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Ecological Economics 57 (2006) 382–399

ECOLOGICAL ECONOMICS

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Analysis

The epistemological challenge of self-modifying systems: Governance and sustainability in the post-normal science era

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Received 11 August 2004; received in revised form 28 March 2005; accepted 20 April 2005
Available online 1 August 2005

Abstract

In this paper, we conceptualize the difference among risk, uncertainty and ignorance and focus on a theoretical analysis of "modeling relation" applied to self-modifying systems within the framework of post-normal science. We provide an overview of the concept of risk and uncertainty elaborating on the work of F. Knight. We extend R. Rosen's theory of "modeling relation" originally aimed in natural science to the issue of science for governance. Knight's analysis of risk and uncertainty can be used to generate a list of various types of uncertainty involved in every stage to model self-modifying systems. Such a list is relevant for gaining insight into the issue of science for governance. It is important for those attempting to model sustainability, especially in the field of ecological economics, to be aware of the theoretical difference between models and similes for self-modifying systems.

Keywords: Uncertainty; Risk; Ignorance; Modeling relation theory; Models; Similes; Self-modifying systems; Post-normal science

1. Introduction

Sustainability issues imply a new role for scientists in relation to human progress. In fact, in this field issue-driven research takes precedence over curiosity-driven research. Moreover, sustainability is associated with complex problems that require addressing simultaneously several relevant perspectives of various actors operating at different scales. In scientific terms we can say that the issue of sustainability requires the integrated use of various methodological approaches to better understand the interplay between actors within the socioeconomic system and between the socioeconomic systems and ecological systems.

"The objective of scientific endeavor in this new context may well be to enhance the process of the social resolution of the problem, including participation and mutual learning among the stakeholders, rather than a definite 'solution' or technological

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doi:10.1016/j.ecolecon.2005.04.023

implementation. This is an important change in the relation between the problem identification and the prospects of science-based solutions" (Funtowicz et al., 1998, p. 104). In relation to this scientific challenge Funtowicz and Ravets (1990) developed a new epistemological framework they called "Post-Normal Science". One of the most important issues for Post-Normal Science is how to put a shared question in a proper perspective, especially in a situation where "facts are uncertain, values in dispute, stakes high and decisions urgent" (Funtowicz and Ravets, 1993, p. 744). To make things more difficult, in real situations, it is often not even sure whether or not values are really in dispute, whether or not stakes are truly high, and how urgent the decision is. Thus, the central issue for Post-Normal Science is to deal with the nature and characteristics of uncertainty in the broadest sense of the term. Sustainability issues imply that uncertainty becomes an essential player in the process required to put a shared question into proper perspective.

The rest of this paper is organized as follows: Section 2 provides an overview of the concept of risk and uncertainty elaborating on the work of F. Knight. Section 3 extends R. Rosen's theory of "modeling relation" originally aimed in natural science to the issue of science for governance. An important lesson for those attempting to model sustainability is the theoretical difference between models and similes. Section 3 also discusses the various types of uncertainty factors involved in every stage of the modeling process. Section 4 examines various aspects of uncertainty when dealing with self-modifying systems and the peculiar epistemological challenge implied by this class of systems. Section 5 summarizes our discussion.

2. The concept of uncertainty by F. H. Knight: a summary

The textbook explanation of Knight's (1964) investigation on risk and uncertainty is well known. Risk represents a situation in which the distribution of the outcome in a group of instances are known either a priori or from statistics. While uncertainty represents a situation in which it is impossible to form a reliable group of instances because the situation is to a high degree unique.

However, a detailed analysis of his approach is yet to be made. Knight recognized the importance of uncertainty as a factor interfering with the perfect workings of competition and its neglect in economic theory. According to Knight, uncertainty gives the characteristic form of enterprise to the whole economic organization and accounts for the peculiar income of the entrepreneur. The title of his book clearly shows his motivation: *Risk, Uncertainty and Profit*.

Knight was particularly interested in humans' forward-looking character: humans can react to a situation before this situation materializes. He discusses four sources of uncertainty:

(1) *perception uncertainty* due to two main problems: (i) we cannot perceive the present as it is; and (ii) we cannot perceive and represent the present in its totality.
(2) *anticipation uncertainty* due to the fact that we have to infer the future from the present without being able to obtain a high degree of dependability from our models.
(3) *effect uncertainty* due to the fact that we cannot know all the consequences of our own actions in the future.
(4) *implementation uncertainty* due to the fact that any policy formulation cannot be implemented in the precise form in which it was imagined and chosen.

From an epistemological perspective the most crucial type of uncertainty is the first one: perception uncertainty. In fact, any perception of the present presupposes: (i) a pre-existing organized set of conceptual categories in our mind which can be used to organize the perception of the present in terms of mental objects; (ii) these mental objects are characterized in terms of a finite number of known properties or modes of resemblance between things which makes possible their classifications. Without these two assumptions, human systems would be in a situation of perfect uncertainty, i.e. ignorance. In this situation, humans could not even deal with the other three types of uncertainty at all. So, the issue of how to deal with perception uncertainty is crucial