

Report on how I have revised the manuscript “Now or Never: Environmental Protection under hyperbolic Discounting”

Ralph Winkler – 02 April 2009

I am very grateful for the constructive comments of the reviewers. They were of great help in revising the manuscript, as described in detail in the following.

1. *Overstrong formalism and lacking economic intuition.* The reviewers’ main criticism was that the paper is not very “user-friendly” and lacks verbal economic intuition for the core analytical results of the paper. I have revised the manuscript along the suggested lines of the reviewers. For example, initial assumptions are now better motivated and all propositions are now followed by an intuitive explanation of the core results. In fact, also a number of misunderstandings have been removed. For example, strategic substitutability of investment decisions of subsequent agents in a neighbourhood around the stationary state is not an assumption but a result. Of course, I take full responsibility for these misunderstandings, as the original manuscript was not clear with respect to these points. However, the paper is a theoretical paper and a full understanding of the results is not achievable without following the proofs of the proposition. I have revised the proofs to make them most accessible to the reader.
2. *Non-negative and bounded environmental protection.* The reviewers claimed correctly that these assumptions were not justified. This has been corrected in the current version.
3. *Exploring further the possibility of multiple equilibria.* The reviewers mention that it would be interesting to further explore the possibility of multiple equilibria in the case of sophisticated agents. In the revised manuscript, I try to give a better intuition for the possibility of multiple equilibria. However, the result per se is well known in the literature (e.g., Karp 2005) and it is only of minor interest to the argument of my paper. Therefore, I decided to be brief on this topic.
4. *Analysis more relevant to local pollution problems.* The reviewers claim that the analysis is more relevant to local pollution problems. With due respect, I disagree. Although global pollutants also exhibit other problems, such as public good properties, they may nevertheless be of a long-run nature. It is particularly the long-run nature which I aim at in the paper. Only because mitigating climate change also suffers from additional problems does not mean that hyperbolic discounting and the related time-inconsistency are not relevant. This is strongly connected to the reviewers’ next point that I cannot prove that hyperbolic discounting is the *sole cause* of the observed weak policy performance. I do not claim that hyperbolic discounting is the only possible explanation. I only claim that the observed patterns are *consistent* with the hypothesis that governments discount hyperbolically and the ex ante optimal plan suggests postponing investments to later periods. Thus, I claim that hyperbolic discounting may also play a role. As a consequence, I still consider the examples appropriate as they exhibit the long-run time pattern assumed in the model (costs occur today while benefits spread over future generations). However, I rephrased the section to make the argument clear.
5. *Possible mistake in equations (A13b) and (A13c).* The reviewers observed correctly that there was a typo in equation (A13c), which has been corrected.

In addition, minor changes were made to the abstract, the introduction and the conclusion to sharpen the argument.

The reviewers have also raised a number of issues and questions that did not make me change the manuscript, but that I would like to answer as follows.

6. *Compare hyperbolic discounting with exponential discounting.* In economics we normally take preferences as given. Thus, if agents discount hyperbolically the question what would they do if they would discount exponentially is ill posed. In my opinion the correct question to ask is, given agents discount hyperbolically, how does the outcome change whether they are aware of the time-inconsistency problem or whether they can commit future agents to their ex ante optimal plan. Moreover, time-inconsistency is not an issue with exponential discounting. As a consequence, all the effects determined in the paper simply cannot occur for exponentially discounting agents.
7. *A numerical example would improve the understanding of the reader.* In my opinion the strength of the paper is its generality, i.e. it derives general results with comparably mild assumptions on the underlying model structure. Of course, it is easy to find some numbers for which the various conditions of the propositions hold or are violated. However, I cannot see how this may improve the understanding of the reader.
8. *Use delay equations as in Kydland and Prescott (1982).* Unfortunately, I do not understand this comment. In fact, the model exhibits a delay. Costly investments in environmental protection accumulate the stock of environmental protection in the next period. As a consequence, costs are borne by the investing generation, while the subsequent generations benefit. Of course, one could easily increase the delay to two, three, etc. periods. However, I do not see how this should reveal any additional insights.