Chapter 12
Complex Technology, Complex Calculations: Uses and Abuses of Precautionary Reasoning in Law

Deryck Beyleveld and Roger Brownsword

Abstract After a honeymoon period in environmental law, the so-called "precautionary principle" has received sustained criticism. This paper does not try to rescue the precautionary principle as such. However, it is argued, using Pascal's Wager, that there are conditions under which precautionary reasoning is valid, which provides a general principle for the limiting case. Although the limiting principle does not apply straightforwardly to the principle that those accused of criminal offences should not be convicted unless found guilty beyond all reasonable doubt, this case suggests an alternative principle that employs precautionary reasoning in a proportionate manner. To apply the limiting principle involves difficult judgments about the relative undesirability of options presented and the proportionality of the precautionary response. Nevertheless, it is argued that the limiting principle provides a strong argument against the death penalty, and that precautionary reasoning is more widely involved in legal reasoning than generally appreciated; e.g., wherever the burden of proof is placed more strongly on one party, where the threshold in relation to a particular option is raised, and, perhaps, in slippery slope and floodgates arguments.

Keywords Precaution · Precautionary principle · Precautionary reasoning · Pascal · Gewirth · Burden of proof · Slippery slope · Floodgates · Proportionality

12.1 Introduction

According to the philosopher, James Moor, "[t]echnological revolutions do not arrive fully mature."[1] Rather, they take time, unfolding in stages and gathering pace as knowledge, understanding, and use of the technology spreads. If this is true

D. Beyleveld (✉)
Durham Law School, Durham University, Durham, United Kingdom
e-mail: deryck.beyleveld@durham.ac.uk

[1] James H. Moor, "Why We Need Better Ethics for Emerging Technologies" in Jeroen van den Hoven and John Weckert (eds), *Information Technology and Moral Philosophy* (Cambridge: Cambridge University Press, 2008) 26, at 27.

P. Sollie, M. Düwell (eds.), *Evaluating New Technologies*, The International Library of Ethics, Law and Technology 3, DOI 10.1007/978-90-481-2229-5_12,

of technological revolutions, it is also true of, so to speak, subrevolutions—that is, of technological revolutions that are embedded in another larger technological revolution—of the kind associated with, for example (Moor's own examples), mobile phone technology and the Web (in each case, representing a subrevolution within the larger revolution in computer technology)[2]; and, no doubt, much the same might be said about the development of ultra-fast telecommunication technologies. Crucially, as Moor puts it, the futures of such technologies, "like the futures of small children, are difficult to predict."[3] In this context, and especially so in relation to modern technologies (information, bio, nano, and neurotechnologies) that have enormous manipulative, transformative and disruptive potential,[4] it is entirely understandable that regulators should be urged to adopt a precautionary approach—indeed, such exhortation is entirely understandable whether precaution is understood broadly as the taking of steps to assess, manage or reduce risk or, more narrowly, as the avoidance of risk-taking in the face of uncertainty about the existence of conceivable risk.

Whilst a precautionary approach in a broad sense commands widespread support, the so-called "precautionary principle", after enjoying something of a honeymoon period in the hands of environmental lawyers, has become a target for sustained criticism. The principle, as formulated by the Nuffield Council on Bioethics, holds that regulators may "impose restrictions on otherwise legitimate commercial activities, if there is a risk, even if not yet a scientifically demonstrated risk, of environmental damage."[5] However, the precautionary principle is formulated in many different ways[6]—indeed, as its critics would have it, in far too many different ways[7]—such that many now doubt that it offers a sound basis for regulation.

The purpose of this paper is not to rescue the precautionary principle as such. Along with its critics, we accept that the most controversial uses of precautionary reasoning are those that conclude that, because an activity might possibly have consequences that are catastrophic, the activity should not be engaged in at all. While

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[2] Ibid., at 31–32.

[3] Ibid at 27.

[4] Compare Mathias Klang, *Disruptive Technology* (Göteborg: Göteborg University, 2006).

[5] Nuffield Council on Bioethics, *Genetically Modified Crops: The Ethical and Social Issues* (London, May 1999) at 162. For a more specific elaboration, see *Pfizer* [2002] ECR II-3305, at para 143: "a preventive measure cannot properly be based on a purely hypothetical approach to risk, founded on mere conjecture which has not been scientifically verified." So, mere conjecture and hypothesis will not suffice. But, a precautionary measure may apply where the risk "has not yet been fully demonstrated" (para 146). The underlying science must be consistent with principles of "excellence, transparency and independence" (para 172).

[6] For helpful recent overviews of the EC jurisprudence, see Veerle Heyvaert, "Guidance Without Constraint: Assessing the Impact of the Precautionary Principle on the European Community's Chemicals Policy" (2006) 6 *The Yearbook of European Environmental Law* 27, esp. 29–37, and "Facing the Consequences of the Precautionary Principle in European Community Law" (2006) 31 *European Law Review* 185.

