Economic change and evolutionary perspectives.

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Abstract

Economic studies with an evolutionary perspective have put the process of change at the centre of the analysis - replacing equilibrium views of economic activity – and have generally focused on the two mechanisms of variety generation – provided by innovation - and selection – provided by market processes, leading to a prevalence of microeconomic investigations. Recent developments in evolutionary biology have emphasised the equally important role of cooperation; cooperative economic behaviour is, in fact, as important as market competition for understanding macroeconomic processes, the role of institutions and public policies, opening up new directions for research. This interdisciplinary discussion has been at the centre of the Roundtable on “Evolution and economic change” organised by the Centro Linceo Interdisciplinare “Beniamino Segre” of the Accademia dei Lincei on 14 May 2012, whose proceedings are published here.

Sintesi

Gli studi economici di tipo evolutivo hanno messo al centro dell’analisi i processi di cambiamento - anziché l’equilibrio economico – e hanno considerato i meccanismi di generazione di varietà, attraverso l’innovazione, e di selezione attraverso meccanismi di mercato, con un’attenzione prevalente a problemi di tipo microeconomico. Gli sviluppi recenti nella biologia evolutiva hanno sottolineato il ruolo, ugualmente importante, della cooperazione; i comportamenti economici cooperativi, in realtà, sono essenziali per comprendere i fenomeni macroeconomici, il ruolo delle istituzioni e delle politiche pubbliche, e aprono nuove direzioni di ricerca. Il dibattito interdisciplinare su questi temi è stato al centro della Tavola Rotonda su “Evoluzione e cambiamento economico” organizzata dal Centro Linceo Interdisciplinare “Beniamino Segre” dell’Accademia dei Lincei il 14 Maggio 2012, i cui atti sono qui pubblicati.

Introduction

Economic studies with an evolutionary perspective have addressed a wide range of issues, including microeconomic behaviour, the nature of knowledge and innovation, firms and industry dynamics, growth patterns, etc. The process of change has been put at the centre of the analysis - replacing equilibrium views of economic activity – considering the variety of economic agents and their specific patterns of growth, characterised by bounded rationality, path dependency, feedback loops, diversity of behaviour, importance of contexts, networks and interactions.
Most evolutionary economic literature has built on analogies with evolutionary biology based on Darwinian insights, and has focused on the two mechanisms of *variety generation* – provided by innovation - and *selection* – provided by market processes. This has usually led to studies with a microeconomic approach, that have focused on utilitarian individual behaviour or on the dynamics of populations of firms, and have considered markets as the context where such processes develop. Also the attention to norms, procedures and institutions has mainly maintained a “micro” perspective. Conversely, macroeconomic dynamics has been mainly considered as the result of the aggregation of individual behaviours, with a limited attention to the evolutionary processes operating the level of the economic system as a whole. The search for macroeconomic analyses with an evolutionary perspective now appears as a major direction for new research.

A renewed interdisciplinary discussion drawing relevant lessons from recent developments in evolutionary biology and mathematical models is a necessary step. In such studies, a growing role is now played by the concept of *cooperation*, that has increasingly been identified by biologists as a factor of equal relevance to *variety and selection* in shaping evolutionary processes. Moreover, economic activities cannot be reduced to market mechanisms alone. Evolutionary perspectives could also address complex individual and collective economic behaviours that are shaped by cooperation, the variety of forms of economic organisation beyond for-profit firms, the importance of public services assuring the provision of public goods, the growing interest in non-market arrangements for the governance of the commons, macroeconomic issues and the pervasive role of institutions and public policies affecting economic activities.

Such an update of the interdisciplinary discussion on economics and evolution has been at the centre of the Roundtable on “Evolution and economic change” organised by the Centro Linceo Interdisciplinare “Beniamino Segre” of the Accademia dei Lincei on 14 May 2012, whose proceedings are published here. Key issues are discussed in the following sections.

**Evolution and economics**

Evolution as a set of concepts, models and methodologies to analyze change has emerged as an important approach not only in biological and natural sciences, but - increasingly - in social sciences, and in particular in economics. Classical economists, Marx and Marshall had often used metaphors and references drawn from evolutionary biology for highlighting the nature of economic phenomena. Schumpeter developed a vision of complex economic phenomena in which change - rather than market equilibrium - was at the center of the analysis, with special attention to the diversity of firms and industries, and to the role of innovation in products, processes and organizations. In parallel, Keynes developed the conceptual framework of modern macroeconomics where economic growth and change can be governed by appropriate policies. In recent years, several strands of economic research have developed evolutionary approaches.

