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From moral hazard to risk-response feedback

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ABSTRACT

The Intergovernmental Panel on Climate Change assessments (IPCC) Special Report on 1.5 °C of global warming is clear. Nearly all pathways that hold global warming well below 2 °C involve carbon removal (IPCC, 2015). In addition, solar geoengineering is being considered as a potential tool to offset warming, especially to limit temperature until negative emissions technologies are sufficiently matured (MacMartin et al., 2018). Despite this, there has been a reluctance to embrace carbon removal and solar geoengineering, partly due to the perception that these technologies represent what is widely termed a "moral hazard": that geoengineering will prevent people from developing the will to change their personal consumption and push for changes in infrastructure (Robock et al., 2010), erode political will for emissions cuts (Keith, 2007), or otherwise stimulate increased carbon emissions at the social-system level of analysis (Bunzl, 2008). These debates over carbon removal and geoengineering echo earlier ones over climate adaptation. We argue that debates over "moral hazard" in many areas of climate policy are unhelpful and misleading. We also propose an alternative framework for dealing with the tradeoffs that motivate the appeal to "moral hazard," which we call "risk-response feedback."

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1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5 °C of global warming is clear. Nearly all pathways that hold global warming well below 2 °C involve carbon removal (IPCC, 2015). In addition, solar geoengineering is being considered as a potential tool to offset warming, especially to limit temperature until negative emissions technologies are sufficiently matured (MacMartin et al., 2018). Despite this, there has been a reluctance to embrace carbon removal and solar geoengineering, partly due to the perception that these technologies represent what is widely termed a "moral hazard": broadly speaking, the danger that environmentally beneficial social, technological, or policy developments may trigger environmentally counterproductive behavioral responses.

The tendency to antagonize specific technologies or categories of action on climate change is a persistent challenge in climate responses (Lin, 2013; Termeer, 2011). Recent arguments attempt to extend the logic of moral hazard to describe other kinds of tradeoffs in climate policy. The literature on geoengineering, for example, is instructive (Hernandez, 2018). Researchers argue that geoengineering will prevent people from developing the will to change their personal consumption and push for changes in infrastructure (Robock et al., 2010), erode political will for emissions cuts (Keith, 2007; Markusson et al., 2018), or otherwise stimulate increased carbon emissions at the social-systems level of analysis (Bunzl, 2008; McLaren and Markusson, 2020).

In this perspective, we argue that debates over "moral hazard" in response to carbon removal and solar geoengineering are both unhelpful and potentially counterproductive. The reason for this is that they frame the relevant policy questions in terms of whether we should substitute mitigation efforts for carbon removal and solar geoengineering technologies or vice versa. Yet, if the IPCC report is to be taken seriously, such questions are ones we no longer have the luxury to consider: the only live question is which combination of available mitigation, adaptation, and technological strategies is most likely to ensure a sustainable, climate-resilient future. For this reason, we argue that we need to move beyond the moral hazard framework and adopt a different approach, which we call "risk-response feedback." The goal of this approach is to shift the focus away from evaluating the potential risks and benefits of *specific* policy interventions, e.g., carbon removal and solar geoengineering, and towards evaluating the costs and benefits of adopting different *policy packages*. By taking this more general perspective on the available policy options, mitigation, adaptation, and technological goals can be evaluated in tandem, thus minimizing in-principle concerns about moral hazard effects.

2. Evaluating moral hazard as a framework

The term "moral hazard" originated in the insurance industry in the nineteenth century to refer to certain risks associated with parties who buy insurance policies, but its precise meaning has been contested since the beginning (Rowell & Connelly, 2012). Even in the late nineteenth century, commentators complained that the term "involves rather a jumble of ideas than a definite perception" (Fowler, 1885, p. 178) and was "of loose application" (The American Exchange and Review, 1894, p. 548). Some used the term to refer specifically to insured parties' deliberate destruction of property to collect insurance money (Fowler, 1885, p. 181) or even to parties purchasing for the express purpose of doing so (Canada. Parliament. House of Commons, 1888, p. 461). Others used the term to refer more generally to risks associated with insured parties' carelessness or character (Canada. Parliament. House of Commons, 1888, pp. 468–469; Rowell & Connelly, 2012, p. 1061; The American Exchange and Review, 1894, p. 548).