[7] For a recent assault on the principle, see, e.g., Gary E. Marchant and Douglas J. Sylvester, "Transnational Models for Regulation of Nanotechnology" (2006) 34 *Journal of Law, Medicine and Ethics* 714.

general application of such a principle undoubtedly has absurd consequences, we will argue, using Pascal's Wager[8] as a starting point, that there are conditions under which such reasoning is valid, which we will state by formulating a general principle for the limiting case. We will then examine the possible application of this limiting principle to the well known principle that those accused of criminal offences should not be convicted unless found guilty beyond all reasonable doubt. We will argue that the principle does not apply straightforwardly in this case. However, an alternative principle, which employs precautionary reasoning in a proportionate manner is suggested by this case. In its application, this principle calls for some difficult judgments concerning both the relative undesirability of the options with which one is presented and the proportionality of the precautionary response that is taken. Nevertheless, we will argue that the limiting principle does at least provide a powerful argument against the death penalty.

If our reflections to this point are sound then they suggest that precautionary reasoning is involved in all instances where the law places the burden of proof more strongly on one party, or where the threshold in relation to a particular option is raised—for example, after the (Butler-Sloss) Cleveland Inquiry, the regulatory response was to make it more difficult for child protection units to justify removing a child (for its own safety) from the family home.[9] It also seems to be the case—and we are mindful of Mark Twain's warning that, once we find a hammer, everything starts to look like a nail—that precaution is much more widely implicated in legal reasoning than we perhaps might have appreciated. Is it not the case, for example that precaution, if not in so many words, is also implicated in slippery slope (and, possibly, floodgates) arguments?[10]

The paper is in five principal parts. First, we sketch the reasons why the precautionary principle is open to a multitude of interpretations as well as being unbalanced in its application. If a principle of precaution could be expressed in a much tighter way and if the lack of balance could be overcome, then we might have a principle that regulators should employ. Secondly, we examine Pascal's Wager as a possible model for precautionary reasoning from which we derive a suggested principle of precaution. Thirdly, we examine the application of this principle to the paradigmatic presumption of innocence, the so-called "golden thread" of criminal justice systems, and argue that it requires modification if it is to be widely applicable.[11] Fourthly, we consider the relationship between our precautionary model and slippery slope arguments. And, finally, by focusing on the recent *Biotech Products* (GM crops)[12] dispute at the WTO, we uncover a further complication about the

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[8] See Blaise Pascal, *Pensées,* trans A., J. Krailsheimer (London, Penguin 1966) p. 151.

[9] The standard is set by the " significant harm" test in s. 31(2) Children Act, 1989.

[10] See Shaun D. Pattinson, *Medical Law and Ethics* (London: Sweet and Maxwell, 2006) pp.15–17.

[11] *Woolmington v DPP* [1935] AC 462, 480 (per Viscount Sankey).

[12] *European Communities—Measures Affecting the Approval and Marketing of Biotech Products* (WT/DS291/23 (United States), WT/DS292/17 (Canada), and WT/DS293/17 (Argentina), August 8, 2003), decided by the WTO in Autumn 2006.

relationship between precautionary policies, scientific uncertainty, and cultural and moral differences.

Our conclusions are twofold. Our first conclusion is that any model of precautionary reasoning, even if not open to the objections ranged against the precautionary principle, will prove controversial in its application because, in the final analysis, we are trying to make moral judgments that are contested, not only as a matter of moral principle, but also in relation to the evidence on which they draw. Our second conclusion is that it is worthwhile to undertake a systematic analysis of the role that precautionary reasoning plays (and should play) in law generally.[13] Even if precaution is not quite everywhere in the law, it is a pervasive fact of regulatory life. To this extent, this paper is the beginning of a prospectus for a full-scale inquiry into the role of precaution and proportionality in the law, the challenge being to identify the basis on which regulators can make good use, not abuse, of precautionary policies.

12.2 The Precautionary Principle and the Standard Critique

If environmental sustainability, biodiversity, and a green ecosphere are all that concern us, then we will probably embrace the precautionary principle. Any activity that might be damaging to the environment should simply not be pursued. Period. However, once the precautionary principle is offered up for general application, its weaknesses are all too apparent. In particular, it invites any number of interpretations and it seems to ignore the sacrifice that is made for the sake of precaution.

The invitation to read the precautionary principle in more than one way arises because its particular formulation hinges on the meaning that we give to the variables that are implicated in the articulation of the principle. Characteristically, we find the following four key variables:

(i) a degree of scientific uncertainty;
(ii) concerning some class, kind, or type of hazard;
(iii) where the damage or hazard is of a certain degree of severity/probability;
(iv) as a result of which some steps to avoid having to risk the hazard are advocated.

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[13] Nicolaas de Sadeleer has written an excellent treatise on the role and function of, amongst other principles, "the precautionary principle" in law in his *Environmental Principles: From Political Slogans to Legal Rules* (Oxford: Oxford University Press, 2002). The approach taken by de Sadeleer differs from our own in focussing on more or less explicit references to the precautionary principle in, for the most part, though not exclusively, environmental law from an historical perspective, rather than trying to develop a purely *a priori* analysis of features that would render a precautionary approach rational, which can then be used to identify uses of precautionary reasoning and their rationality in any area of law whether or not this is explicitly recognised. De Sadeleer's approach leads him to an important thesis about the function that a shift to a precautionary approach has in maintaining rationality in a system of "post-modern" law. Such an ideological focus is not necessarily incompatible with our own, but it is beyond the scope of this paper to consider his analysis in the light of our own.

We can speak briefly to each of these variables.

