



Surveys

A bibliometric account of the evolution of EE in the last two decades Is ecological economics (becoming) a post-normal science?

Manuela Castro e Silva ^{a,e}, Aurora A.C. Teixeira ^{a,b,c,d,*}

^a Faculdade de Economia, Universidade do Porto, Portugal

^b CEFUP, Portugal

^c INESC Porto, Portugal

^d OBEGEF, Portugal

^e EDGE - Estudos de Gestão - Centro de Investigação, Estudos e Serviços, Portugal

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ABSTRACT

In ecological economics the debate on formalism and formalization has been addressed in the context of a lively discussion on ecological economics as a 'post-normal' (versus 'normal') science. Using ecological economics (EE) as a 'seed' journal and applying bibliometric techniques to all (2533) the articles published in EE from January 1989 to December 2009, we analyze the evolution of the field of ecological economics aiming to shed light on this debate. We observe the predominance (and increased relevance) of certain research topics: 'Methodological issues', 'Policies, governance and institutions' and 'Valuation'. Moreover, 'Collective action', 'Technical change and the environment' and 'Values' stand as emergent themes of research. Finally, we note that ecological economics experienced an 'empirical turn' reflected in a shift away from exclusively formalized papers towards exclusively empirical and, to a larger extent, 'formal and empirical' ones. The combination of the prominent and emergent topics and the 'empirical turn' mirrors the increasing awareness among researchers in the field of the need to address a key specificity of ecological economics – the interdependence of the economic, biophysical and social spheres. On this basis, we argue that at least through the lens of EE, ecological economics has evolved towards a post-normal science.

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1. Introduction

The field of ecological economics has emerged from the need to rethink the relationship between nature and humans and to know how to live in a sustainable way within the limits of the global ecosystem. It is methodologically pluralistic (Norgaard, 1989; Costanza et al., 1997a,b; Costanza and King, 1999), meaning that researchers do not subscribe to a single unified theory or methodology.

Ecological economics is primarily engaged in the search for solutions to some of the most urgent problems facing society today (Müller, 2003). The new environmental problems involve facts that are uncertain, there are values in dispute, the stakes are high and decisions are urgently needed (Funtowicz and Ravetz, 1994). In other words, ecological economics has to deal with issues of far-reaching consequences where uncertainty is high and where the normative questions of value cannot be avoided, going well beyond the scope of 'normal' disciplinary science in the sense of 'puzzle solving' (Kuhn,

1962).¹ In the same line, Costanza (1991: 335) emphasizes that ecological economics is a "new transdisciplinary field of study... [which] goes beyond the normal conceptions of scientific disciplines and tries to integrate and synthesize many different disciplinary perspectives." In short, ecological economics is said to be an example of post-normal science (Funtowicz and Ravetz, 1994).²

As a post-normal science, ecological economics should not claim, according to Funtowicz and Ravetz (1994), ethical neutrality, nor an indifference to the policy consequences of its arguments. The imperative for research within ecological economics of not being "... divorced from the policy and management process" was quite emphatically highlighted by Costanza (1991: 341) almost two decades ago. More recently, Gallopín et al. (2001) considered that it was vital for science in general, and ecological economics in particular, to focus

¹ Kuhn (1962) proposes that 'normal science' is the hallmark of science. Scientists should undertake 'puzzle-solving' activities because this contributes enormously to scientific development. Notwithstanding, Kuhn also acknowledges the limitations of normal science and points out that when scientists encounter anomalies that cannot be dealt with within the existing paradigm, a crisis may arise and research becomes extraordinary rather than normal (i.e., it may lead to changes in the paradigm).

² Funtowicz and Ravetz (1994) call ecological economics 'post-normal' so as to better contrast it with the 'puzzle-solving within a (dogmatic) paradigm' of 'normal science' as articulated by Kuhn (1962).

* Corresponding author. Faculdade de Economia, Universidade do Porto, Rua Dr Roberto Frias, 4200-464 Porto, Portugal. Tel.: +351 225571100; fax: +351 225505050.

E-mail addresses: mcsilva@fep.up.pt (M. Castro e Silva), ateixeira@fep.up.pt (A.A.C. Teixeira).

on the linkages between the social, political, economic, biological, physical, chemical, and geological systems. However, Müller (2003) argues that in spite of its claimed status as a post-normal science, ecological economics is evolving in the direction of a 'normal' science. According to this author, ecological economics tends to neglect the social aspect, which does not conform to its claim to be the science of sustainability and policy issues tend to be neglected as well (Gale, 1998; Söderbaum, 1999). Shi (2004: 34) also underlines that "... ecological economics still has a long way to go to actually achieve the goal of better management of sustainability."

Beside this dispute on the status of ecological economics and the evolution of the relative importance of topics researched in this field, namely those related with policy, another closely related issue – 'rigor' and 'formalism' – has raised passionate debates among ecological economists.

