CLIMATE ECONOMICS: A RESPONSE TO ACKERMAN'S CRITIQUE OF  
CLIMATE DAMAGE MODELING

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Response to comments

All edits accepted, at least in spirit, except the one on suppressed evidence. We had extensive email correspondence with Mr Ackerman prior to the submission of the original paper, pointing out that the alleged error was never observed in our version of the model, that the code has multiple safeguards against these kind of errors, and that Ackerman's tests are inconclusive. I therefore agree with David Stern's verdict that evidence was suppressed rather than inadvertently omitted.

## DEBATING CLIMATE ECONOMICS: A RESPONSE TO ACKERMAN'S CRITIQUE OF CLIMATE DAMAGE MODELING

Ackerman and Munitz (2016) offer a critique of estimates of the economic impact of climate change and the social cost of carbon in general, and the *FUND* model in particular. I am grateful for the opportunity to reply. In this response, I note that (i) their concerns are not new; (ii) they highlight strengths of *FUND* rather than its weaknesses; and (iii) they revisit their old mistakes. I conclude with a few improvements to *FUND* prompted by Messrs Ackerman and Munitz.

### **Incremental contribution**

There is little if anything new in Ackerman and Munitz (2016). They note that *FUND*'s estimates of the social cost of carbon are highly sensitive to assumptions about (i) carbon dioxide fertilization and (ii) vulnerability to climate change. Anthoff, Tol, and Yohe (2009) and Waldhoff et al. (2014) previously report a strong sensitivity to carbon dioxide fertilization. Tol (1996) and Anthoff and Tol (2012b) previously highlight the importance of development and vulnerability. It is unfortunate that these papers were not referred to by Messrs Ackerman and Munitz.

### **Highlighting *FUND*'s strengths**

That said, I am grateful to Messrs Ackerman and Munitz for highlighting two of *FUND*'s main strengths. Other integrated assessment models attribute all impacts of climate change to global warming. *FUND*, on the other hand, separates climate change, sea level rise, ocean acidification, and carbon dioxide fertilization. This is key because the dynamics of these processes are quite distinct.

Although it is generally acknowledged that poorer countries are more vulnerable to climate change, other integrated assessment models assume that growing richer leaves vulnerability unaffected. Instead, *FUND* assumes that societies will become less vulnerable in the future if they grow richer.

### **Repeating past mistakes**

A third concern is that Ackerman and Munitz (2016) revisit an earlier paper (Ackerman and Munitz 2012a) but omit key details. Having downloaded the source code, Messrs Ackerman and Munitz altered the code, and

claimed there was an error and that this error was due to Anthoff and Tol. Ackerman and Munitz (2012b) withdraws some of the more egregious claims by Ackerman and Munitz (2012a), particularly that the alleged error was made by Anthoff and Tol. Stern (2012) notes that Ackerman and Munitz had suppressed evidence that contradicts their claim of an error. Anthoff and Tol (2012a) show that the Ackerman and Munitz test for errors is inconclusive. In other words, Ackerman and Munitz (i) claimed an error had been made without evidence, (ii) ignored evidence that there was no error, and (iii) blamed the error-that-wasn't on the wrong people.

### **Improvements to *FUND***

1 Upon reflection, we changed access to the model code. *FUND* can still be freely downloaded  
2 and used by anybody, but changes in code or data are now attributed to specific users. This  
3 prevents a repetition of Ackerman and Munitz (2012a): Any alteration is tied to a particular  
4 programmer and therefore no one can blame someone else for an error they themselves made.  
5

6 We also changed the model specification. Reading the agricultural impact function as a  
7 univariate probability distribution, a reader may conclude that, in *FUND3.6* and prior, there is  
8 a risk of dividing by zero. There is not. The probability distribution is bivariate, not univariate,  
9 so that the risk is minimal – and indeed unobserved in the many Monte Carlo experiments run  
10 with the model. Furthermore, the code has safeguards at three levels against numerical errors.  
11 (These issues were pointed out to Mr Ackerman before Ackerman and Munitz (2012a) was  
12 submitted for publication.) Nevertheless, in order to avoid further misinterpretation, we  
13 reformulated these equations.  
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17 At the end of the day, I am grateful to Messrs Ackerman and Munitz for prompting these  
18 improvements, although I would wish for more nuanced and rigorous analysis in the future.  
19 At code school, we learned that a user interface has to be robust to anything. Our software  
20 engineering lecturer used the metaphor of a chimp typing random keys. That metaphor does  
21 not apply here. When putting *FUND* in the public domain, I overlooked that I created a new  
22 interface, one prone to interpretation and reinterpretation. Messrs Ackerman and Munitz  
23 usefully remind us that interfaces have to be robust to the unexpected.  
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## 29 **Acknowledgements**

30 Benjamin Sovacool had helpful comments on a previous version of this note.  
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