The degree of scientific uncertainty

If we use the language of lawyers, we can say that the scientific uncertainty is such that we cannot be sure *beyond all reasonable doubt* (or perhaps, even, all possible doubt) that risk of the relevant hazard either does or does not exist. It follows that those who argue for precaution must maintain either (a) that the evidence of relevant hazard being risked is made out on *a balance of probabilities* or (b) that the evidence falls short of that standard. Where advocates of precaution can make out the case on a balance of probabilities, so that the risk is more likely than not, then even if this does not yet qualify as a scientifically demonstrated risk, it is still a plausible basis for precaution. Characteristically, though, the argument for precaution does not meet this threshold and advocates are making out their case from a much less compelling platform—either from the very weak position that it has not yet been shown beyond all reasonable doubt that there is no risk, or that there is some evidence of risk albeit short of the balance of probabilities threshold. However, whether the case for precaution assumes that the evidence lies above or below the balance of probabilities threshold, there is scope for endless argument about just how strong the evidence needs to be before precaution kicks in.

The class, kind, or type of hazard or risk

In relation to the second variable, whereas in some communities, especially in scientific communities, precaution tends to be focused on risks to health and environment, in other communities, precaution is thought to be appropriately applied additionally to a broad class of economic, social, and cultural risks.[14]

The degree or character of the perceived hazard

Then, there are questions about the degree or character of the damage that is risked. With regard to severity, in relation to environmental hazards, it is often stipulated that the damage threatened must be serious and irreversible,[15] as well as large-scale.[16] But, the first and the third of these stipulations, in particular, leave plenty of room for interpretation. Moreover, these leeways in the interpretation of the precautionary principle carry over if it is applied to non-environmental risks—for example, to the risks associated with stem cell-based therapies or germ-line gene therapy. As regards probability, the issues concern what degree of probability associated with what severity of hazard justifies risk avoidance.

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[14] Compare, e.g., Ronald Sandler and W.D. Kay, "The National Nanotechnology Initiative and the Social Good" (2006) 34 *Journal of Law, Medicine and Ethics*, 675, at 679.

[15] As in the famous Principle 15 of the Rio Declaration (June 1992) which requires parties to "take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects." In this context, the Declaration continues: "Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures."

[16] See *EU Communication on the Precautionary Principle* (IP/OO.96) (February 2000).

The measure of precaution to be taken

Finally, once the principle is engaged, it remains to specify the required response. If there is a relevant risk, how is it to be tackled? Does precaution require outright prohibition or cessation, or is it sufficient to limit or adjust the activity or simply to monitor it?[17] Again, the opportunities for finessing the principle are endless.[18]

However, even if the variables within the precautionary principle could be stabilised, we should not forget the potential perversity of precaution, surely nowhere better exemplified than in the price paid by Samuel Butler's fictitious Erewhonians when they decided to destroy their machines for fear that they would supplant humans.[19] Modernising this old lesson, Cass Sunstein has subjected the precautionary principle to a damning critique. Sunstein's point is that the taking of precautionary measures—or, at any rate, the taking of precautionary measures that involve giving up some activity—itself involves risk (sacrifice) and that this must be brought into what is otherwise a one-sided narrow screen calculation.[20]

To appreciate the force of this point, we need only reflect on the choice between a safety-first (ex ante) regulatory strategy that delays the market authorisation for what might prove to be life-saving medical products and a strategy that facilitates bringing products to market subject to ex post safety monitoring. More generally, as Adam Burgess concludes in his study of precautionary responses to the perceived hazards presented by mobile phones and cell phone towers, there is a worrying tendency to create risk shadows and then commit large resources to chasing them—thus, "In the elusive quest to establish a risk-free existence, our autonomy, intelligence, and capacity for change and enlightenment stand in danger of being compromised and diminished."[21]

We conclude, therefore, that, with its present bias and deficiencies, the precautionary principle has no future. However, it would be silly to abandon a precautionary approach in the broad sense; and it would be a missed opportunity if, in our eagerness to ditch the precautionary principle, we overlooked a model of precautionary reasoning that regulators could, and should, adopt.

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[17] For an excellent discussion, see Richard B. Stewart, "Environmental Regulatory Decision Making Under Uncertainty" in Timothy Swanson (ed), *An Introduction to the Law and Economics of Environmental Policy: Issues in Institutional Design* (Amsterdam: Elsevier Science, 2002) 71.

[18] Compare Council for Science and Technology, *Nanosciences and Nanotechnologies: A Review of Government's Progress on its Policy Commitments* (London, March 2007) para 52 et seq (for the view that, while precaution does not entail a moratorium on the development of nanotechnology, the basic research should not be neglected). For similar emphasis on the importance of conducting the basic research, see the French National Consultative Ethics Committee for Health and Life Sciences, Opinion No 96 ("Ethical Issues Raised by Nanosciences, Nanotechnologies and Health", 2007) p. 10.

[19] Samual Butler, *Erewhon* (London: Penguin Books, 1985: first published 1872).

[20] Cass Sunstein, *Laws of Fear* (Cambridge: Cambridge University Press, 2005).

[21] Adam Burgess, *Cellular Phones, Public Fears, and a Culture of Precaution* (Cambridge: Cambridge University Press, 2004) 281. But, the elusive quest continues: see, e.g., Geoffrey Lean, "Wi-Fi: the Backlash" *The Independent on Sunday*, July 15, 2007, p. 14 (Haringey council resolving to adopt a precautionary approach to wi-fi technology in schools).