As the idea of moral hazard has spread beyond economics and insurance, philosophers and social scientists have sought to further clarify the concept (Braynen, 2014; Hale, 2009). Despite the fact that the term suggests a "moral" problem, Benjamin Hale's seminal contribution argues that moral hazards are "morally neutral," echoing a point made earlier by Mark Pauly (Hale, 2009; Pauly, 1968). Economists adopted and clarified the concept by defining it in terms of risks *posed by* undetected *changes in the insured parties' behavior that are caused or exacerbated by the provision of insurance* (Arrow, 1963; Zweifel & Eisen, p. 268, 2012). This excluded certain things that had previously been included (for example, characteristics of the insured party, such as health history) that increase their risks. It also clearly included risks that were sometimes excluded by stricter definitions, such as people becoming less careful because they have insurance. For instance, someone who declines to install expensive fire protection systems in a building because the building is insured exemplifies moral hazard in the economist's sense, even if they have no intention of burning the building down.

More recently, Markusson, McLaren, and Tyfield (2018) have proposed a climate-specific conception of the notion of moral hazard, which they refer to as "mitigation deterrence" (see also McLaren 2016). Their framework generalizes the notion of moral hazard beyond the individual-level, aggregative analysis found in economics to include changes to social-systemic behavior resulting from emergent interactions between cultural, political, and technological processes. This generalized conception of moral hazard usefully abstracts away from many of the modeling assumptions that characterize the standard economic analysis and isolates the climate-relevant aspect of the notion of moral hazard: namely, whether "considering or promoting [a given climate intervention] might for any reason *deter or delay* desirable levels of mitigation" (Markusson, McLaren, and Tyfield 2018, 1). This might happen either (1) as a result of direct effects on individual behavior, (2) through changes to the culturally salient framings of the available policy options, or (3) by influencing entrenched economic and political interests. But, however it happens, the climate-relevant concern is the same: an increased focus on these technological interventions could deter collective mitigation efforts.

As we see it, Markusson, McLaren, and Tyfield's mitigation deterrence framework marks an important point of progress in the debate over moral hazard and solar geoengineering, as it serves to clarify and correct many of the conceptual issues that have both plagued this debate and contributed to its unproductive character. However, in doing this, they have also made clear the central problem with applying the notion of moral hazard to the climate debate—even in generalized form. To see this, we need only look at the way in which the notions of moral hazard and mitigation deterrence construe the problem with which we are faced. At the core of

these notions is the idea that the intended effect of a given intervention (e.g., minimizing an individual's exposure to a given kind of risk, in the case of insurance, or keeping global temperatures below a certain level, in the case of climate) will be reduced or eliminated by a compensatory response that is outside of the interveners control. The result is a dynamic in which the target system uses the effects of the intervention as a *substitute* for whatever it was doing before, thus minimizing the intervention's intended effect. The result is that the decision problem that the intervener is ultimately taken to be faced with is whether the intervention is worth it once this substitution dynamic is "priced in."

In the insurance case, this way of framing the problem makes sense because insurers are related to the insured party in a well-defined and narrowly circumscribed fashion: namely, through the insurance policy itself. Thus, for the insurer, the only question that is relevant to their decision is how to structure and price their insurance policies, given that the insured party will likely exhibit this substitution dynamic to some degree. However, when we consider the case of climate policy, it becomes clear that this way of framing the problem misconstrues the decision problem that policymakers face. There are two related reasons for this. The first is that, unlike insurers, policymakers have more than one kind of intervention at their disposal. In particular, they can implement interventions, such as preference adjustment or incentive-based policies, that can minimize or even eliminate the moral hazard effects associated with interventions such as carbon removal or solar geoengineering. It is thus simply not true that the decision policymakers face is adequately characterized in terms of whether the benefits of pursuing these interventions outweigh their potential risks, since, unlike insurers, policymakers are also in a position to directly influence those risks. As a result, by framing the problem in terms of moral hazard, the debate over carbon removal and geoengineering has artificially excluded a wide range of options that should be considered as part of the broader climate debate.

The second reason that the moral hazard framing misconstrues the decision problem facing policymakers is that, in the case of climate policy, the most salient locus of substitution is at the level of policy selection itself, rather than at the level of downstream policy consequences. In particular, one of the most pressing worries driving the moral hazard debate is that policymakers will promote unproven geoengineering technologies *rather than* implement effective mitigation policies such as creating a sustainable electric grid. Yet there is no reason to think that these options must be in opposition to each other: policymakers can do both. Indeed, as we see it, one of the most counterproductive aspects of the moral hazard framing is that it implies that substitution in either direction is our only option. In fact, however, not only are these not our only options, they are not even options: as the IPCC Report (IPCC, 2015) makes clear, both carbon capture and robust mitigation efforts will almost certainly be required to stave off the worst effects of climate change. The result is that the moral hazard framing ultimately directs attention away from the options we need to be considering and towards options that are not actually available.

