

Distinguishing morale hazard from moral hazard in geoengineering

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Abstract

Geoengineering is the deliberate modification of the climate system. It has been discussed as a technique to counteract changes expected as a result of Anthropogenic Global Warming (AGW).¹ Speculation has occurred that the possibility of geoengineering will reduce or delay efforts to mitigate AGW. This possible delay or reduction in mitigation has been described as 'moral hazard' by various authors. We investigate the definitions and use of the term 'moral hazard', and the related (but significantly different) concept of 'morale hazard', in relevant law, economic and insurance literatures. We find that 'moral hazard' has been generally misapplied in discussions of geoengineering, which perhaps explains unexpected difficulties in detecting expected effects experimentally.² We clarify relevant usage of the terms, identifying scenarios that can properly be described as moral hazard (malfeasance), and morale hazard (lack of caution or recklessness). We note generally the importance of correctly applying this distinction when discussing geoengineering. In conclusion, we note that a proper consideration of the risks of both moral and morale hazards allows us to easily segment framings for both geoengineering advocacy and the advocate groups who rely on these framings. We suggest mnemonics for groups vulnerable to moral hazard (Business as Usuals) and morale hazard (Chicken Littles) and suggest the development of an experimental methodology for validating the distinction thus drawn.

Keywords

Geoengineering, moral hazard, morale hazard, carbon dioxide removal, greenhouse gas removal, negative emissions technology, solar radiation management (SRM)

1. National Academy of Sciences, *Climate Intervention: Reflecting Sunlight to Cool Earth*, (National Academies Press: Washington, DC 20001, 2015); J. G. Shepherd et al., *Geoengineering the Climate: Science, Governance and Uncertainty* (Royal Society: London 2009).
2. J. Reynolds, 'A Critical Examination of the Climate Engineering Moral Hazard and Risk Compensation Concern' (2014) 2(2) *The Anthropocene Review* 174–191.

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Introduction

Climate change³ is one of the most important political issues of the twenty-first century. Significant economic expenditure will be required to address the problem.⁴ Considerable political capital has been expended to reach the necessary agreements⁵ to constrain rises in temperature. Difficulties in effecting a near-term transformation of the global energy system to decouple energy production from carbon emissions have led to the consideration of geoengineering as an alternative. This discipline can be broadly described as the deliberate modification of the climate system. Fundamentally, there are two prongs to the approach described as geoengineering.

First, the use of techniques described as either Carbon Dioxide Removal (CDR) or (more generally) Greenhouse Gas Removal (GGR). GGR includes the treatment of climate-forcing agents such as methane, as well as the more important carbon dioxide.

Secondly, the discipline of Solar Radiation Management (SRM) concerns itself with the direct adjustment of the planet's radiation balance, by reflecting incoming sunlight. Various SRM schemes have been suggested, such as: the use of mirrors in space, and the injection of sulphur-containing gases or aerosols into the stratosphere, to emulate the cooling effects of a volcanic haze.

While no large-scale geoengineering schemes exist today, nor do the technologies necessary to make them possible exist (in fully developed form), this theoretical technology is nevertheless exerting a significant present-day influence on both discourse and policy. The recent Paris agreement envisages extensive use of Negative Emissions Technology (NET) in the second half of the twenty-first century.⁶ In this context, NET can be taken to mean any technological process that produces a long-term removal of greenhouse gases, especially carbon dioxide, from the atmosphere.⁷ Were there no possibility of using CDR/NET to achieve carbon removal, extremely rapid and deep cuts to carbon emissions would be required to achieve the same eventual atmospheric CO₂ levels – potentially disrupting the global economy.

It is therefore possible that the even the theoretical existence of geoengineering technologies results in a reduced urgency to cut emissions.⁸ This has been described by various authors as 'moral hazard'.⁹ To summarise – the possibility of controlling future global temperatures without resorting to swinging and rapid cuts in emissions leads to concerns that even the *possibility* of future geoengineering will lead to a

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3. IPCC, 'Summary for Policymakers' in Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds) *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA 2013).
 4. N. Stern, *Stern Review on the Economics of Climate Change* (pre-publication edition). Executive Summary. (HM Treasury, London 2006). Archived from the original on 31 January 2010.
 5. For example, see 'Report of the Conference of the Parties on its twentieth session, held in Lima from 1 to 14 December 2014', United Nations, FCCC/CP/2014/10. Available at: <http://unfccc.int/resource/docs/2014/cop20/eng/10.pdf>.
 6. 'The Dirty Secret of the Paris Climate Deal'. *Foreign Policy* (2015) Available at: <https://uk.news.yahoo.com/dirty-secret-paris-climate-deal-120042875.html>. Last accessed 13 March 2016.
 7. Current examples include bio-energy with carbon capture and storage (BECCS), carbon-negative materials (e.g. concrete or olive), the use of air capture and both natural and artificial carbon sinks, etc.
 8. C. Baatz, Can We Have It Both Ways? On Potential Trade-offs between Mitigation and Solar Radiation Management (2016) 25(1) *Environmental Values* 29–49; J. Latham, P.J. Rasch, and B. Launder, 'Climate Engineering: Exploring Nuances and Consequences of Deliberately Altering the Earth's Energy Budget' (2014) 372(2031) *Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences*, 20140050.
 9. For the first usage of the term, see D.W. Keith, 'Geoengineering the Climate: History and Prospect 1 (2000) 25(1) *Annual Review of Energy and the Environment* 245–284. For the argument that concerns about moral hazard prevented any serious discussion of geoengineering before 2006, see C. Preston, 'Ethics and Geoengineering: Reviewing the Moral Issues Raised by Solar Radiation Management and Carbon Dioxide Removal' (2013) 4 *WIREs Climate Change* 23–37.