12.3 Pascal's Wager: A Model for Precautionary Reasoning?

One of the most famous arguments that rely on precautionary reasoning is contained in what is known as Pascal's Wager.[22] If God is conceived of as an omnipotent being (as is the case in the Bible), then it is impossible to know whether or not God exists. However, (according to Pascal), the biblical God requires us to believe in Him and live the life prescribed in the Bible or suffer eternal damnation. So, reasons Pascal, you can believe that God exists or not believe that God exists. But if you are wrong in not believing that God exists you lose everything, while if you are wrong in believing that God exists, you lose nothing. Ergo, you rationally must believe that God exists.

There are fatal problems with this argument. One of these is that belief (as against conforming behaviour) is not something that can be chosen. At best, the argument can provide good reason for acting in accordance with God's requirements for action. However, even so limited, there is another problem, which is that the existence or non-existence of the biblical God is not the only issue of fact that is relevant to the fear of eternal damnation that drives the argument. If it is unknowable whether or not the biblical God exists, it is equally unknowable whether or not a different "God" exists, whose requirements regarding belief/action might conflict with those of the God of the Bible. In other words, the omnipotent being that exists might damn you for believing in the biblical God. So a parallel argument constructed in relation to the requirements of such an alternative "God" would require non-belief in the biblical God/non-conformity with the requirements set by the biblical God.

The problem here is that the hazard to be avoided depends on the existence of the biblical God, and precaution, driven by the severity of that hazard, is directed to make it rational to presume the existence of the biblical God. So, if we disentangle these things, the question is whether we can find a valid application of the idea, central to Pascal's Wager, that actions are to be avoided simply because they *might possibly* threaten wholly unacceptable outcomes. We think that we can.

Some moral philosophers (e.g., Immanuel Kant[23] and Alan Gewirth[24]) claim to have demonstrated that there is a moral principle that is categorically binding on all agents. In other words, reason categorically requires agents to act in accordance with this principle and not to violate it. In the case of Kant, this principle is the Categorical Imperative, which in one of its formulations requires all agents to treat all other agents never solely as means but always at the same time as ends in themselves. In the case of Gewirth, this principle is the Principle of Generic Consistency, which requires all agents to act in accordance with a structure of so-called generic rights possessed by all agents. Suppose then that someone "A" agrees that either

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[22] See Blaise Pascal, *Pensées,* trans A., J. Krailsheimer (London, Penguin 1966) p. 151.

[23] See *Groundwork of the Metaphyisics of Morals* (1785) translated with a commentary by H. J. Paton under the title *The Moral Law* (London Hutchinson 1948).

[24] See *Reason and Morality,* (Chicago: Chicago University Press 1978).

Kant or Gewirth (it does not matter which) is correct on this point. It is still possible for A to try to evade the practical consequences of this acceptance by denying that there are any agents other than A. This is because to be an agent is to possess certain mental and emotional capacities. While A knows directly that A has these capacities, A cannot know that any other being has the same capacities. At best A can know that other beings behave as though they have these capacities. Nevertheless it is possible that beings that act as though they have these capacities do not. Hence it is possible, as far as A can know, that all other beings that act as though they are agents are not agents, only apparent agents.[25]

In this example the only issue relevant to how A must act is whether or not B is an agent. If B is an agent, then A must treat B in accordance with the principle that A believes to be categorically binding otherwise the principle will be violated. If B is not an agent then A need not so treat B. Although A cannot know whether or not B is an agent, to part paraphrase Pascal, "If A wagers that B is an agent and loses then he loses little; but if he wagers that B is not an agent and loses, then he loses everything. Hence, A must wager that B is an agent" The only proviso is that A must be able to treat B as an agent, and this A will be able to do if (as we have supposed) B acts as though B is an agent.

We submit that this is sound reasoning. While the precautionary reasoning here is formally identical to that involved in Pascal's Wager, the structure of its application is different in that the requirement that sets up the value to be served (the avoidance of violating the rights of an agent/ of failing to treat an agent as an end in itself) does not depend on B's existence as an agent. In Pascal's Wager, uncertainty about the existence of the biblical God carries with it uncertainty about the need to obey the prescriptions attributed to this God, hence uncertainty about whether the hazard to be avoided actually exists. On the other hand, when arguing, as above, that the Categorical Imperative/the PGC requires agents to treat apparent agents as agents, the hazard to be avoided is given by the Categorical Imperative/the PGC, which is axiomatic for the precautionary argument and not a conclusion derived from it. Of course, if Kant's/Gewirth's arguments for a categorical imperative are not sound[26] *and* belief that there is a categorical imperative is merely a matter of subjective commitment, then the conclusion of precautionary reasoning guided by the values enshrined in the categorical imperative will not be something that those who do not accept that there is a categorical imperative will be required to accept. Commitment to a categorical imperative will be no more rational than fear of eternal damnation by the biblical God. Consequently, the conclusion of the precautionary

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[25] For more on this precautionary argument see Deryck Beyleveld and Roger Brownsword *Human Dignity in Bioethics and Biolaw* (Oxford: Oxford University Press 2001) pp. 119–134.

