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Methodological and Ideological Options

Justifying precautionary policies: Incommensurability and uncertainty

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A B S T R A C T

When decisions are taken in conditions of Keynesian or Knightian uncertainty, and when there is a threat of serious or irreversible environmental damage, the Precautionary Principle is often recommended to guide decision-making. However, the Precautionary Principle has been widely criticised. In response to these criticisms, a qualitative version of the Precautionary Principle is developed which draws its normative content from a blend of formal decision theory and political philosophy. It is argued that precautionary action can be justified by some flexible combination of uncertainty and incommensurability. The 'greater' the uncertainty, the 'less' incommensurability is required to justify precautionary action, and vice versa. Throughout the paper, the arguments are explored using the example of climate change decision problems.

1. Introduction

The Precautionary Principle has been repeatedly advocated to inform environmental policy-making. The Precautionary Principle (PP) cannot be easily defined, because it has been invoked in different policy contexts, to serve different purposes, drawing on a wide range of academic disciplines (O'Riordan et al., 2001; Raffensberger and Tickner, 1999; Stirling, 2009). Sandin (1999) analyses a large number of definitions of the PP and concludes that most of them share a common structure. A simplified version of Sandin's structure is as follows:

> *If there is a threat of harm, which is uncertain, then some kind of action should be taken.*

For the moment, this empty structure will suffice as a working definition of the PP. Although different versions of the PP fill out this structure in different ways, a common feature is the mention of uncertainty. In general, 'uncertainty' might refer to decision-making under risk, in which a unique probability can be attached to all possible outcomes or states of the world, or decision-making under Keynesian or Knightian uncertainty (Keynes, [1921], 1973; Knight, 1921), in which some probabilities are absent. In what follows, 'uncertainty' refers to decision-making under Keynesian/Knightian uncertainty unless indicated otherwise.[1] Another note on terminology: throughout, we say that the decision-maker chooses between various alternatives or *options*; each option leads to one of several possible *outcomes*.

The meaning and existence of uncertainty remains disputed among those favouring a 'Bayesian' view of probability (Ramsey, 1931; Savage, 1954). On the Bayesian view, decision makers are assumed to rely on subjective probabilistic beliefs, reducing decision problems under uncertainty to decisions under risk. No attempt will be made to challenge this view here; we assume simply that the standard Bayesian approach, eliminating *prima facie* uncertainty, is not always available.[2] There are at least two reasons why it may be unavailable in environmental policy contexts such as climate change. First, the evolution of knowledge about climate change in both the social and natural sciences does not appear consistent with Bayesian updating. There are many instances in which scientists appear to have rationally revised their beliefs not because of new information, but in light of arguments suggesting that different conclusions should be drawn from existing scientific knowledge. Indeed, since mathematics as a discipline consists entirely of such 'fact free learning', it provides a plethora of examples: beliefs may be updated when the scientist makes a new mathematical deduction from the existing information about the world, even though the information is unchanged. Bayesian updating cannot account for this kind of belief revision in the absence of new information (Aragones et al., 2005). Second, there may often be an 'expert panel problem' — experts disagree about the probabilities of different possible outcomes. Woodward and Bishop (1997) suggested that this situation can be viewed as a problem of choice under 'pure uncertainty'.

Several prominent public-policy and legal statements of the PP (the 1992 Rio Declaration UNCED, 1993; Wingspread, 1998) emphasise the role of uncertainty. The Rio Declaration refers to 'lack of full scientific

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[1] Of course there are other usages of 'uncertainty' too, notably in the risk assessment literature. In that literature, 'unknown uncertainty' roughly corresponds to the focus here, namely Keynesian/Knightian uncertainty in which probabilities are absent (but again some authors adopt different terminologies). See also Dequech (2011).

[2] Gilboa et al. (2008, 2009) provide approachable discussion of the arguments justifying departures from Bayesianism.

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certainty' (Principle 15), while the Wingspread Statement urges precautionary action 'even if some cause and effect relationships are not fully established scientifically'.

Some economists appear to share Gollier and Treich's view that 'the common formulation of the Precautionary Principle (PP) has no practical content and offers little guidance for conceiving regulatory policies' (Gollier and Treich, 2003: 99). Against this view, the main purpose of this paper is to develop a normative argument for a precautionary approach, drawing on insights from both political philosophy and formal decision theory under uncertainty. The defence of the PP will be limited to situations of uncertainty or incommensurability. (Outcomes are *incommensurable* when, even in conditions of certainty, their value cannot be precisely measured along some common cardinal scale. In contrast, outcomes are *incomparable* when they cannot even be ranked on an ordinal scale. Thus comparability is a necessary but not sufficient condition for commensurability.[3]) It is difficult to develop this argument in isolation; throughout this paper we shall focus on climate change policy problems. At least since the Rio Declaration, the PP has been repeatedly invoked in the context of climate change; moreover, climate change policy is often seen as a paradigm case of the PP in action. Against this view, it might be argued that the PP works best in the hands of benevolent global decision-makers, whereas global climate mitigation policy is plagued by free-rider problems. In response, it is true that climate mitigation policy faces some specific challenges, beyond the purview of the PP. But free-rider problems do not make the PP redundant. For example, a single nation, deciding solely on the basis of self-interest, may find the PP relevant to mitigation policy-making, especially if major climate change would harm that nation (which is likely, since most major climate change scenarios involve harm to most nations). Of course some nations, such as small island states, have little power to mitigate future climate change, but for small island states the PP remains relevant, as a basis for adaptation policy.