reduction in present-day mitigation efforts, especially by those who would deny the existence of climate change per se. Claims that geoengineering necessarily encounters varying degrees of moral hazard have been vigorously debated for over a decade without a decisive resolution, as opponents of the moral hazard argument have regarded it as vague, ambiguous and difficult to falsify.¹⁰ Fears about moral hazard in geoengineering have attracted some empirical validation in Britain, in a study commissioned by the Royal Society that asked whether or not the public found the moral hazard argument persuasive, while a recent large study in Kiel, Germany has shown the opposite to be the case there, namely that awareness of geoengineering technologies actually increases support for mitigation efforts.¹¹ One way forward is to continue the empirical work, while another is to critique the concept itself. In order to evaluate the appropriateness of this established nomenclature, we take an agnostic view on the normative debates, and instead discuss the appropriate use of the phrase ‘moral hazard’ in this context, with the hopes of clarifying some of the conceptual questions and promoting better framings of the issues in both theoretical and empirical literatures.

As a concept, ‘moral hazard’ has two distinct pedigrees. In the economics literature, in a general sense, a ‘moral hazard’ arises when one party takes risks they would otherwise avoid because another party is bearing the costs associated with those risks.¹² Although other variations are possible, these situations usually arrive either as the result of information asymmetries (known in economics as the ‘lemons problem’¹³) or as a result of a principal–agent problems, which are essentially conflicts of interest:¹⁴ thus what one set of authors described as the distinction between ‘hidden information’ and ‘hidden action’.¹⁵ Both categories of moral hazard were widely used to explain the misalignment of risks and incentives associated with the recent financial crisis, depending on whether or not the focus was on the conflicts of interest between traders and shareholders, mortgage underwriters and retail depositors, or on the investment bankers who structured opaque collateralised debt obligations and the investors who were sold them.¹⁶

10. For a summary of the refutation see B. Hale, ‘The World that Would Have Been: Moral Hazard Arguments against Geoengineering’, in *Reflecting Sunlight: The Ethics of Solar Radiation Management*. (Rowman and Littlefield: Lanham 2012). Influential interventions on both sides include M. Bunzl, Researching Geoengineering: Should Not or Could Not? (2009) 4(4) *Environmental Research Letters* 045104; A. Robock, et al., ‘20 reasons why Geoengineering May Be a Bad Idea’ (2008) 64(2) *Bulletin of the Atomic Scientists* 14–59; S.M. Gardiner, ‘Some Early Ethics of Geoengineering the Climate: A Commentary on the Values of the Royal Society Report’. (2011) 20(2) *Environmental Values* 163–188; A. Corner and N. Pidgeon, Geoengineering the Climate: The Social and Ethical Implications’. (2010) 52(1) *Environment: Science and Policy for Sustainable Development* 24–37; A. Borgmann, et al. *Engineering the Climate: The Ethics of Solar Radiation Management*. Rowman & Littlefield: Lanham, 2012; A.C. Lin, ‘Does Geoengineering Present a Moral Hazard’ (2013) *Ecology LQ*, 40, 673; D. McLaren, ‘Guns Do Kill People: Reasons To Worry About Moral Hazard In Geoengineering – Duncan McLaren’. (2013) *FCEA*. Available at: <http://dcgeoconsortium.org/2015/02/01/guns-do-kill-people/>.
11. A. Corner, and N. Pidgeon, ‘Geoengineering, Climate Change Scepticism and the ‘Moral Hazard’ Argument: An Experimental Study of UK Public Perceptions. (2014) 372 (2031) *Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences* 20140063; C. Merk, G. Pönitzsch and K. Rehdanz ‘Knowledge about Stratospheric Aerosol Injection Does Not Decrease Mitigation’. (2016) 11 *Environmental Research Letters* 054009. Available at: <http://dx.doi.org/10.1088/1748-9326/11/5/054009>.
12. K. Arrow, *Essays in the Theory of Risk-bearing* (Chicago: Markham, 1971).
13. G.A. Akerlof, ‘The Market for “Lemons”: Quality Uncertainty and the Market Mechanism’ (1970) 84(3) *Quarterly Journal of Economics* 488–500.
14. M.C. Jensen, and W. H. Meckling, ‘Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure’ (1970) 3(4) *Journal of Financial Economics* 305–360.
15. O. Hart and B. Holmström, ‘The Theory of Contracts’ in T. Bewley (ed.) *Advances in Economics and Econometrics* (Cambridge University Press: Cambridge 1987) 71–155.
16. K. Dowd, ‘Moral Hazard and the Financial Crisis’ (2009) 29 *Cato Journal* 141; V.V. Acharya and S. Viswanathan, ‘Leverage, Moral Hazard, and Liquidity’ (2011) 66(1) *The Journal of Finance* 99–138.