According to some (e.g., Wätzold et al., 2006), the pronounced transdisciplinarity of post-normal sciences tends to undercut the development of formalism.³ And the lack of formalism and generally accepted definitions and ideas tend, according to others (e.g., Müller, 2003), to weaken the field's position with respect to higher formalized sciences. Tacconi (1998), however, has another view point. Following the line of Lincoln and Guba (1985), this author argues that even outside 'normal' science, the 'rigor' of the research process may be maintained by setting criteria aimed at guiding a process of 'disciplined inquiry', which includes prolonged and/or intense inquiry, persistent observation, triangulation, analysis of difference, peer debriefing, member checks, reports with working hypotheses and thick description, impact on stakeholders capacity to know and act, and inquiry audit. Stressing the relevance of formal methods of research within ecological economics (more specifically, the virtues of computer simulation models as preminent tools to help understand the complex, non-linear, and often chaotic dynamics of integrated ecological economic systems), Costanza (1991) recalls nevertheless that even with elaborate modeling capabilities, researchers will always be confronted with large amounts of uncertainty about the response of the environment to human actions.

From what has been said, we can conclude that post-normal science is not at odds with 'formalism', quite the opposite. Instead, it is characterized by a multiplicity of methods, quantitative and qualitative (Swedeen, 2006), deductive and inductive, involving also phenomenological approaches (Ramos-Martin, 2003).

Aiming to contribute, at least to some extent, to clarifying the status of ecological economics, this paper presents a quantitative and comprehensive account of the evolution of the field by depicting the trends in topics and type of methods which underlie studies published in ecological economics, based on bibliometric techniques.

Bibliometric-based studies are increasingly being used as they provide key insights into the terms of influence, specializations and trends of a research field, involving a more objective assessment of the patterns of scientific research (van Raan, 2003; Silva and Teixeira, 2008, 2009). Although there are some recent bibliometric analyses in the environmental and ecological field of research (e.g., Fisher and Ward, 2000; Smith, 2000; Costanza et al., 2004; Krauss, 2007; Jappe, 2007; Rousseau, 2008; Luzadis et al., 2010), they do not deal with issues related to the evolution of the topics analyzed and type of methods employed in ecological economics.

Using all (2533) the articles published in the area's 'seed' journal, Ecological Economics (EE),⁴ we classified the articles according to the main topic of research. To identify such topics, a review of key studies in the area was conducted. Additionally, we classified articles

according to their type (i.e., method of analysis) following an initial distinction, proposed by Nelson and Winter (1982), and later extended by Silva and Teixeira (2008, 2009) and Cruz and Teixeira (2010). The categorization of each article in terms of research topics and type was made on the basis of a thorough analysis and interpretation of the complete articles.

This paper is structured as follows. The next section defines the main themes in ecological economics based on a qualitative review of the field of ecological and environmental economics. This exercise helped us to identify the most prominent research topics in the area. Section 3 details the methodological underpinnings of the study, and Section 4, based on the bibliometric exercise, highlights the main topics that have emerged and developed in the environmental and ecological field as well as the declining ones, giving particular emphasis to the issue of collective action. Finally, the Conclusions summarize the main contributions of this study.

2. Defining the Main Themes in Ecological Economics

The importance of ecological (and environmental) issues in the field of economics shows a clear upward trend (cf. Fig. 1).⁵ Over the period from 1970 to 2009, there is an increasing number of articles and reviews in the field of the 'Social Sciences and Humanities' (SS&H) using 'ecology' or 'environment' as search keywords. Although displaying discontinuous temporal changes, both ecological economics and all articles in ecological and environmental economics have increased significantly over time.

The breadth of research topics is considered one of the strengths of ecological economics (van den Bergh, 2001; Røpke, 2005) and the distinct contributions accommodate some of the concerns of very different scientific domains, namely moral philosophy, politics, ethics, ecology, thermodynamics, economics, biology, natural history and natural sciences. Albeit recognizing the difficulty to categorize ecological economics in the same way one would a 'normal' academic discipline, we propose to group it into ten main topics.⁶

2.1. Theory Building

This topic outlines the sustained process of theory building which is a recurring cycle linking data, methods and theory itself in a coherent connection towards the generation, verification, and refinement of phenomena (Lynham, 2000). It includes conceptual and historical contributions and formative approaches.

2.2. Methodological Issues

Since ecological economics is a multidisciplinary field of research (Norgaard, 1989; Costanza et al., 1997a,b; Costanza and King, 1999), there is a wide array of methods and models to analyze issues in

⁵ It is important to recall here that 'ecological economics' and 'environmental and resource economics' are distinct groups of research. The latter, according to De Zeeuw (2008: 22), "... can be seen as a subfield in [mainstream] economics, [whereas] ecological economics originates from a strong disappointment with the economics profession, ... [being] more geared towards interdisciplinary research and action."

⁶ To identify such topics, a review of key studies in the area was conducted, namely the 'Ecological Economics Elgar Reference Collections Critical Writings in Economics' (Costanza et al., 1997a,b), the 'International Yearbooks of Environmental and Resource Economics' (Tietenberg and Folmer, 2006), 'Handbook of Environmental and Resource Economics' (van den Bergh, 1999), and the 'Recent Development of Ecological Economics' (Martinez-Alier and Røpke, 2008). Existing surveys published in key journals (e.g., Ecological Economics and Journal of Environmental Economics) were also reviewed. Table A1, in Appendix, details how we arrived at the ten themes proposed here. In each column of Table A1 we placed the main topics mentioned in each handbook's/journal's aims; then through in-depth content analysis we organized the topics by their degree of similarity, leading to the classification of the ten topics presented in the column 'Our proposal'.

³ 'Formalism' involves robust and widely accepted frameworks (e.g., mathematization and simulation) to sustain discussions – especially discussions with traditionally formalized sciences.

⁴ From here forth, EE is used to refer to the journal and 'ecological economics' when referring to the field of research.

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