We shall assume that climate change policy decisions take place under conditions of uncertainty, whether due to uncertainties arising in the climate science, or the economic predictions based on that science, or both. A full defence of this assumption is beyond our scope. However, it be might be argued that there is a growing consensus regarding climate science, evidenced by trends towards consensus in successive rounds of IPCC assessments.[4] But this growing consensus, if it exists, does not contradict the assumption of uncertainty made here, for two reasons. First, it is at least partly a consensus that important aspects of climate science remain uncertain. Second, it concerns climate science, and leaves open the possibility of more fundamental disagreement – including expert panel problems – in climate economics.[5] A more radical interpretation of the state of climate science and economics is that it leaves decision-makers facing not merely uncertainty, but pervasive *ignorance* — as well as an absence of probabilities, the range of possible options and/or outcomes is unknown too. This challenge should be taken seriously, but in this paper we set discussion of ignorance aside until the concluding section.

Another defining feature of climate change decision-making is the potentially catastrophic nature of some outcomes. These twin features – uncertainty and possibly catastrophic impacts – arguably lie behind the impetus to apply the PP to climate change policy.

Section 2 explores how decision theory under uncertainty might provide a rationale for the PP, while Section 3 introduces a version of the PP with similar origins, which seems well suited to informing climate policy. Central to the interpretation of the PP developed here is the claim that precautionary action can be justified by some combination of uncertainty and incommensurability. Roughly speaking, the greater the uncertainty, the less incommensurability is required to justify precautionary action. Alternatively, with less uncertainty, a stronger incommensurability claim is needed to justify a precautionary approach. Section 4 defends this interpretation of the PP and Section 5 concludes, stressing the limitations of the analysis and avenues for future research. But first, the status of the PP in the relevant economics literature will be briefly assessed.

For many economists, cost–benefit analysis (CBA) is the obvious tool to aid policy-making. But some economists who generally support the use of CBA in environmental policy appear to suggest that it should not be applied to climate change, on grounds of uncertainty (Dasgupta, 2008; Weitzman, 2007, 2009). Some have gone further, suggesting that a formalization of the PP may be more appropriate in this context (Dietz, 2009; Heal, 2009). The formalization which has so far received most attention is based on option values: 'most economists, if asked to think of a justification for [the Precautionary Principle] would probably couch it in terms of learning, irreversibilities and option values' (Heal and Kristrom, 2002: 26). Essentially, precautionary action is justified whenever it supports a sufficiently large option value, the value of 'keeping one's options open' — maintaining flexibility by avoiding irreversible commitments now, while awaiting better information about the alternatives. It is a dynamic optimization model, incorporating better information through a process of Bayesian updating of beliefs (Gollier and Treich, 2003; Gollier et al., 2000). This raises an obvious difficulty. Given the presence of uncertainty, a justification for the PP which assumes that probability distributions can be attached to states of the world, albeit subjective probabilities, is problematic. Put bluntly, faced with uncertainty, the Bayesian approach to the PP is 'conceptual rather than operational' (van den Bergh, 2004: 391). Moreover, there are some deeper flaws in this approach which we have explored elsewhere: (i) it focuses on the information which eliminates uncertainty, rather than the persistence of uncertainty; (ii) it does not recognise the distinctiveness of environmental irreversibilities (as opposed to ubiquitous investment irreversibilities); (iii) theoretical models have ambiguous results, because there are irreversible commitments to be avoided on both sides of the decision; yet (iv) the models always favour more flexibility, while precautionary action might involve reducing flexibility in some contexts (Aldred, 2012).

A modest conclusion will suffice here: while the option value justification of the PP may have a role to play, it is not so robust that alternative rationales for the PP are not worth exploring.

2. Towards a Decision-theoretic Rationale for the Precautionary Principle

2.1. A Selective Review of Decision Theory

'Decision theory under uncertainty' is not traditional decision theory under risk – subjective expected utility (SEU) theory following Von Neumann and Savage – but the less familiar literature analysing Keynesian/Knightian uncertainty, which arguably began with Arrow and Hurwicz (1972). In a setting of complete uncertainty, Arrow and Hurwicz prove that the only decision rules satisfying their relatively weak axioms of rationality are those which rank options entirely in terms of their best and/or worst outcomes. In other words, choice should be based solely on the extreme possible outcomes of different options; information about all other outcomes should be ignored. This criterion may usefully be compared with the more familiar maximin decision rule.[6] The maximin rule is clearly a special case of the Arrow–

[3] The definition here follows Chang (1997), but many other writers use these terms differently. See Aldred (2006) for detailed discussion in the context of environmental valuation.

[4] Against this, for some limited evidence of persisting disagreement among climate scientists, see Rosenberg et al. (2010).

[5] There is much disagreement even among orthodox economists committed to some form of cost–benefit analysis, as demonstrated by the continuing controversy provoked by the *Stern Review*. For some heterodox perspectives on climate economics, see Barker (2008), van den Bergh (2004) and van den Bergh (2010).

[6] The maximin decision rule tells the decision-maker to choose the option with the best 'worst outcome' — the option with the worst outcome which is superior to the worst outcomes associated with all other options.