While these distinctions are powerful, an equally important analytical distinction is made in the insurance literature between ‘moral’ and ‘morale’ hazard. We are not the first authors to suggest that maintaining this distinction is particularly useful in thinking about the hazards associated with policy responses to climate change,¹⁷ and we believe it is particularly salient in the case of geoengineering.

To introduce the concepts, and to emphasise the difference between them, we offer the following simple examples.

Morale hazard: a householder fails to replace the batteries in his fire alarm, install sprinklers or maintain his fire extinguishers. He does so because his insurance policy covers his risk of a fire and does not specifically require him to perform these actions. He is at best careless, at worst reckless. In this context, ‘morale’ denotes ‘esprit’, ‘disposition’, or ‘conscientiousness’ rather than the more commonplace meaning of ‘confidence’ or ‘mettle’.¹⁸

Moral hazard: a householder sets a fire deliberately, in the hope that it will spread – allowing him to refurbish his house at the expense of his insurance company. His act is distinguished from morale hazard by his *mens rea* – criminal intent. His intention is to profit from his insurance policy and thereby to cause the insurance company a loss.

While this distinction is clear in the field of insurance, it is often only haphazardly applied in other fields, especially the field of economics, where the aforementioned distinction between ‘hidden actions’ and ‘hidden information’ is often employed instead.

To elaborate the range of scenarios in which moral or morale hazard may operate, consider the following:

- a. *Ex-post* actions of one party to a contract may cause harm to another party after the completion of a financial transaction, such as a Credit Default Swap (CDS),¹⁹ where one party’s assumption of the risk of a default can incentivise another party to contribute to that outcome. For example, were a bank the subject of a CDS deal, one party to the contract would have an incentive to see the bank fail to meet its obligations. This may incentivise this party to act to undermine the bank’s creditworthiness (e.g. by circulating harmful rumours or information, so as to cause a run on the bank) or by aggressively shorting the firm’s stock.
- b. Issues may arise as the result of the aforementioned principal–agent problems, where the agent (usually the employee of a firm) may be incentivised to take on risk that is borne by the principals (shareholders) because monitoring is difficult or insufficient. This may particularly be the case where a bonus or commission system is in place, leading to situation where (for example) an employee may knowingly sign a sales or loan contract with a customer who is unlikely to pay their debt – knowing that he does not personally bear the risk of this contractual default, and will be paid a bonus as a result of the transaction (whether successful for otherwise).²⁰ These may be either moral or morale hazards, depending on the intentions of the actors. Bankers may intentionally work against the best interests of their clients or shareholders in order to receive higher levels of compensation in

17. R. McLeman and B. Smit, ‘Vulnerability to Climate Change Hazards and Risks: Crop and Flood Insurance’ (2006) 50 *The Canadian Geographer/Le Géographe canadien* 2217–226; J.D. Ford, et al., ‘How to Track Adaptation to Climate Change: A Typology of Approaches for National-level Application’ (2013) 18(3) *Ecology and Society* 40.

18. For the distinctions involved, see ‘morale, n.’. *OED Online*. March 2016. Oxford University Press. Available at: www.oed.com/view/Entry/122088?redirectedFrom=morale (last accessed 19 March 2016).

19. G.R. Duffee and C. Zhou, ‘Credit Derivatives in Banking: Useful Tools for Managing Risk?’ (2001) 48(1) *Journal of Monetary Economics* 25–54; A. Kimball-Stanley, ‘Insurance and Credit Default Swaps: Should Like Things Be Treated Alike?’ (2008) 15 *Conn. Ins. LJ*, 241; Beltratti, A. and Stulz, R.M., *Bank Sovereign Bond Holdings, Sovereign Shock Spillovers, and Moral Hazard during the European Crisis* (No. w21150) (National Bureau of Economic Research 2015).

20. A. Berndt and A. Gupta, ‘Moral Hazard and Adverse Selection in the Originate-to-Distribute Model of Bank Credit’ (2009) 56(5) *Journal of Monetary Economics* 725–743.

the short term, which is moral hazard or they may simply fail to exercise due care, such as in relaxing underwriting standards for sub-prime loans, because they knew they would be bundled up, collateralised and sold onto others. That is morale hazard.