**Variety and selection.** The major stream of research has combined the Schumpeterian legacy with evolutionary perspectives, with a key role played by the contributions of Nelson and Winter (1982), Dosi (1982), Dosi and Nelson (2010). These approaches address the dynamics of economic change, the evolving nature of knowledge and the trajectories of technologies, the characteristics and diversity of firms and their performance, and the dynamics of industries. Based on the biological metaphor, firms are typically the unit of observation, inserted in a population that defines the industry and the market in which they operate, in competition with each other, interacting with a wider environment that includes suppliers and customers, consumers and workers, the financial and innovation systems, public institutions and policies. The state of the art of this research is provided by the chapter by Dosi in this volume (see also Dopfer, 2005)

Such approaches have emphasised, first, the process of differentiation and variety generation and, second, the selection mechanisms. The former effectively describes research and innovative
activities that introduce changes in products, processes and organizational forms of enterprises. The latter is rooted in the mechanisms of market competition between firms - but also between technologies, new products, different organizational models. More complex views on the evolution of industries, such as history-friendly models - see the contribution by Orsenigo in this volume - have introduced the role of R&D and inventions, institutional factors and public policies to explain the emergence and trajectories of industries such as the computer and the pharmaceutical ones.

**Macroeconomic change.** While the original contribution by Nelson and Winter (1982) included an effort to provide an alternative explanation of US aggregate growth, macroeconomic studies in the evolutionary tradition have so far had a limited development. Building an evolutionary picture of the macroeconomic system taking into account demand, distribution, fiscal and monetary policies, besides developments on the supply side has proved to be difficult. In the search for bringing together Schumpeter and Keynes, recent research by Dosi et al. (2010, 2013) has developed agent-based models where macroeconomic dynamics and policies can be investigated within an evolutionary framework.

Conversely, a wide range of post-Keynesian approaches, moving in particular from Kaldorian growth models, have extended aggregate and industry-level economic models considering the variety of processes of change, the role of technology and institutions. Major streams of research include those on the role of technology (Sylos Labini, 1969) and the dynamics of structural change (Pasinetti, 1981, 1993). An assessment of approaches based on the analysis of economic structures is provided by the contribution by Roncaglia in this volume.

Recent works at the industry levels combining structural change and evolutionary views include models - with feedback loops - on the diversity of innovation and the impact on performance and profits in Bogliacino and Pianta (2013a,b); a model linking innovation and wage-profit distribution in Pianta and Tancioni (2008); a study on how business cycles affect such relationships and employment in Lucchese and Pianta (2012). The technology-employment relationship is investigated by Vivarelli and Pianta (2000) and Pianta (2005).

**Institutions and history.** Institutional approaches have long shared many common elements with evolutionary views. However, according to North, “in contrast to Darwinian evolutionary theory, the key to human evolutionary change is the intentionality of the players” (North, 2005, p. viii) who make decisions based on expected consequences of their actions. In institutional perspectives the complexity of interactions between economic agents and their environment – that go well beyond market mechanisms – and the way in which institutions emerge in particular contexts have been put at the centre of the analysis (see Beinhocker, 2005). A discussion of institutional economics and of its research agenda is provided in the contribution by Franzini in this volume.

The historical dimension has been a major theme of investigation by historians of technology and the economy sharing similar concerns. As an example, the history of the emergence and evolution in the last five centuries of Western science systems based on the principle of “open science” is examined in the contribution by David in this volume.

**Behaviours and heterogeneous agents.** Other evolutionary approaches have put individual behaviour at the centre of the analysis. Consumption behaviour, the dynamics of demand and the importance of variety in economic choices are some of the themes addressed in this research. A rapidly growing area of research concerns the models with heterogeneous agents that can overcome – to some extent - the limitations of the “representative agent” of mainstream economics and provide microfoundations to simulation models. In recent years studies of experimental economics have also rapidly grown, combining analyses of behaviours and laboratory experiments on individual choices. A discussion of some of these issues is in the contribution by Bogliacino in this volume, where the limitations of microfounded models are pointed out, and it is argued that
“macrofoundations” can more effectively capture the fundamental aspects of economic relationships.

*Mathematical models.* A wide variety of mathematical models have taken on board key elements of evolutionary perspectives and have abandoned the mainstream assumptions of fully informed, rational economic agents operating under some “maximizing” criteria. Agents are increasingly modelled as heterogeneous, boundedly rational, with limited information, operating under some “satisficing” criteria. Dynamic, adaptive models – including evolutionary game theory - are increasingly used where agents can choose among different strategies and learn from outcomes. The contribution by Bisci in this volume provides a survey of such developments. The chapter by Bazzani and Freguglia offers a specific model – parallel to one developed within evolutionary biology - where agents have to choose between a strategy of innovation and a conservative strategy in order to maximize benefits.

**Lessons from evolutionary biology: the importance of cooperation**

Evolutionary economics – with its focus on variety and selection - appears to have relied on a very “crude” version of evolutionary biology. The studies of evolutionary biology – discussed by the contribution by Buatti in this volume - point out that human evolution is fundamentally different from that of other species, which are selected on the basis of their genetic complement. Human evolution and adaptation has been rooted in behavioural and cultural factors, rather than in the material processes of genetic variation and selection. Thanks to the development of the brain and to the attitude for cooperation, humans have engaged in the exchange of information and in symbolic activities, resulting in the capacity to actively change their environment.