The significance of this point cannot be overstated. As Markusson, McLaren and Tyfield emphasize, culturally available framings play a central role in determining how social-systemic processes unfold across social, economic, and political levels. By framing the problem in terms of moral hazard or mitigation deterrence, the idea that substitution is an option is made salient to both policymakers and the general populace. And this, in turn, will make it more likely that substitution dynamics will be realized at both the policy level and at the level of individual behavior. In this respect, the moral hazard framing of the debate over geoengineering is itself a moral hazard, as it plausibly contributes to mitigation deterrence by making it seem as though the use of carbon capture or solar geoengineering technologies can serve as potential substitutes for mitigation efforts. Yet they cannot, and the implication that they can will only harm mitigation efforts. For this reason, we maintain that the debate over carbon capture and solar geoengineering must be reframed to reflect the realities of the climate crisis at it currently stands.

3. An Alternative: risk-response feedback

In place of the moral hazard framing, we propose an alternative framework that we call *risk-response feedback*.

By contrast to the moral hazard framing, which focuses on the effects of individual interventions, the risk-response feedback approach focuses on modeling the effects that climate policy *packages* have on climate outcomes—both as a function of indirect effects via social-systemic behavior (e.g., risk profiles and incentive structures) and as a function of direct effects on target climate parameters. This approach is part and parcel of thinking in social-ecological systems (SES) literatures (Milkoreit et al., 2018). Since this approach tracks social-system level behavior in relation to various climate targets, the effects that risk-response feedback describes are legible from the total behavior of the social systems as typically modeled by climate researchers.

The primary goal of the risk-response feedback approach is to delineate a set of pathways: essentially, sequences of causal relations which correspond to the different SES trajectories that could result from different climate policy packages. In general, a climate intervention can have two kinds of effects on the climate: direct effects on biophysical parameters and indirect effects on sociological parameters. These can interact in complicated ways. Figuring out which pathways are likeliest to result from a climate intervention depends on the interactions between these parameters, which are difficult to reason about *a priori*. The risk-response feedback approach provides a framework for integrating our best empirical knowledge about such interaction effects into a modeling framework that is useful for decision-making.

Because the risk-response feedback approach aims to explicitly represent the effects of climate interventions on SES behavior, the core insight underlying the notions of moral hazard and mitigation deterrence can be retained: namely, that (1) intervening on incentive structures can have perverse consequences for the risk profiles and behaviors of individuals and that (2) those consequences need to be carefully considered when evaluating climate policies.

However, since this framework doesn't restrict the set of available options to a forced choice between adaptation interventions and geoengineering interventions, the possibility of managing these mitigation deterrence effects with additional interventions is left open.

This then makes it possible to evaluate climate policies in a way that is live to the possibility of substitution without having this contingency built into the framework's basic conceptual architecture. This, in turn, will allow us to both explicitly consider the ways in which the risk of mitigation deterrence trades off against the benefits of geoengineering technologies and evaluate strategies for using additional policy measures to manage mitigation deterrence effects at the individual level.

To see the generality of this approach, it will be useful to first consider the way this proposal would work outside the context of geoengineering. For instance, just as in the case of geoengineering, adaptation interventions, such as building a sea wall to manage the effects of sea-level rise, may deter mitigation by making people or corporations more willing to engage in emissions-causing behaviors. At the same time, social feedback resulting from the adaption efforts could militate in the opposite direction by making climate change more salient to people, thereby encouraging individuals to reduce their carbon footprint (these possibilities are much discussed by theoretical and experimental literatures on risk compensation, moral hazard, and so-called "negative moral hazard" (Lin, 2013; Braynen, 2014; Carrico et al., 2015; Reynolds, 2015)). The question, then, of whether the risk of mitigation deterrence is worth the benefit of the adaption response is going to depend on the relative magnitude of each of these effects, as it is only by evaluating the combined effects of these processes that one can determine whether the net behavioral effect of the intervention is counterproductive. Moreover, because the relative magnitude of each of these effects can itself be influenced by additional policies, researchers and policymakers should not just be evaluating what would happen if, for instance, a sea wall was built, but also how to couple the building of the sea wall with additional interventions that minimize or even eliminate the mitigation deterrance effect.