- c. Information asymmetries more generally cause moral hazards. To summarize Akerlof's famous paper on the 'Lemons' Problem²¹: people who know their cars are lemons have good reason to sell them on to people who don't, thus increasing the cost of all used cars, under-pricing good ones and over-pricing bad ones. This also creates adverse selection for insurers (e.g. in the sale of breakdown insurance) which may be more frequently purchased by owners of unreliable cars. When this behaviour deliberately conceals serious defects, it can only be reasonably categorised as moral hazard. Otherwise, it is morale hazard.
- d. Recent studies of the insurance industry have shown significant cultural differences in perceptions of moral and morale hazard by insurers, both correctly in cross-cultural comparisons and incorrectly with respect to racial difference.²² Thus some communities may actually be more prone to these hazards, whereas others communities may be perceived erroneously to be more prone than average when they actually are not.

Obviously some of the associated hazards represent inducement to criminal behaviour (usually fraud) whereas others refer to inducements to negligent or reckless behaviour. Economic theorists are at some pains to point out that 'morality' is not central to their own usage of the terms,²³ as they can find precedent for the 'moral' in 'moral hazard' to mean both 'fundamental principle of right and wrong' and 'sense of confidence or purpose' well back to the eighteenth century.²⁴ This, however, is largely because 'moral' and 'morale' were spelled interchangeably – not because of any confusion over the intended contemporary meaning.²⁵

Other authors have deliberately tried to make morality central to the argument, which can cause confusion in lay audiences. To some extent, this confusion is perpetuated by the uses of 'moral hazard' in certain scholarly literature in the fields of philosophy and ethics, where moral hazard is the result of the aforementioned principal-agent (or agency) problem and denotes a 'lack of effort' on behalf of the agent when insufficiently monitored by the principals.²⁶ Theories of 'moral motivation' and 'moral sensitivity' offer a partial solution, particularly in the organisational theory literature, when discussing, for instance, how to design optimal salary contracts that try to minimise shirking on the part of workers.²⁷ A related literature tries to understand how to overcome moral hazard problems of this variety when developing codes of professional ethics.²⁸ Although both literatures are helpful for thinking about the ethical and moral

21. G.A. Akerlof, 'The Market for "Lemons": Quality Uncertainty and the Market Mechanism' (1970) 84(3) *Quarterly Journal of Economics* 488–500. doi:10.2307/1879431.
22. Y. Sakai and Y. Maeda, *Japanese Risk Management as a Product of Social Culture: with Special Reference to Insurance Companies* (2009) Working Paper No. A-13; G.D. Squires, 'Racial Profiling, Insurance Style: Insurance Redlining and the Uneven Development of Metropolitan Areas' (2003) 25(4) *Journal of Urban Affairs* 391–410; F. Barachini 'Cultural and Social Issues for Knowledge Sharing' (2009) 13(1) *Journal of Knowledge Management* 98–110.
23. A.E. Dembe and L.I. Boden, 'Moral Hazard: A Question of Morality?' (2000) 10(3) *New Solutions* 257–279.
24. T. Baker, 'On the Genealogy of Moral Hazard' (1996) 75 *Tex. L. Rev.* 237.
25. The problem was compounded by the widespread use of French cognates in literature ('morale' is the plural of 'moral', i.e. 'morals' in French); the current spelling and associated distinctions became standard in both American and British English only in the first half of the nineteenth century. See above citation of 'morale, n.' *OED Online*. Oxford University Press, 13 March 2016.
26. K.M. Eisenhardt, 'Agency Theory: An Assessment and Review' (1989) 14(1) *Academy of Management Review* 57–74.
27. D.E. Stevens and A. Thevaranjan, 'A Moral Solution to the Moral Hazard Problem' (2010) 35(1) *Accounting, Organizations and Society* 125–139; K.A. Brekke and K. Nyborg, *Moral Hazard and Moral Motivation: Corporate Social Responsibility as Labor Market Screening* (2004) (No. 2004, 25). Memorandum, Department of Economics, University of Oslo.
28. K. Jamal and N. E. Bowie, 'Theoretical Considerations for a Meaningful Code of Professional Ethics' (1995) 14(9) *Journal of Business Ethics* 703–714; R. Santore and A. D. Viard, 'Legal Fee Restrictions, Moral Hazard, and Attorney Rents' (2001) 44(2) *Journal of Law and Economics* 549–572.

dimensions of agency problems, they are not particularly relevant to the challenges posed by geoeengineering. It is essentially an outgrowth of the agency theory as framed by economists, whatever the normative overtones.²⁹

The problem with the moral hazard as used in economic theory is that it does not sufficiently consider the specific nature of the hazard. As described above, a more subtle use of the term can be found in the insurance sector and the law that accompanies it. In these literatures, moral and morale hazard are held as distinct.

In insurance, a morale hazard arises when an insured party is indifferent to risks because another party is insuring them. This indifference may take the form of:

- a. a lack of due diligence (in say writing self-certified mortgage loans);
- b. a lack of due care (by failing to buy a fire or burglar alarm; or by failing to install sprinklers); and
- c. a lack of caution³⁰ (failing to wash your hands to prevent viral and bacterial transmissions because you have health insurance), etc.

