Complexity, Evolutionary Economics and Environment Policy

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'Exploring Complexity Economics for Sustainability'

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Background

Joint project with Albert Faber for the Netherlands Environmental Assessment Agency in 2006 who wanted to learn about the use of evolutionary modelling for policy making

… which lead to the review paper Faber/Frenken, forthcoming, "Models in evolutionary economics and environmental policy: towards an evolutionary environmental economics", *Technological Forecasting and Social Change*

… as part of a special issue: Frenken/Faber (eds.), forthcoming, "Evolutionary methodologies for analyzing environmental innovations and the implications for environmental policy", *Technological Forecasting and Social Change*

Special issue TFSC

--- The use of modeling tools for policy in evolutionary environments, **Verspagen**

--- Models in evolutionary economics and environmental policy: towards an evolutionary environmental economics, **Faber/Frenken**

--- An evolutionary model of recycling and product lifetime extension, **Brouillat**

--- A percolation model of eco-innovation diffusion: The relationship between diffusion, learning economies and subsidies, **Cantono/Silverberg**

--- Agent-based modeling of the diffusion of environmental innovations: An empirical approach, **Schwarz/Ernst**

--- Graded eco-labels: A demand-oriented approach to reduce pollution, **Bleda/Valente**

--- An information-based adaptive strategy for resource exploitation in competitive scenarios, **Boschetti/Brede**

--- Consumer heterogeneity and the development of environmentally friendly technologies, **Windrum/Ciarli/Birchenhall**

--- Environmental impact, quality, and price: Consumer trade-offs and the development of environmentally friendly technologies, **Windrum/Ciarli/Birchenhall**

--- Sectoral systems of environmental innovation: An application to the French automotive industry, **Oltra/Saint-Jean**

--- Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims, **Hekkert/Negro**

DIME Network of Excellence

http://www.dime-eu.org/

Workpackage 2.5 on Environmental innovation

Vanessa OLTRA (University of Bordeaux IV)

Structure of the presentation

1. 1st generation Evolutionary Economics
   - critique on NE within neoclassical welfare framework
2. 2nd generation Evolutionary Economics
   - critique on NE outside neoclassical welfare framework
3. Complexity economics
   - integrating social and natural sciences into a unified theory of evolution
4. Some tentative remarks on policy

Overview

	Neoclassical	*Evolutionary 1st generation*	*Evolutionary 2nd generation*	*Complexity (Beinhocker)*
Technology	**Exogenous**	**Endogenous**	**Endogenous**	**Endogenous**
Institutions	**Exogenous**	**Exogenous**	**Endogenous**	**Endogenous**
Nature	**Exogenous**	**Exogenous**	**Exogenous**	**Endogenous**

1st generation evolutionary economics

Technology endogenous - Institutions exogenous - Nature exogenous

Joseph Schumpeter

- restless capitalism (Stan Metcalfe)

- markets may tend to equilibrium if innovation is absent

- … but capitalism is a system that precisely rewards non-equilibrium behaviour (temporary monopoly rents stemming from innovation)

1st generation evolutionary economics

Technology endogenous - Institutions exogenous - Nature exogenous

Increasing returns: Static versus dynamic efficiency

1. Irreversible technology adoption (Arthur 89; David & Foray 97)
markets may select sub-optimal technology due to small events

2. Technological substitution (Bruckner et al. 96)
centralised decision-making necessary to jump to superior Nash-equilibrium

3. Recombinant technology (Van den Bergh 08; Alkemade et al. 09)
loss of variety diminishes recombinant innovation potential

4. Diffusion as percolation in social networks (Cantono & Silverberg 09)
cost-efficiency of product subsidies depends on timing

1st generation complexity economics

Technology endogenous - Institutions exogenous - Nature exogenous

Technological regimes and sectoral specifities

1. Sectors differ greatly in technological regimes (Malerba & Orsenigo 96):
   - technological opportunities
   - the nature of the knowledge base
   - the degree of cumulativeness of knowledge production
   - appropriability conditions

2. Environmental policies are likely to have very different effects in different technological regimes (Oltra & Saint-Jean 09)

3. Possible trade-offs between environmental innovation, static efficiency and dynamic efficiency

1st generation complexity economics (cont.)

Technology endogenous - Institutions exogenous - Nature exogenous

Observations

1. Implicit assumption of a social planner maximizing consumer surplus as in cost-benefit analysis; this is only useful is well-defined and short-run problem contexts (Barker 2008)

2. Trade-off between variety and standardisation may be misleading: standardisation in a technology technology generally may facilitate variety creation in other technologies (decentralised infrastructures, modular systems)

3. Users as passive consumers: the firm-centred approach ignores user-producer interaction and ‘open innovation’ (Von Hippel 88; Von Hippel 05)

2nd generation evolutionary economics

Technology endogenous - Institutions endogenous - Nature exogenous

Chris Freeman / Dick Nelson

Institutions matter, because they matter for innovation

1. National systems of innovations (Freeman 87)

2. Co-evolution of technology and institutions (Nelson 95)

2nd generation evolutionary economics

Technology endogenous - Institutions endogenous - Nature exogenous

Co-evolution of technology and institutions

1. Technology and institutions are mutually shaping (Nelson 95)

2. Windows of Locational Opportunity concept (Storper & Walker 89; Boschma & Lambooy 99)

3. Empirical work, e.g., 19th century chemical industry, 20th century wind power, 20th century paper and pulp industry

2nd generation evolutionary economics (cont.)

Technology endogenous - Institutions endogenous - Nature exogenous

Observations

1. Becoming influential in mainstream development economics (Rodrik 06)

2. Interdisciplinary opportunities with sociology, political science, geography and history, e.g., the work on technological transitions (Rip & Kemp 98)

3. Poorly formalised in models, though some attempts exist:
- coalition formation in standard-setting (Axelrod et al. 95)
- co-evolution of preferences and technology (Windrum & Birchenhall 98)

(agent-based models are many, but few address technological change)

4. The lack of an alternative welfare theory is problematic to substitute for cost-benefit analysis; behavioural economics may also turn out to be limited

Complexity economics

Technology endogenous - Institutions endogenous - Nature endogenous

Towards a unified theory of human evolution

1. Entropy is decreasing through technological evolution, institutional evolution and natural evolution in a co-evolutionary process (Beinhocker 06)

2. Evolution takes place through
   - retention: the storage of knowledge* (*PT, ST, genes*)
   - variety: recombination/mutation of information
   - selection: differential reproduction depending on environmental fitness

   * as *fit* information

3. Compatibility with thermodynamics (“order does not come for free”)

Complexity economics (cont.)

Technology endogenous - Institutions endogenous - Nature endogenous

Observations

1. A possible comprehensive model for *ecological economics* in which technological and institutional evolution are integrated

2. In line with some earlier work of evolutionary economists
   - increasing-variety-hypothesis of economic growth (Saviotti 96)
   - continuity thesis in consumption (Witt 02)
   - generalised framework of diversity (Stirling 07)

3. Theoretical and methodological challenges, since one has to deal with three co-evolving systems

Concluding remarks

Government: part of the problem of part of the solution?

Government policy may remain limited as economic growth remains prime objective (tax revenues) and international coordination is weak (national interest)

Current rise of industrial policy at the level of national governments is potentially worrying

Case study: the unfortunate success of the technological transitions concept in the Netherlands

History: little evidence that (national) governments have been successfully driving technological development, institutional change nor nature conservation

What role for social movements?