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Evolutionary approaches for sustainable innovation policies: From niche to paradigm?☆

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ABSTRACT

Fostering technological innovation is considered as an important element of policies towards sustainable development. In the past 10 years, evolutionary policy approaches have been increasingly advocated. For several reasons, they seem well equipped to underpin sustainable innovation policies. They focus on dynamics of change and their drivers, they allow for a substantive perspective on technologies beyond mere input–output relations, taking into account trajectories and different characteristics of innovation, and they are able to describe circumstances under which established technologies might persist even when they are to some extent inferior to their new competitors (lock-in). However, the policy effectiveness of evolutionary approaches in cases in which radical or systemic changes are involved is not yet proven. In this paper we assess the theoretical rationale, instrumental aspects and the coping with policy constraints of three evolutionary policy approaches which have also been used in empirical studies: strategic niche management, transition management and time strategies. Each approach has its strengths and specific problems and all three have to be further developed and tested out but they hold promise for contributing to non-incremental change with economic and environmental benefits, by shaping processes of variation, selection and retention, with the outcomes feeding back into policy. They may also be used in other areas in which innovation direction is important, for instance health care or food.

1. Introduction

Fostering technological innovation is often considered as an important element of policies towards sustainable development. It is increasingly acknowledged that a focus on incremental innovation along established paths does not suffice for achieving demanding environmental sustainability goals such as mitigating climate change. A need for radical technological change or even system innovation has been expressed (e.g. Carrillo-Hermosilla, 2006; Freeman, 1992; Smith et al., 2005; Weaver et al., 2000). This raises the question of an appropriate policy framework for sustainable innovation policies which takes up this challenge. Its necessary scope goes clearly beyond a simple extension of an (neoclassical) environmental policy framework to account for environmental innovation. The neoclassical externality and market failure framework is useful for thinking about innovation policy, too, but as pointed out by critics one cannot define actual policies on this basis. It provides a general rationale for innovation support but it is inherently imprecise in its detailed prescriptions (Metcalfe and Georghiou, 1998). Moreover, it is basically static and abstracts from the dynamics of specific technologies.

In dealing with issues of innovation support, policy makers have often adopted a systemic view in which attention is giving to the "system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts that define new technologies" (Metcalfe, 1995, p. 38). Actual policies following from this are oriented towards improving the "national system of innovation" through the support for industry–university collaboration, training, with some of the support targeted to areas in which innovation is viewed to be needed. Concrete policies have evolved with experience, with the help of evaluation studies. They are partly theory-based, and partly experience-based. Smits and Kuhlmann (2004) speak of the co-evolution of innovation practice, intervention strategies and theory. The theory behind modern innovation policy is broadly indicated, e.g. by Mytelka and Smith (2002). It can be said to be a combination of market failure and system failure, where system failures have to do with the facilitating structure, which may be ill-developed for innovation in general or unhelpful for certain types of innovation, causing problems of adaptation and problems in the creation of novelty. Even when innovation

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policy tries to correct for market failures there is a clear commitment to markets as a mechanism for coordination, precisely because of the evolutionary process that is involved—of variation and selection of ideas, technologies, product designs, routines and institutional arrangements, with an important role for trial-and-error because optimal designs cannot be determined ex ante (cf. Nelson and Winter, 1982).

It seems therefore correct to say that broadly speaking a systemic-evolutionary view is behind actual innovation policies. Recently an interest in evolutionary aspects surfaced in actual innovation policies related to sustainability goals, too. This is most evident in the Dutch transition management policies for fostering a transition in energy technologies in an evolutionary manner, by supporting variation within a broad portfolio chosen by platforms involving business actors, government officials, academics and one environmental NGO (see Kemp and Loorbach, 2005; Loorbach, 2007).

The term evolutionary policy is new and in need of definition. In theory outside biology, the term evolutionary is often coined in relation to innovation and change (e.g. Nelson and Winter, 1982). It may refer to gradual change or to the evolutionary mechanism of variation, selection and retention (inheritance). With evolutionary policy, we mean an adaptive policy approach that is concerned with the dynamics of variation, selection and retention. The analytical foundation and scope of an evolutionary perspective on policy, however, are not straightforward. A dynamic perspective renders the dominant theoretical policy framework of static neoclassical welfare economics inappropriate (e.g. Metcalfe and Georghiou, 1998; Witt, 1996), in which the diagnosis of market failures is endogenously linked with the derivation of optimal or at least welfare-improving policies (this issue is further dealt with in Section 2). Given that a comparably specified evolutionary policy framework is still lacking, different approaches to cope with this challenge have been developed. From the mid-1990s the first tentative applications of elements of an evolutionary framework to policy issues related to environmental sustainability could be observed (Cowan and Kline, 1996; Erdmann, 1993a; Goodstein, 1995; Kemp, 1994; Schot, 1992; Schot et al., 1994). Reichel (1998) combines neoclassical and evolutionary elements in a policy framework focusing on the overcoming of barriers to the market introduction of new environmental technologies.