There is no necessary moral turpitude and the indifference, even when it might lead to carelessness or recklessness, is by no means criminal. Insurance policies can be written to require some precautions (e.g. fire alarms, burglar alarms, health screenings, etc.) with cancellation or increases in premiums if thresholds are not met, but the risk-seeking behaviour need not be conscious – let alone malicious. Most insurance companies try to reduce these by monitoring premiums and imposing ‘deductibles’ in American English, or ‘excesses’ as they are known in British English. Equally, research has shown that a certain amount of morale hazard can even be attributed to uncertainty on the part of the insured about what their policy covers, which leads to complacency even when the loss so sustained is not, in actual fact, covered by the policy.³¹

A moral hazard is one that results when the fact of insurance creates a positive incentive for risk-taking. At the extremes, it includes actions that are obviously criminal (e.g. burning down a house because you’ve insured it), to actions that meet the criteria for civil rather than criminal frauds (concealment of material information – such as a driver failing to declare previous accidents or convictions), to actions that are the result of conflicts of interest (see principal–agent problems) that the agent should have been able to foresee. Moral hazards ought to be subject to regulation and criminal statute, though in the insurance industry co-pays (where the insured pays a flat-fee contribution to each claim) and deductibles are also used to curb frivolous claims. The insurance industry has been good at self-regulating against them, which is why, in 1746, the Lloyds Syndicate banned taking out life insurance on third parties on whom the policy holder had no insurable interest (i.e. was not a parent, partner or child) because that created a positive incentive to murder.³² The same applies to property and casualty insurance, and is the basis for the doctrine of insurable interest.³³ You can’t insure your neighbour’s house because you will not suffer the loss, if it burns down.

It should be emphasised that, when delineated in this fashion, those parties who are prone to morale hazard (in the form of diminished conscientiousness and indifference to taking risk-reducing measures) in a particular set of circumstances are generally not the same people who are susceptible to moral hazard (i.e. those who engage in the deliberate assumption of risk with the intention to profit at the expense of the party

29. D. Rowell and L.B. Connelly, ‘A History of the Term “Moral Hazard”’ (2012) 79(4) *Journal of Risk and Insurance* 1051–1075.

30. Conventionally ‘lack of caution’ implies a lack of reasonable foresight as to likely consequences, whereas ‘due care’ refers to the manner in which an action is performed. See J.A. Appleman, ‘Duty of Liability Insurer to Compromise Litigation’ (1937) 26 *Ky. L.J.*, 100.

31. D.A. Kerr, ‘Understanding Basis Risk in Insurance Contracts’ (2006) 9(1) *Risk Management and Insurance Review* 37–51.

32. R.W. Duesenberg, ‘Insurer’s Tort Liability for Issuing Policy without Insurable Interest’. (1959) *California Law Review* 64–73.

33. A. Minto, ‘Early Insurance Mechanisms and Their Mathematical Foundations’ (2008) 5(2) *The Mathematics Enthusiast*, Article 16; J. Oldham, ‘Judicial Activism in Eighteenth-Century English Common Law in the Time of the Founders: The More Things Change, the More they Stay the Same’ (2005) *Green Bag 2d* 8, 269–404.

providing the insurance).³⁴ Although both parties may suffer from diminished moral sensitivity, insurance companies confront these hazards differently: they deal with morale hazard by changing the provisions of insurance policies, whereas they combat moral hazard by recourse to the criminal justice system.³⁵

By the same token, not all attempts to exploit information asymmetries are the result of moral hazard (i.e. the mere fact of hidden information making a party tempted to act upon it). Moral hazard is not at the base of every fraud. Some parties simply intend to commit fraud from the outset. For instance, public ignorance about medicine might make the public vulnerable to snake-oil salesmen, and may make some parties tempted to sell snake oil when they would not have done it otherwise. Those people are vulnerable to moral hazard. Other people always intended to commit fraud. What makes the Lemon Problem is that there is a market for used cars; some of them are good, others are bad and only the seller knows what they have. This creates a moral hazard if they withhold the fact that their car is a lemon and has hidden problems. Failing to disclose faults, unless specifically asked, is not required and, in fact, forms part of the 'caveat emptor' rule.³⁶ If the seller claims, when queried, that the car has an engine and it turns out that it does not, they are simply committing fraud.

Discussion

One of the key issues in geoengineering is the idea that the existence of techniques for climate change engineering represent what we would classify as a morale hazard, namely that they reduce the political will to cut carbon emissions, or that they might make individuals or society less inclined to change behaviours.³⁷ In that sense, some climate change campaigners are afraid that the public will see geoengineering as a kind of magical 'get out of jail free' card. Alternatively, and somewhat more worryingly, some regimes (signatories even to Climate Accords) may devote resources to geoengineering as a way of bartering against compliance with voluntary carbon-reduction quotas. Private providers of geoengineering services are also incentivised to over-promise and under-deliver given the long-term ideas involved.