The question of cooperation – ignored by most evolutionary economic studies – is a crucial theme in evolutionary biology. As argued by Nowak (2011), for species that live in colonies the trajectory of evolution is strongly influenced by the presence and effectiveness of cooperative relations in various forms - symbiosis, complementarity, or the complex "division of labour" of species such as bees and ants. Game theory applications to biology have shown that natural selection favours defectors, not cooperators, but groups of cooperators are superior to all other groups; the sources of cooperative behaviour are identified in five mechanisms: repetition (direct reciprocity), reputation (indirect reciprocity), spatial selection (relationships with neighbours), multilevel selection (relationships within groups), kin selection (“blood” relationships) (ibid., p.270-272). In short, behaviours that are “hopeful, generous, forgiving” sustain cooperation and improve the possibilities of success, so much that “cooperation – not competition - underpins innovation” (ibid. p.xvii).

The most systematic study of cooperation from an economic perspective has been developed by Bowles and Gintis (2011) who have explored the conditions, behaviours and context where cooperation emerges as a form of successful economic interaction. In this approach, however, cooperation is often modelled as an individual preference integrating utility-oriented behaviour and research questions tend to focus on the microeconomic determinants, incentives and effects of cooperative attitudes. The implications of cooperation at the macroeconomic level have received much less attention and the concept has yet to be integrated in much of current evolutionary economic research.

A specific field of study on the cooperative institutional arrangements that make the efficient provision of common goods possible has been developed by Ostrom (2005). Her work has shown that collective action and cooperation can lead to appropriate solutions to the provision and governance of common goods, where both market and government driven solutions may fail; this evidence is of particular importance in the case of local and global environmental issues.

**Cooperation, institutions and the macroeconomy**
Building on the evidence so far provided, an important direction for advancing evolutionary perspectives is the consideration of cooperation alongside variety and selection as fundamental mechanisms of change. And a major question to be addressed is the integration of macroeconomic issues into an evolutionary approach.

We have seen above that so far the evolutionary drivers of variety and selection have been set in the context of market processes where “self-interested” individual agents operate. When we add the third mechanism of cooperation, we have to locate it at the same time within market processes – as cooperation underpins the division of labour and innovation - and within social processes ruled by non-market principles, such as reciprocity and solidarity among individual agents, or the exercise of rights guaranteed by government authority. Figure 1 summarizes such concepts.

In this approach cooperation plays multiple roles. First, within a market context, cooperation among economic agents supports the generation of variety through innovations in products, processes and organisations. Different streams of evolutionary literature – such as those on national innovation systems, inter-firm alliances, R&D cooperation etc. - have acknowledged its relevance and investigated specific patterns. As in the typical evolutionary narrative, once different varieties appear – produced by agents that are both competing and cooperating - market processes will then operate the selection, identifying the most “appropriate” varieties; the result is the growth, survival or exit of the agents concerned. Cooperative behaviour now becomes one of the determinants of successful innovation (as suggested by Nowak, 2011) and of survival of the agents concerned.

Second, the non-market dimension of cooperation leads to a social process of reproduction of social relationships – for instance within groups that fulfill a relevant function for the agents concerned. Different streams of research in economics – such as those on business networks, industrial districts, wiki-based activities, open source software, etc. - have acknowledged the relevance of such non-market patterns of cooperation and have investigated specific behaviours and outcomes. The “success” of particular cooperative-based social arrangements may lead to a parallel selection of the most “appropriate” ones, affecting again the performance or well-being of the agents concerned.

Differently from markets – where competition is the dominant rule – in such social processes there is an obvious collective and public interest in consolidating the most “appropriate” social arrangements and turning them into broad social norms embodied in institutions, rules and public policies. In an evolutionary perspective, therefore, cooperation among individuals could be considered as a source of social arrangements that – when “appropriate” and successful – can be stabilised into institutions and policies carried out by governments – just think of the welfare state and public services. In this way a macroeconomic and policy context emerges that is “endogenous” to the model, being the result of the cooperative behaviour of agents and of the social and political selection mechanisms. Such macroeconomic and policy factors affects again the growth, survival or exit of the agents concerned, as well as the stability and performance of the economic and social system as a whole. The model proposed here appears promising in filling some of the current gaps in evolutionary economics and will soon be applied to specific analyses.

Learning new lessons from evolutionary biology, taking cooperation seriously as a key mechanism of evolutionary change - alongside variety and selection -, bringing institutions into the picture and addressing macroeconomic questions appear to be important challenges for the progress of evolutionary perspectives on the study of economic change.

References


Figure 1. Cooperation and institutions in an evolutionary approach

Institutions, rules, policies

Social process of selection, reproduction

Agents

Cooperation

Variety in products, processes

Market process of selection