Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2017-117-RC1, 2018

Earth System Dynamics
Discussions

Interactive comment on "The Role of Bioenergy and Carbon Capture and Storage (BECCS) in the Case of Delayed Climate Policy — Insights from Cost-Risk Analysis" *by* Jana Mintenig et al.

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Received and published: 3 January 2018

General comments

This paper allows for negative emissions and BECCS with bio-energy as a representative method of CO2 removal. It uses the MIND integrated assessment model to trade off mitigation costs against the associated risks of violating temperature constraints in scenarios (tolerating a risk of 1/3 that temperature exceed 2 degrees Celsius above preindustrial). It investigates this trade-off under the assumption that there is a delay in implementation of the appropriate climate policy. This can be seen an exercise in political second best, since politicians are known to procrastinate and postpone policies. This paper does not explain why policy makers dither and postpone. It would have

been nice to use the theory of say hyperbolic discounting developed by David Laibson or a theory of political economy to get a more rigorous explanation of why policy makers postpone policies. As it is, the delay is imposed in an ad hoc manner.

Its main findings are not too surprising: BECCS avoids corner solutions that were previously identified for delayed policy scenarios and thus gives a larger window of opportunity to act, postpones mitigation efforts and thus allows longer use of fossil fuel, and curbs welfare losses by a lot. The main claim of this paper is, however, that mitigation-induced welfare losses decrease with delay whilst climate risk-induced welfare losses increase with delay by roughly the same order of magnitude. Hence, with cost-risk analysis (CRA, effectively a combination of CBA and CEA) which trades off mitigation losses against risks of overshooting temperature targets, there is a strong welfare case for BECCS in case of delayed policy implementation.

The CRA framework was first developed in Neubersch et al. (2014) and Roth et al. (2015). This study is a follow up to Roth et al. (2015), which finds that delaying climate policy by 40 years (and having business as usual with no climate policy in the run-up period) leads to a doubling of welfare losses when using a linear welfare metric, i.e., when using a zero coefficient of relative risk aversion. The metric apparently plays a minor role compared with risk itself, where uncertainty is modelled by a lognormal distribution of the climate sensitivity. For any policy implemented beyond 2020 the temperature target will be exceeded (at least) temporarily. This paper evaluates what happens when adding BECCS to the analysis of Roth et al. (2015).

Specific comments

Taking the climate science aspects as given, let us focus on the results. What we see from Figure 3, panel (c) is that emissions are on a rising business as usual path until they start to decline where the rate of decline is larger the longer the delay. Panels (d) and (e) show that, with BECCS, CO2 emissions can fall more substantially. What is missing from this paper and what would be very nice to know is the required time path

of the carbon price, whether implemented via a carbon tax or a price that comes out of a competitive market for emission permits, that is needed to make sure that these emission reductions in fact take place.

If one ignores the production damages from global warming, the carbon price compatible with the safe temperature or safe carbon budget constraint should rise at a rate equal to the interest rate in view of the exhaustible nature of the carbon budget as has first been shown by William Nordhaus. In other words, the carbon price should follow a Hotelling path. However, a 2017 paper by Lemoine and Rudik in the American Economic Review allow for temperature inertia and find that the carbon price does not rise for many decades and then follows a non-monotonic pattern. In view of Ricke and Caldeira in a 2014 issue of Environmental Research Letters this latter study seems unrealistic and perhaps even irrelevant given that the time it takes for temperature to rise following a carbon impulse is only a decade. It would be good to read more on the level and shape of the time path of the carbon price that comes out of this study.

If the temperature constraint is ignored but production damages from global warming are taken account of, the carbon price rises roughly in line with GDP if damages are proportional to GDP as has been shown in a 2014 Econometrica article by Michael Golosov et al. However, if both the temperature constraint and production damages are taken account of as seems to be the case in this study, the carbon price path is a combination of these provided the temperature constraint bites. So it would be good to know what path of carbon prices delivers the immediately implemented and the various delayed emission-reduction paths shown in Figure 3. One expects the larger the delay, the higher the carbon price path needs to remain below the threshold temperature.

Another important issue the paper does not deal with is that second-best policies such as delayed policies suffer from the problem of the Green Paradox as has been forcefully pointed out by Hans Werner Sinn in his 2008 book. If fossil fuel is scarce and not abundant, fossil fuel owners anticipating a higher price of carbon in the future will pump more oil and gas today ahead of the carbon price hike. This will lead to unintended

acceleration of global warming in the short run, although admittedly more fossil fuel may be locked up in the crust of the earth. It would be good to know whether MIND has such Green Paradox effects or not. If it does, it would be good to discuss them. If it does not, it would be good to adjust MIND to allow for them where one should notice that the adverse welfare effects of such Green Paradox effects are larger if the supply of fossil fuel is less elastic and demand for fossil fuel is more elastic.

Such Green Paradox effects also lead to the issue of time inconsistency. It is important whether policy makers can commit to such a future rise in carbon prices, see a 2016 paper by Armon Rezai and Frederick van der Ploeg in Environmental and Resource Economics. Policy makers have an incentive to renege and deviate from announced plans. The challenge for future research is to investigate what second-best policies look like if policy makers cannot commit to future policies as this seems more likely and to compare these policies with those when policy makers can commit. These issues are important as these intertemporal inefficiencies might be just as important as international free rider problems. Alas, both frustrate the implementation of an ambitious climate policy.

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