It would be generally helpful in economic theory to revive the distinction of moral and morale hazards, and to apply it rigorously. Climate change, and specifically geoengineering, represents an example where such a distinction is particularly merited. This is principally the case because externalities are so high. Climate change entails both catastrophic risks, and widespread harms, which necessarily will be socialised. It is important because insurance companies have already begun to consider how they can help to insure the safety issues associated with geoengineering.³⁸ It is thus also helpful for policy-makers and advocacy groups to understand how the insurance industry conceptualises the problem.

It is helpful at this point to give examples relevant to geoengineering, which can capably distinguish between moral and morale hazards.

Moral hazard may exist when a fossil fuel company pays to lobby for legislation changes, which will defer or reduce mitigation efforts, based on the argument that geoengineering renders such cuts unnecessary. To meet the test for moral hazard, a number of criteria would have to be met.

34. D.A. Stone, 'Beyond Moral Hazard: Insurance as Moral Opportunity' (1999) 6 *Conn. Ins. LJ*, 11.

35. C.A. Heimer, *Reactive Risk and Rational Action: Managing Moral Hazard in Insurance Contracts* (Vol. 6) (University of California Press: Berkeley 1989).

36. For the relationship between the 'caveat emptor' rule and information problems, see J. Vickers, 'Economics for Consumer Policy'. In *Proceedings of the British Academy* (Vol. 125) (Oxford University Press: Oxford, 2004) 304.

37. See Corner, and Pidgeon above n. 11. Contra Corner and Pidgeon, we do not consider their 'social,' 'individual' or 'political' moral hazard distinctions to be particularly helpful, as they are variants of the same logic.

38. E. Mills, A global review of insurance industry responses to climate change. (2009) 34(3) *The Geneva Papers on Risk and Insurance-Issues and Practice*, 323–359, esp. p. 326.

- a. The firm would have to have a vested interest in the transaction.
- b. The interest would have to be served by the use of geoengineering.
- c. The firm would have to be making representations in favour of geoengineering which were either knowingly false, or which served to promote a decision-making process that grossly and wilfully favoured its own interests over those of society.

The key test in the above is of malfeasance: deliberate actions, which harm their transactional counterparty for financial gain. In this case, the counterparty is global commons, as the bearer of any negative externalities, and the global community has to act as the insurer of last resort.

Morale hazard may exist where a householder votes for a party, which places an emphasis on geoengineering technology, over and above mitigation. The householder in this example would not be deemed to have a particular vested interest in the use of geoengineering, other than as a member of wider society. It is *possible* to recast such an action as moral hazard, in that the householder would be socialising risks onto future generations.³⁹ However, we consider in this instance that the householder has a normal level of care for their descendants. Accordingly, what we see here is best described as a potential recklessness to risk to future generations, rather than in the above example of moral hazard, in which the malfeasance is obvious. In the case of the householder (morale hazard), they do not *will* the transaction to harm their counterparty – in fact, the reverse is true. They simply are vulnerable to misjudging risk. In the case of the oil firm, they are advocating a course of action knowing that this inherently results in an unfair transaction between themselves and society. Akin to Akerlof's 'lemons', they are party to a transaction in the fulsome knowledge that they are passing an inequitable deal to their counterparty. This deal *necessarily* results in harm to the counterparty – at least on average.

Accordingly, we can consider one possible approach to judging the advocacy of geoengineering. Evaluating the extent to which a geoengineering advocate is financially leveraged to the fossil-fuel economy, enables us to appraise whether they are more vulnerable to moral hazard, or morale hazard. The more leveraged a party is to fossil fuels, the more we can regard their actions as vulnerable to moral hazard, as opposed to morale hazard.

This logic would appear to help divide geoengineering advocates into two 'camps', broadly in line with their degree of leverage (both financial and psychological) to the fossil fuel economy or to geoneengineering as a nascent industry. While it would be unfair to paint all those vested in fossils as malfeasant, there necessarily exists a greater *risk* of malfeasance among those who are so leveraged.

In further clarification, not all parties that act in bad faith are necessarily guilty of moral hazard. They may act in bad faith in order to profit directly. For instance, a geoengineering firm that deliberately over-promotes the merits of the technologies it is developing, knowing those claims to be false or misleading, to take advantage of anticipated subsidies, would be guilty of trying to take advantage of information asymmetries, and might possibly be accused of fraud. However, this particular behaviour is not necessarily the consequence of moral hazard per se. One might, however, conceive of scenarios where geoengineering technology firms are prone to moral hazard, for instance if they campaign against mitigation efforts to ensure that there will be demand for geoengineering solutions.