[26] It is no secret that we consider Gewirth's argument to be sound. For a defence of Gewirth's argument see, in particular, Deryck Beyleveld, *The Dialectical Necessity of Morality: An Analysis and Defense of Alan Gewirth's Argument to the Principle of Generic Consistency*. (Chicago: Chicago University Press 1991). For an analysis of the relationship between Gewirth's and Kant's arguments, see Deryck Beyleveld and Roger Brownsword, *Human Dignity in Bioethics and Biolaw* (Oxford: Oxford University Press 2001) pp. 86–110.

argument will be no more rationally compelled than commitment to the value that guides it. Nevertheless, the precautionary argument guided by commitment to a categorical imperative is not viciously circular in the way that Pascal's Wager itself appears to be.

Be this as it may, the general principle involved in the above argument may be stated as follows.

> P1: If doing X (e.g., not treating B as an agent) risks something that is categorically prohibited (not granting the generic rights to an agent) whereas not doing X (treating B as an agent) risks something not categorically prohibited, then doing X must be prohibited even if it cannot be known whether or not the risk is real (whether or not B is an agent, thus, whether or not B has generic rights to violate), provided only that not doing X is possible

P1 has special features. In particular, it concerns prohibition of speculative risk on the basis of a hazard being categorically prohibited. Were the hazard to be less than categorical either prohibition could not be justified/or the risk would have to be less than speculative.

We will later comment on some of these issues, which are key to the question about the legitimacy of wider applications of precautionary reasoning in a narrow sense. But first it is worth seeing if P1 itself has any application in legal reasoning.

12.4 Innocent Until Proven Guilty and Precaution

It is a general principle of criminal law that persons accused of crimes are not to be convicted unless proven to be guilty beyond a reasonable doubt. Being guilty on the balance of the evidence is not enough to secure a conviction. Any reasonable doubt about guilt must yield an acquittal.

Can this policy be justified by P1? The reason for this policy is clearly to avoid convicting an innocent person of a criminal offence. The policy, however, increases the risk that a guilty person will be acquitted. Now, for P1 to apply, convicting an innocent person must be something that is categorically prohibited, whilst acquitting a guilty person must be something not so heinous as to be categorically prohibited. If we suppose this to be the case, however, and whether or not we consider it to be the case is clearly a value-judgment, P1 does not seem to apply because in such a case it is surely necessary that persons convicted of criminal offences be shown to be guilty beyond any possible doubt. It is *possible* to acquit persons accused of crimes (whether they are guilty or not). If convicting them when they are innocent is categorically prohibited when it is possible not to convict them, they must be acquitted unless it is certain that they are guilty.

These observations, however, suggests another principle

> P2: If doing X risks (or constitutes) something that is undesirable (convicting an innocent person) whereas not doing X (acquitting a guilty person) risks (or constitutes) something less undesirable, then doing X must be prohibited when there is a degree of suspicion that X might be done, even if it cannot be known whether or not the risk is real (whether or not X is certainly guilty), provided only that not doing X is possible

P2 is, however, too vague to instantiate the reasoning involved in the requirement to acquit those not found guilty beyond a reasonable doubt. This is because the "beyond a reasonable doubt" condition prescribes a specific level of suspicion that X might be done. Furthermore, it is surely reasonable that this level of suspicion must be proportional to the degree of undesirability of doing X as compared to the undesirability of not doing X. This suggests the more precise principle.

> P2*: If doing X risks (or constitutes) something that is undesirable (convicting an innocent person) whereas not doing X (acquitting a guilty person) risks (or constitutes) something less undesirable, then doing X must be prohibited when there is a degree of suspicion that X might be done that is proportionate to the undesirability of doing X in relation to the undesirability of not doing X, even if it cannot be known whether or not the risk is real (whether or not X is certainly guilty), provided only that not doing X is possible

The requirement to acquit those not found guilty beyond a reasonable doubt is justified by P2* if it is judged that the requirement of guilt beyond a reasonable doubt is proportionate to the importance (relative to that of not acquitting a guilty person) of not convicting an innocent one.

If P1 does not apply to the requirement to acquit those not found guilty beyond a reasonable doubt, then as we have already indicated this is only because the prohibition on convicting the innocent is not (at least universally) categorically prohibited and/or P1 applies prohibition regardless of the degree of evidence beyond mere possibility for the prohibited outcome occurring. Those who attach a deontological value to not convicting the innocent might well argue that this is categorically prohibited; but, if they do, they should require acquittal on the mere possibility of innocence. On the other hand, if they are of a more utilitarian persuasion, they might hold that whether or not conviction of the innocent is to be categorically prohibited depends on the consequences of conviction. Thus they might contend that where conviction requires the death penalty to be imposed conviction of an innocent person is more serious than when conviction carries a "lesser" penalty, and they might be prepared to accept that execution of an innocent person is categorically prohibited. If so, P1 applies and requires that the death penalty should not be applied to those convicted of crimes unless they are shown to be guilty beyond a possible doubt.

If it is, furthermore, argued, that guilt in relation to a crime always involves an element of *mens rea,* then it surely follows that there must always be a possibility of innocence. How can we possibly know with certainty another person's intentions? Indeed, as work in the new brain sciences casts doubt on the extent to which defendants are "in control",[27] how can we confidently maintain the penal character of criminal justice? If we entertain any such doubts, the death penalty should never be imposed. While there are many ifs here, the general form of this reasoning is surely both clear and sound.

When we review the other end of the criminal justice system, we find a different tilt to the precautionary approach and a different placing of the burden. So long as

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[27] See, e.g., Patricia Smith Churchland, "Moral Decision-Making and the Brain" in Judy Illes (ed), *Neuroethics* (Oxford: Oxford University Press, 2006) p. 3.