In recent years, three relatively well-developed evolutionary sustainable innovation policy approaches have been proposed which attempt to integrate the insights gained in innovation policy practice. The approach of "strategic niche management" highlights the importance of protected spaces and of user involvement in early technological development to create new paths which are able to replace unsustainable technologies (e.g. Hoogma et al., 2002; Kemp et al., 1998; Raven, 2005; Van der Laak et al., 2007). These insights informed the approach of "transition management" with its broader scope on system changes and system innovation, and reliance on evolving adaptive portfolios (e.g. Rotmans et al., 2001; Kemp and Loorbach, 2005). More recently, the concept of "time strategies" has been proposed which focuses on the political preparation and utilisation of time windows of opportunities in unstable phases of technological competition (e.g. Nill and Zundel, 2001; Zundel et al., 2005a).[1] All three approaches have been used as analytical framework for the empirical analysis of policies in range of empirical cases in the domains of transport, energy, construction, iron and steel production, chemicals and waste management. Also first attempts to integrate some insights from the different approaches can be observed (Foxon et al., 2005; Kemp and Zundel, 2007).

The effectiveness, however, of evolutionary policy approaches in stimulating radical or systemic sustainability innovations is not yet proven. The uptake in sustainability-oriented policy making is still moderate and mainly conferred to policy niches such as the use of transition management in the Netherlands to foster sustainable (system) innovations. Nevertheless, based on the existing analyses and an evaluation of first policy experiences, it is possible to assess their strengths, complementarities and remaining weaknesses systematically. By comparing and contrasting these three approaches, we are able to illustrate how the approaches have been conceived theoretically and how they can be or have been applied in the policy context. The purpose of the paper is to start this process of integration of the three approaches and set the agenda for other scholars to engage with as well as for further research. As contributors to the development of the three approaches we feel to be in a good position to do so.

The remainder of the paper is structured as follows. Based on the literature review, Section 2 sets out the framework and criteria of the assessment. Subsequent sections cover the three main themes of the assessment, which are: the appropriate matching of policy objectives with problem analysis in the three covered approaches (Section 3), appropriate and empirically meaningful criteria for policy evaluation (Section 4) and the coping with policy constraints with regard to information constraints and the political context (Section 5). It is shown that each approach has its strengths and specific problems and that their complementarities for contributing to radical and system innovation with sustainability benefits have not yet been fully exploited. Section 6 discusses the prospects of integrated evolutionary approaches to become a new paradigm for sustainable innovation policy and points out directions for further research.

2. An economic framework for assessing achievements and challenges of evolutionary approaches to sustainable innovation policy

An appropriate assessment framework for policy concepts needs to cover analytical soundness as well as empirical usefulness of policy approaches. We use the theory of economic policy as reference for the analytical dimensions of the assessment. Building on the seminal work of Tinbergen (1952), traditional approaches to the theory of economic policy have a normative and instrumental focus and can be described as decision-oriented "objective + means-approaches". They have been first developed in a macroeconomic context. Policy makers have the capacity to autonomously define objectives with regard to desired states of the economic system and choose corresponding means by using an explicative economic theory which contains the means as (exogenous) variable and the policy objective as endogenous variable. The economic objectives to be addressed are not determined a priori.

Neoclassical welfare economics grounded in microeconomics contributed elements of the combined definition of problems and objectives into the core of economic theory by demonstrating that under specific – and as we will see from an evolutionary perspective problematic – conditions an equilibrium attained in competitive markets exhibits desirable normative properties. The latter are contained in the concept of (Pareto-)efficiency, i.e. a state in which no economic actor can achieve a better situation without worsening the situation of other economic actors. Relevant economic problems arise and policies are only legitimate if these conditions are not met ("market failure"), e.g. if there are environmental and/or

[1] A fourth evolutionary framework for policy is offered by van den Bergh et al. (2007). It consists of evolutionary-economic principles for policy such as extended level playing field. The framework lays down a scheme for evaluating government policies (environmental, innovation and economic policy), which is applied to Dutch energy innovation policies. Lack of space prohibits us from including it fully in our discussion.