By the same token, climate change deniers (by which we denote those who are presented with clear evidence of anthropogenic global warming, but who nevertheless refuse to publicly acknowledge its existence) who endorse geoengineering as a vehicle for reducing political support for the mitigation efforts of others are not themselves prone to morale hazard (as they feign not to believe anthropogenic climate change exists, when they know it does), but they may well be trying to take advantage of the morale hazard

39. See for example K. Parkhill, Karen, and Nick Pidgeon, 2011. Public engagement on geoengineering research: preliminary report on the SPICE deliberative workshops. *Understanding Risk Working (2011–11)* 29.

experienced by the wider public. Those bad actors are falling prey to moral hazard. There may also be ‘mixed’ effects, in which individuals can more easily be lulled into complacency, because they are sceptical of the realities of climate change (or the extent to which it is anthropogenic) and of the likelihood of successful mitigation efforts, and they too may be prone to morale hazard.

To further aid our discussions, we divide geoengineering advocacy into two framings. As a mnemonic only, we will describe them as ‘Chicken Littles’ and ‘Business as Usuals’. The existence of opposing camps, and the complex interplay between them, has been noted by other authors. Steven F. Hayward notes: ‘there might ironically be surprising agreement between environmentalists and conservatives over geoengineering, albeit for opposite reasons’.⁴⁰ Cairns and Stirling also note a range of competing framings for geoengineering, although they do not limit their analysis to advocacy.⁴¹ By contrast, Corner and Pidgeon use a grouping comparable to our own,⁴² as does Kahan⁴³ (using the labels ‘Hierarchical Individualists’ and ‘Egalitarian Communitarians’). We suggest that a clear understanding of moral versus morale hazard can help better understand the ideological division between these groups, and can also help analyse their rationale and decision-making processes.

Our ‘Chicken Littles’ advocate geoengineering because ‘the sky is falling’ – they perceive climate change as an existential threat, and fear that mitigation efforts, in themselves, will prove inadequate. This group is likely to be characterised by a low economic leverage to the fossil economy, and a high willingness to honestly discuss the potential pitfalls of geoengineering. They are potentially vulnerable to morale hazard – a misguided or hubristic faith in the usefulness of geoengineering. Those in the ‘Chicken Little’ camp are more likely to hold the view that geoengineering is not an alternative to mitigation, but is a complement to it⁴⁴ – buying time and reducing risks which persist even under a mitigated future. Our hypothesis appears to be born out experimentally, in that recent research at Kiel has independently found that members of the public ‘do not back-pedal on mitigation when they learn that the climate change problem could be partly addressed via Stratospheric aerosol injection (SAI)’.⁴⁵

By contrast, the ‘Business as Usuals’ can be characterised by a high level of financial (or possibly psychological/political) leverage to the fossil fuel economy. They typically use arguments such as those set out in the popular and influential book ‘Freakonomics’.⁴⁶ This economics-led stance on geoengineering presents an argument that can be crudely summarised as ‘get out of jail (nearly) free’. Framing the argument in this manner fits their stance well, but it has of course been controversial among those with other frames – notably climate scientists, who rarely, if ever, view geoengineering (especially SRM) as a substitute for mitigation, but instead as a complement to it.⁴⁷ What we term the ‘Business as Usuals’ advocacy group has also been linked to climate denial.⁴⁸

40. S.F. Hayward, ‘Conservatism and Climate Science’ (2014) 30(3) *Issues in Science and Technology* 52.

41. R. Cairns and A. Stirling, “‘Maintaining Planetary Systems’ Or “‘Concentrating Global Power?’” High Stakes in Contending Framings of Climate Geoengineering’ (2014) 28 *Global Environmental Change* 25–38.

42. See Corner and Pidgeon above n. 11.

43. D. Kahan, 2016. Cultural Cognition Project – Cultural Cognition Blog – Could Geoengineering Cool The Climate Change Debate? *Culturalcognition.net*. Available at: www.culturalcognition.net/blog/2016 (Last accessed: 19 March 2016).

44. See Royal Society above n. 1

45. C. Merk, G. Pönitzsch and K. Rehdanz, 2016. Knowledge about stratospheric aerosol injection does not decrease mitigation. *Environmental Research Letters*. Vol. 11. 054009. Available at: <http://dx.doi.org/10.1088/1748-9326/11/5/054009>.

46. S.D. Levitt and S.J. Dubner, *Freakonomics: A Rogue Economist Explores the Hidden Side of Everything* (Revised and expanded edition). (William Morrow: New York, 2006) xiv. See also S.D. Levitt and S.J. Dubner, ‘Superfreakonomics: Global Cooling, Patriotic Prostitutes and Why Suicide Bombers Should Buy Insurance’ (2009) *New York Times*.

47. ‘Why Superfreakonomics Authors are Wrong on Geo-Engineering’ (2009) *The Guardian*. 13 March 2016; A. Gelman and Kaiser Fung, ‘Freakonomics: What Went Wrong?’ (2012) 100(1) *American Scientist* 6.

48. D. Appell, *Strange Bedfellows? Climate Change Denial and Support for Geoengineering* (2013) Yale Climate Connections.