Smith is merely a suspect or a defendant in the criminal process, as we have said, the burden is on the prosecution. However, once Smith is convicted, everything changes. Crucially, even when Smith has served a tariff custodial punishment, we cannot assume that he will be released back into the community. For, if Smith is one of those persons now indefinitely imprisoned (for the sake of public protection) under Section 225 of the Criminal Justice Act 2003, the burden lies on Smith to persuade the relevant parties that it is safe to release him. Is such an approach defensible under the precautionary model that we have outlined? On the one hand, by doing X (detaining Smith indefinitely) we seriously interfere with Smith's freedom and do him wrong. It is perfectly possible to release Smith; but we do not do so if we believe that there is some risk that Smith might violate the legitimate interests of third-parties. On the face of it, this looks like an abuse of precaution and a disproportionate burden on Smith.

12.5 The Precautionary Model and Slippery Slopes

Our analysis suggests that precautionary reasoning is involved whenever the law places the burden of proof more heavily on one side of a case than on the other. This is because the central consideration that drives precautionary reasoning is that, given uncertainty about the right answer to a question, it is judged to be more serious to err in one direction than in another.

It also seems to us that precautionary reasoning might be involved in the acceptance of slippery slope arguments. Such arguments are characteristically concerned with holding a regulatory line. For example, a judge might refuse to accept an incremental extension of liability for fear that it will, as a matter of principle or practice or both, weaken the power of regulatory control. In its most pointed application, the slippery slope argument is directed against activities that are conceded to be harmless in themselves on the grounds that acceptance of these activities will, or might, lead to acceptance of harmful activities. So, for example, in the current debate about the use of cytoplasmic hybrid embryos as research tools,[28] we might detect two versions of the slippery slope argument. One version does not take a position on whether the use of cytoplasmic hybrid embryos would be harmless; the view is that the current regulatory line should be held because, quite simply, it is a line that regulators can plausibly stand on. By contrast, the other version accepts that the use of cytoplasmic hybrid embryos would be harmless but worries that, having authorised the use of such hybrids, it would then be difficult to draw a distinction between one kind of hybrid and another, or between hybrids and chimeras.

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[28] House of Commons Science and Technology Select Committee, *Government Proposals for the Regulation of Hybrid and Chimera Embryos* (Fifth Report of Session 2006–2007) (HC 272-I, 5 April, 2007); the Academy of Medical Sciences, *Inter-Species Embryos* (London, July, 2007); and, most recently, House of Lords and House of Commons Joint Committee on the Human Tissue and Embryos (Draft) Bill, *Human Tissue and Embryos (Draft) Bill*, HL Paper 169-I, HC Paper 630-I (London: The Stationery Office, August 1, 2007).

Such arguments frequently rely on assumptions that require empirical evidence. However, to obtain such evidence requires the intrinsically harmless activities that are held to threaten the intrinsically harmful ones to be performed. At this point, if the slippery slope argument is to work, precautionary reasoning kicks in. If it is not validly deployed then the slippery slope argument will itself be fallacious.

Consider the much-debated cases of physician assisted suicide (PAS) and active euthanasia. The standard reason given by rights-committed legal regimes for their refusal to recognise the *public* lawfulness of assisted suicide or active euthanasia is that such recognition would potentially undermine the right to life of third parties, particularly the rights of vulnerable third-party agents. So, for example, in *Washington v Glucksburg*,[29] we find Chief Justice Rehnquist, delivering the opinion of the Court, saying:

> [t]he State has an interest in protecting vulnerable groups—including the poor, the elderly, and disabled persons—from abuse, neglect, and mistakes. The Court of Appeals dismissed the State's concern that disadvantaged persons might be pressured into physician assisted suicide as "ludicrous on its face."... We have recognized, however, the real risk of subtle coercion and undue influence in end of life situations ... Similarly, the New York Task Force warned that "[l]egalizing physician assisted suicide would pose profound risks to many individuals who are ill and vulnerable ... The risk of harm is greatest for the many individuals in our society whose autonomy and well being are already compromised by poverty, lack of access to good medical care, advanced age, or membership in a stigmatised social group."... If physician assisted suicide were permitted, many might resort to it to spare their families the substantial financial burden of end of life health care costs.
>
> The State's interest here goes beyond protecting the vulnerable from coercion; it extends to protecting disabled and terminally ill people from prejudice, negative and inaccurate stereotypes, and "societal indifference."...The State's assisted suicide ban reflects and reinforces its policy that the lives of terminally ill, disabled, and elderly people must be no less valued than the lives of the young and healthy, and that a seriously disabled person's suicidal impulses should be interpreted and treated the same way as anyone else's...
>
> Finally, the State may fear that permitting assisted suicide will start it down the path to voluntary and perhaps even involuntary euthanasia.[30]

The Chief Justice employs a belt and braces approach to precaution: first, precaution for the sake of vulnerable persons; and, then, precaution in order to prevent a slide towards euthanasia. Yet, how convincing, on either score (belt or braces), is this reasoning?

Notoriously, the problem with the former expression of precaution is that we simply do not know whether the rights of vulnerable agents would be compromised;[31]

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[29] 117 S.Ct. 2258; 138 L Ed 2d 772.

[30] 117 S.Ct. 2258; 138 L Ed 2d 772, 795–796.

