Yes, we should discount the far-distant future at its lowest possible rate: A resolution of the Weitzman-Gollier puzzle
Response to Referee 3

I greatly thank the referee for taking the time and effort to comment on my paper and welcome the opportunity presented here to respond to the points raised.

- "It is already known from the literature that the ENPV and the ENFV criterion are not equivalent. It therefore must be the case that a project can pass one criterion while it fails to pass the other one." This is clearly true. However, what the previous literature does not do is say which one should be used. Previous work either suggests that both measures are wrong (Gollier, 2004), both are in some ways "right" (Gollier 2009a, 2009b and Hepburn and Groom 2007) or that the ENFV approach is to be preferred (Buchholz and Schumacher 2008). One of my contributions is to show that Weitzman (1998) has got this right. In fact, since the submission of my paper, Gollier and Weitzman have jointly produced a new working paper ("How should the distant future be discounted when discount rates are uncertain?", November 2009) that stresses this same point themselves. As they note in their abstract "What we would wish a reader to take away from this paper is the bottom-line message that the appropriate long run discount rate declines over time toward its lowest possible value." Gollier & Weitzman (2009) would not have needed to make this bottom-line message had it previously been established in the literature and my paper is the first to make this point unequivocally.

- "It says that it can happen that a project that passes the ENPV criterion does not pass the ENFV criterion, but does not give conditions, when a project that passes the ENPV criterion fails to pass the ENFV criterion or vice versa." This is true — I give an example of a project that passes the ENPV but not the ENFV. This single example is sufficient to act as a disproof by counterexample to the hypothesis that the ENFV is always consistent with expected welfare maximisation. However, the general condition is entirely straightforward. If $pe^{r_d(T)T} < D_T < pe^{r_c(T)T}$ then the project passes the ENPV but not the ENFV. As $r_c(T) > r_d(T)$, a project can never pass the ENFV but not the ENPV in the Weitzman-Gollier setting. I will include this point in the next version of the paper.

- "Moreover, the Theorem does not prove that the ENPV is the one and only criterion." I believe that the theorem does prove that the ENPV criterion is the only criterion that is always consistent with expected welfare maximisation within the risk-neutral endowment economy that forms the basis for my paper. This is the central point. I would welcome further elaboration from the referee on why (s)he feels that this result has not been successfully established as this would help me provide better exposition for other readers.

- "The author claims that the social planner is risk neutral. At the same time he assumes that he has a strictly concave utility function. (How can you assume that u is strictly concave, $u(\cdot) \equiv v(\cdot)$ but $v''(\cdot) = 0$?)" I do not assume that $u(\cdot) \equiv v(\cdot)$ but do assume that $v''(\cdot) = 0$. The concavity comes from $u''(\cdot) < 0$. The paper notes in passing that, if $u(\cdot) \equiv v(\cdot)$, then the utility function would be time-separable, but here it is not.

- "If the social planner is risk neutral the certainty equivalent must be equal to the expected payoff, which here is not the case." I agree that the certainty equivalent must be equal to the expected payoff, which is why in my paper I state that "To capture risk neutrality, here $v''(\cdot) = 0$, so that $m_t = E_0[\widetilde{c}_t] = \overline{c}_t$" (page 6). This, of course, does not mean that the current value of the project is equal to its certain payoff as the project does not deliver cash flows until time T. Due to the impatience of the investor (reflected through the parameter ρ) and the desire to smooth consumption between times 0 and T (reflected through the concavity of $u(\cdot)$) the current value of the project is different from the expected payoff even under risk neutrality.

- "Third, the paper jumps back and forth between the own formal model and different contributions in the literature. This makes the paper hard to read. In particular for readers who are not rooted in the finance literature, section 3.2 is hard to follow.". This is consistent with the opinions of the other commentators on this paper. I apologise for this and will endeavour to make this clearer in subsequent versions of this section.

- "Fourth, the author claims to make methodological progress? I do not see this.". I think this is because the referee has read the paper believing that $u(\cdot) \equiv v(\cdot)$. This is not the case. The non-concavity in $v(\cdot)$ enables me to retain risk-neutrality, which is a clear methodological improvement on Gollier (2009a) – see my response to Referees 1 & 2. By working in a Lucas (1978) pure exchange economy, I am also able to extend Proposition 2 of Gollier (2009a). He shows that the ENPV is "right" when the coefficient of relative risk aversion of the social planner is exactly equal to one. In the framework of my paper the ENPV is always right.

- "Fifth, the author does not refer to the title's issue of the "lowest possible" rate. What is the lowest possible rate?" In Section 2 of the paper, I refer to (and sketch a proof of) the well known existing result of Weitzman (1998) that, if $\widetilde{r}$ is bounded within $[r_{\min}, r_{\max}]$ then $r_d(T) \longrightarrow r_{\min}$ as $T \longrightarrow \infty$. As I am arguing that Weitzman's ENPV criterion is "right", then this result still holds.