When considering the ‘Business as Usuals’, we note both their high level of investment in the fossil economy, and their increased likelihood of denial of relevant science. This group is therefore generally more prone to moral hazard in advocacy of geoengineering. They are likely to invest in geoengineering technologies, to fund research that overstates their potential benefits, and to discourage mitigation efforts. To be specific, they are at risk of advocating geoengineering because it allows them to further their economic and other interests at the (relative) expense of wider society, secure in the knowledge that they will not have to pay for the damage they cause. They may be secondarily prone to morale hazard if they suffer from confirmation bias, the tendency to ‘believe their own press releases’ (about the efficacy of geoengineering), but primarily the ‘Business as Usuals’ are all too aware of what they stand to gain by geoengineering advocacy.⁴⁹

By contrast, the ‘Chicken Littles’ are not prone to moral hazard. However, they may still be prone to morale hazard – in that they may advocate geoengineering without a thorough appraisal of the risks. While they may advocate geoengineering in a manner aligned with the traditional and erroneous ‘moral hazard’ description (i.e. using geoengineering as a way to justify delaying or reducing mitigation), they may also be guilty of another form of morale hazard. Specifically, they may advocate geoengineering hubristically, in spite of the risks.⁵⁰

Conclusions

Our discussion of what is commonly termed ‘moral hazard’ in relation to geoengineering has revealed that it is, in fact, a conflation of two separate concepts: moral hazard and morale hazard. Furthermore, the definition of ‘morale hazard’ fits better the phenomenon traditionally discussed under the moniker ‘moral hazard’. The result of this confusion has been a failure to tie in a large body of relevant literature on the subject, and a failure to analyse these important concepts with appropriate precision. This has manifested itself in a concept that, despite being entrenched in geoengineering literature, has failed to find direct support from experimental data, and only limited indirect support through the Royal Society survey about perceptions of how ‘other people’ might respond to news of geoengineering.

We have identified from the literature the (generally inappropriate) use of ‘moral hazard’ in existing geoengineering literature, and its (correct) use in other fields. Our strong recommendation is that writers on the subject (as relevant to geoengineering) avail themselves of both the relevant definitions and associated literature, thereby bringing it in line with the technical distinction between the two that prevails in the insurance industry.

Specifically, we find that the concepts of moral hazard and morale hazard are *both* relevant to discussions of geoengineering. In particular, we find that:

- the concept of moral hazard is most relevant to situations where the party under discussion has a specific vested interest in continuing pollution under a business-as-usual situation,
- morale hazard to be most relevant when discussing parties who have a lesser degree of financial dependency on the outcome – and may be regarded as merely complacent or hubristic, rather than actively malfeasant.

49. For a discussion of these confirmation biases, see D.M. Kahan, ‘The Politically Motivated Reasoning Paradigm’ (2015) *Emerging Trends in Social & Behavioral Sciences*, *Forthcoming*.

50. J. Horton, ‘Geoengineering Politics: Climate Scientists, Geoengineering Community Slam AMEG’. Available at: www.geoengineeringpolitics.blogspot.co.uk. (Last accessed 13 March 2016).

We label these groups ‘Business as Usuals’ and ‘Chicken Littles’ respectively, purely as mnemonics to aid discussion.

This separation of morale hazard from moral hazard has several advantages. First, it suggests that consciousness-raising can be effective with the unleveraged wider public, because morale hazard is relatively benign and amenable to educative efforts designed to promote moral sensitivity about a particular issue, as well as to incentives, such as those used by the insurance industry (lower premiums, deductibles, preventive medicine, tax credits for carbon reduction, etc.)⁵¹ Genuine moral hazard, on the other hand, with its intractable conflicts of interest, ordinarily requires intervention by regulators or the courts.

Second, it opens up new avenues for empirical work. Our next step is to determine the usefulness of our new groupings of those vulnerable to moral hazard (Business as Usuals) and morale hazard (Chicken Littles) for understanding the various motivations behind geoengineering advocacy. We believe that our typology can help to reconcile the UK and Kiel studies, in that morale hazard better explains why the British public might believe that most of their compatriots will not reduce their carbon footprint if they think technology will solve the problem, whereas German citizens are more likely to support mitigation efforts once they themselves are educated about geoengineering. As we acknowledge above, some of this may also be the result of cultural differences in vulnerability to morale hazard when discussing climate change, but it is also possible that educative efforts can shift attitudes among those prone to morale hazard in both countries.

We also plan to extend our investigation of moral versus morale hazard in geoengineering to the United States, where engagement with climate change is less well-developed than it is in Germany. We postulate that the Chicken Littles may well be amenable to educative efforts about the realities of climate change and the possibilities of geoengineering, and that, as such, the problem is not intractable. We expect the Business as Usuals, on the other hand, will be deaf to such efforts.

Finally, our distinction promotes rigour in policy discussions insofar as it helps policymakers anticipate both the morale and moral hazards associated with treaty provisions for Negative Emissions Technologies, which are presumed to be only decades away.

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51. Some specific strategies for addressing moral and morale hazards are discussed in X. Landes, ‘Moral Hazard’ in *Encyclopedia of Corporate Social Responsibility* (Springer: Berlin Heidelberg 2013) 1715–1722.