[31] The comparative evidence is very difficult to interpret. Compare Ronald Dworkin, *Sovereign Virtue* (Cambridge, Mass.: Harvard University Press, 2000) Chapter 14, esp. at 470–472, who asks whether we can be confident that such empirical accounts as we have are (i) ethically clean (i.e., untainted by background ideological bias), (ii) methodologically sound, and (iii) applicable from one jurisdiction to another. For extended discussion of both the methodological and the comparability reservations, see Penney Lewis, "The Empirical Slippery Slope from Voluntary to Non-Voluntary Euthanasia" (2007) 35 *Journal of Law, Medicine and Ethics* 197.

and, so long as we refuse to relax the legal restrictions on PAS, we are not going to find out. In other words, precaution is applied to minimise the risk to third-parties but in such a way that we are not able to ascertain whether the risk that we fear is a real one. Similarly, a restrictive approach to PAS prevents any slide towards active euthanasia (with or without consent); but, in the same way, precaution obstructs our knowing whether the risk of a slide is a real one. If those who argue against such blanket criminal restrictions (rather than a regulated procedure for PAS of the kind that has been advocated over the years) were to do so on the basis that the precautionary approach implicated in the policy is applied disproportionately, they would seem to have a point. On the face of it, precaution is abused when it is translated into blanket prohibitions against PAS.

12.6 Precaution and Trade

For a number of years, the European Union operated with a controversial de facto moratorium against the approval of GM crops. Matters came to a head in *Biotech Products*, where the legality of the EU's policy was challenged by the US, Canada and Argentina.[32]

Where, as in *Biotech Products*, the science relating to the safety of GM crops is contested, how is the matter to be resolved? An innocent response is that the question should be determined by reference to the view supported by "sound science", this being taken to be a neutral and reliable arbiter. However, for many commentators on the practice and politics of science, this is a naïve view.[33] Science just is not like that. Scientists reasonably disagree with one another, not just about the bottom-line questions, but about matters of methodology, relevance, and focus, and so on. Science is never going to be theory-neutral (that is the whole point of the enterprise) but some deny, too, that it is "value-neutral".

The case of GM crops is almost a textbook example of such non-neutrality:

> The "products approach" to regulating GMOs assumes that no untoward risk occurs merely from applying this technology to agricultural production. GMOs are subjected to strict rules only when the end products are not substantially equivalent to their conventional counterparts. In contrast, the "process approach" rests on the idea that genetic engineering itself may entail novel and unique risks to human health or the environment. Whereas the United States has embraced the products approach to GM agriculture, the European Union and its member states have tended to adopt the more precautionary process approach.[34]

So, if scientists on one side of the Atlantic make safety judgments by reference to the end product while scientists on the other side of the Atlantic make (different) safety judgments by reference to the process used, and if both practices are regarded

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[32] Note 12 above.

[33] See, e.g., David Winickoff, Sheila Jasanoff, Lawrence Busch, Robin Grove-White, and Brian Wynne, "Adjudicating the GM Food Wars: Science, Risk, and Democracy in World Trade Law" (2005) 30 *Yale Journal of International Law* 81.

[34] Ibid., at 87

in their own territories as sound science, then "sound science" simply cannot serve as a neutral court of appeal.

In the event, the WTO Disputes Panel in *Biotech Products* made no attempt to settle the question of whether GM crops are safe. The question was not whether the EU position was scientifically vindicated, nor even whether it was a reasonable position as judged by common opinion. Rather, the question was the narrower and more specific one of whether the EU position was consistent with Members' obligations under the Sanitary and Phytosanitary (SPS) Agreement. In particular, the question was whether the EU was entitled to invoke the precautionary position implicit in Article 5.7. This Article provides:

> In cases where relevant scientific evidence is insufficient, a Member may provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information, including that from relevant international organizations as well as from sanitary or phytosanitary measures applied by other Members. In such circumstances, Members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the sanitary or phytosanitary measures accordingly within a reasonable period.

In other words, under conditions of scientific uncertainty, where the risks are unclear, Members may exercise precaution by derogating from the usual market access principles.

In favour of the EU, it was decided that the de facto moratorium on the approval of biotech products was a legitimate response to the uncertain state of the scientific evidence—in other words, the moratorium was a legitimate provisional and precautionary measure as contemplated by Article 5.7 of the SPS Agreement. However, in favour of the complainants, it was found that the EU was in breach of its obligations by failing to progress individual approval procedures without undue delay and that it was vicariously in breach of its obligations in respect of the safeguard measures taken by the six member states that represent the strongest opposition to GM crops in Europe.[35] Bearing in mind that the Commission had itself defended its own internal market principles by refusing to permit Austria (one of the group of six) to establish a "GMO-free area", one imagines that, at least in some quarters of Brussels, the latter part of the WTO ruling was neither unexpected nor altogether unwelcome.[36]

Would the EU's approach pass muster relative to the precautionary model that we have outlined? The dilemma is whether to do X (open one's markets to GM crops) or not do X (deny market access to GM crops). The argument against the former option is that GM crops, once planted out and commercially exploited, might present a serious risk to human health and the environment. It is possible to avoid this risk by not doing X. The cost of taking this latter option is that it impedes international trade and, possibly, causes some economic hardship to exporting Members.

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[35] Annex C1(a) of the SPS Agreement requires Members to undertake and complete "without undue delay" procedures for checking and ensuring the fulfilment of sanitary or phytosanitary measures.