Similarly, whether a given geoengineering intervention should be pursued cannot be evalauted in isolation of its policy context, since the effects it will have on behavior will depend on the policy context in which it is pursued. As we argued in the previous section, whether and to what extent pursuing such an intervention will deter mitigation will depend, in large part, on how the intervention is framed. The fact that geoengineering is percieved as an alternative to mitigation reflects a substitution framing predicated on the assumption that we can choose between geoengineering and mitigation. However, if geoengineering interventions were reframed as a way to buy time to implement necessary mitigation efforts, then many of the behavioral risks associated with such interventions could be minimized. By providing an approach to evaluating the different socio-ecological pathways made available by different policy packages, the risk-response feedback framework provides the resources needed to move beyond an oppositional framing of the relationship between mitigation and geoengineering and towards a complementary and constructive framing. While "mitigation deterrence" accurately describes the set of pathways in which the other forces in the social system slow down emissions reduction in response to the intervention, risk-response feedback describes the total set of pathways of response without deciding in advance which are the more likely or salient.

In general, the prospective benefits of a given climate intervention will depend on (1) the direction and magnitude of its effects both on the climate and on individual behavior, as well as (2) the other policy interventions with which it is being deployed. As such, establishing that a climate intervention will generate a moral hazard or will deter mitigation simply does not answer the question of whether or not we should pursue this intervention because (1) there are cases where mitigation deterrence and moral hazard fully undermines the goal of the intervention and cases where it does not (Morrow, 2014; Reynolds, 2015) and (2) policymakers can implement additional policy measures to manage these downstream behavioral consequences and counteract their effects. By contrast, the risk-response feedback approach keeps our eyes on the prize: the total effect on the socio-ecological system, all things considered. We turn in the next section to a discussion of possible uses of the risk-response feedback framework.

4. Future directions

The risk-response feedback approach provides a productive way forward on many thorny discussions in the literature and lends additional weight to a number of promising new directions that are already emerging.

We no longer have the luxury to selectively choose between different policy interventions, and our policy debate should reflect that. New approaches to policy generation and evaluation usefully resist the "substitution" framework that pits climate policies against each other. One useful way forward is suggested by McLaren et al.: separate targets for mitigation reduction and carbon removal, to preempt either substituting for the other in policymaking environments (McLaren et al. 2019). The increasingly widespread use of evaluating policy portfolios can likewise aid the more holistic analysis aimed for by the risk response feedback approach suggests evaluating bundles of climate policies or "portfolios."

Another promising example is the emerging social science treatment of "tipping points" in climate literature. These have long been under discussion with respect to physical and ecological parameters: for example, Timothy Lenton defined "tipping points" as occurring when "a small change in forcing triggers a strongly non-linear response in the internal dynamics of part of the climate system, qualitatively changing its future state" (Lenton, 2011; Bathiany et al., 2016). Lenton focused on causal feedbacks between aspects of natural world systems, for example, the possibility that "tipping of the Greenland or West Antarctic ice sheets would accelerate sea-level rise, in turn increasing the impact of hurricane-driven storm surges or tsunamis."

But the constituent parts of the social world also interact causally in ways that can produce sharp, non-linear interactions (Lemoine & Traeger, 2016). In one telling example, "the writings of one man, Martin Luther, injected through newly available printing technology into a public ready for such change, triggered the worldwide establishment of Protestant churches" (Otto et al., 2020). For this reason, Manjana Milkoreit and co-authors discuss "social tipping points": points "within an SES at which a small quantitative change inevitably triggers a non-linear change in the social component of the SES, driven by self-reinforcing positive-feedback mechanisms, that inevitably and often irreversibly lead to a qualitatively different state of the social system" (Milkoreit et al., 2018).

This helps explain why risk-response feedback is potentially of value to researchers and policymakers studying any aspect of climate science. After all, social system behavior may be relevant for even the tipping points Lenton describes in ecological terms and

thus on physical and ecological parameters (if that behavior, for example, causes emissions). Since risk-response feedback uses the SES approach, it provides a conceptual framework that integrates both social and ecological parameters and may be of use to researchers that want to combine the kind of analysis Otto et al. and Lenton both explain here. The risk-response feedback approach is well suited to this approach for social, ecological, and combined aspects of the SES and to the study of climate change and policy.

It is important to emphasize, in closing, that we do not take our proposal to reflect any kind of deep insight or development when it comes to either the significance of moral hazard or the current state of the climate debate. Indeed, if our proposal seems obvious, then we are happy to agree. Rather, our primary goal in proposing this framework is to reorient the debate over the behavioral risks of geoengineering towards a way of thinking about climate policy that is already gaining significant currency among climate researchers and policymakers. In this respect, our concern has more to do with the questions being asked and the options being considered than it does with concrete details of the models and policies being deployed. Nevertheless, it is these concrete details that will ultimately determine the viability and value of adopting any policy strategy on offer and which must be carefully evaluated before pursuing any policy intervention. Our hope is that the risk-response feedback approach will help lay the foundations for a more productive debate over how best to navigate the climate crisis we all face.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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