

Authors' Reply to 1st Referee's Report on "The Sustainable Development Goals and the Systems Approach to Sustainability"

We are grateful to this referee for providing a thorough and helpful review of our paper. We are also delighted that the referee recommends our paper for publication based on its potential contribution, noting that "the overall SDGs debate clearly lacks such theoretical approaches (with empirical application) to assess trade-offs."

Here are our replies to the major issues raised by the referee:

1) We believe that our approach for assessing tradeoffs across system goals does require "the assignment of goals to one of the three dimensions", i.e. economic, social and environmental. As we explain in our introduction, the 17 SDGs and their underlying targets and indicators provide an ideal opportunity to show how this trade-off assessment can be conducted, using a standard welfare analysis. Thus, as stated on p. 2, "We illustrate how each of the 17 SDGs can be characterized as a goal primarily attributed either to the environmental, economic or social system, and as suggested by the systems approach, there may be important tradeoffs in attempting to attain all these goals simultaneously....By adopting standard theoretical methods of the theory of choice and welfare under imposed quantities (Freeman 2003; Lankford 1988), we show that is possible to measure the welfare effects of an increase in the indicator level for one SDG by identifying the tradeoffs that occur with achieving another goal."

The referee notes that "the system approach could be used to discuss the distinction between weak and strong sustainability". This latter distinction arises in a completely different approach to sustainability, which is the "capital" approach to sustainability (see Barbier and Markandya 2012, ch. 3 who compare and contrast the capital and systems approach to sustainability). As pointed out by the authors, "the main disagreement is whether natural capital has a unique or essential role in sustaining human welfare, and thus whether special 'compensation rules' are required to ensure that future generations are not made worse off by natural capital depletion today" (Barbier and Markandya 2012, p. 42). Weak sustainability assumes that there is no difference between natural and other forms of capital (e.g. human or reproducible), and thus as long as depleted natural capital is replaced with more value human or reproducible capital, then the total value of wealth available to current and future generations will increase. In contrast, strong sustainability argues that some natural capital is essential (e.g. unique environments, ecosystems, biodiversity and life-support functions), value of and thus sustainability requires maintaining and enhancing the value of the aggregate capital stock, and preserving essential natural capital. As recommended by the referee, the distinction between a systems approach and a weak and strong sustainability approach can be explained and clarified in this paper.

2) We agree with the referee that the assignment of the 17 SDGs as primarily economic, environmental and social goals is not unambiguous, and is based solely on our judgment for illustrative purposes in this paper. In revising the paper, we will follow the referee's suggestion that "the authors should state that the presented assignment is based on their assessment and an assignment which cannot be resolved by science but requires stakeholder interaction/democratic justification."

3) We agree with the referee that we should explain more clearly the difference between the systems approach to sustainability and the more prevalent “capital approach” to sustainable development. We did not do this initially, as this comparison of sustainability approaches has been done in previous work (e.g., see Barbier and Markandya 2012, ch. 3). However, we agree that to assist the reader it may be helpful to include some discussion in this paper as well.

4) The referee is correct that there may be relative price effects associated with attaining one or more SDGs. To keep our welfare analysis uncomplicated, we have assumed relative prices to be unchanged, which is a standard economic assumption. We are happy to acknowledge that this is a simplifying assumption.

5) We thank the referee for the useful references, which we will include in the revised manuscript.

Here are replies to the minor issues raised by the referee:

1) Our interpretation of Holmberg and Sandbrook (1992, p. 24) is that they are referring to “different priorities” assigned to “different goals”, which would imply differential weighting of goals across systems and not “shadow values” for capital stocks as the referee suggests.

2) We agree. However, we want to make sure that this is clearly understood who is not especially familiar with the theoretical framework of Freeman (2003) and Lankford (1988).

3) The limitation of ANNI in terms of measuring changes in the environmental system, e.g. depletion of ecological capital, is an excellent point, and we will acknowledge it in the revision. We will also include Weitzman (1976).