[36] Compare Sara Poli, "Restrictions on the Cultivation of Genetically Modified Organisms: Issues of EC Law" on Han Somsen (ed), *The Regulatory Challenge of Biotechnology* (Cheltenham: Edward Elgar, 2007) p. 156.

On balance, the precautionary EU response, as found by the WTO, does not look disproportionate. However, there are two hidden complications.

First, if Members are permitted to rely on a state of scientific uncertainty in order to close their markets to allegedly risky products or services, they might abuse the privilege. There is a risk, in other words, that precaution might be used as a pretext for trade protectionism. If the real reasons behind EU precaution were financial, it would not do, in an international free trade agreement, to prioritise EU financial interests over those of the Americas. Still, this is not a major problem. It means only that the WTO needs to take a hard look at precautionary positions taken up by Members and not simply defer to them.

The second complication is more serious as well as being much more important for our purposes. This is that European resistance to GM crops does not rest purely and simply on uncertain hazard to health, safety and the environment. There is a view that GM crop manipulation is wrong, that it is incompatible with dignity. Here we have an ethic of veneration,[37] following which GM is categorically off limits.[38] This factor, in turn, gives rise to two complications.

One complication is to do with the transparency and honesty of the precautionary policy. The real reasons for market closure need to be declared. If the real reason why Austria and others want GM-free zones is cultural rather than scientific, then this needs to be brought into the open. Irrespective of whether the precautionary argument is a sound one, not to declare it for what it really is certainly is an abuse of precaution. Again, a hard look on the part of decision-makers is probably the best that we can ask for.

The other complication is more profound. This is that a model of precautionary reasoning, as an exercise in the legitimate regulation of risk, necessarily builds on certain values. In the end, there is no neutral application of precaution because precaution is always framed in a value-laden way; precautionary reasoning is necessarily driven by value judgments. If the EU puts its moral cards face up on the table, there is no simple response. For a tribunal to say that European culture and local values cannot be allowed into a precautionary calculation is not to maintain a separation of precaution and value; rather, it is to say that one value-laden paradigm of precaution is to be preferred to another.

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[37] Jean-Christophe Galloux, Arne Thing Mortensen, Suzanne de Cheveigné, Agnes Allansdottir, Aigli Chatjouli, and George Sakellaris, "The Institutions of Bioethics" in Martin W. Bauer and George Gaskell (eds), *Biotechnology—The Making of a Global Controversy* (Cambridge: Cambridge University Press, 2002), where three ethical frames are identified—one organised around the principle of utility, a second around the principle of democracy, and a third around the principle of veneration.

[38] Compare Nuffield Council on Bioethics, *Genetically Modified Crops: The Ethical and Social Issues* (London, May 1999) paras 1.32–1.50 (discussing the natural/unnatural boundary, taboos, and moral conservatism).

12.7 Conclusion

The frequency with which burden of proof and slippery slope considerations appear in reasoning, policies, and principles, argues for a general examination of the role that precautionary reasoning plays in law. Detailed work will need to be done before we can be in any position to offer a confident comprehensive analysis. However, our analysis in this paper does enable us to draw a number of lessons. First, the application of precautionary reasoning involves value judgments about the desirability/undesirability of doing something X vs the desirability/undesirability of not doing X. Second, except where doing X is judged to be categorically undesirable, this will not be a straightforward or easy matter. Third, when the value attributed to not doing X is not categorical, then questions of the degree/standard of evidence for the relevant risks being instantiated becomes relevant. While evidence must clearly be proportionate to the severity of the hazards involved, such calculations raise difficult issues concerning the commensurability of the variables involved, which, in our opinion, make judgments of this kind not susceptible to non-arbitrary quantification and perhaps not even to non-arbitrary qualification.[39]

The importance of the fact that precautionary reasoning is driven by value judgments must not be underestimated. Precautionary reasoning has been used to justify calls for genetic modification of crops to be banned on the grounds that we do not know that this will not have disastrous consequences to human health or the environment; and, even though the European Group on Ethics in Science and New Technologies has emphasised that precautionary policies are not zero-risk policies, we can be sure that similar objections will be made against nanotechnology.[40] When it is responded that there is no evidence that this is the case, the counter-response is that there is no evidence that there is no proof that this is not the case. To this it will be pointed out that such reasoning could justify a ban on virtually everything, which if the matter can be ended here, appears to reduce the precautionary argument to absurdity. However, the matter cannot be ended here. This is because there is almost certainly the hidden assumption in the precautionary case that genetic modification is an unnecessary activity, one that does not need to be engaged in (because to the extent that it offers meaningful benefits, other activities deemed more desirable for some reason can reap these benefits instead). If a risk, however, speculative, is unnecessary in this sense, then it is not irrational to eschew it on the grounds of its mere possibility. But then it is clear that the issue is at root an evaluative one. This, of course, means that precautionary arguments will be inherently controversial, but if we are right then the controversiality does not lie so much in the form of the arguments but in the details of their substance.

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[39] See further, Deryck Beyleveld and Roger Brownsword, *Human Dignity in Bioethics and Biolaw* (Oxford: Oxford University Press 2001) pp. 255–258.

[40] European Group on Ethics in Science and New Technologies to the European Commission, *Opinion on the Ethical Aspects of Nanomedicine* (Opinion No 21) (17 January, 2007).