



# Complexity paths in neo-Schumpeterian evolutionary economics, structural change and development policies



Verónica Robert<sup>a,\*</sup>, Gabriel Yoguel<sup>b</sup>

<sup>a</sup> Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina and Instituto de Industria, Universidad Nacional de General Sarmiento, Buenos Aires, Argentina

<sup>b</sup> Instituto de Industria, Universidad Nacional de General Sarmiento, Buenos Aires, Argentina

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## ABSTRACT

Recently, several authors of evolutionary and neo-Schumpeterian economics have identified in complex systems a common framework for accounting for a range of attributes they have been claiming are present in economic systems: path-dependence, positive feedbacks, micro-heterogeneity, emergent properties, and self-organization. Complexity seems to be broad enough to accommodate very different positions and it has been seen as a unifying approach for evolutionary and neo-Schumpeterian streams. This pluralism is reflected in the fact that many authors that draw upon complexity ideas from neo-Schumpeterian evolutionary theory, make contrasting policy recommendations in terms of if it should be vertical or horizontal or if it should promote bottom-up process or direct interventions. This is possible because the complexity approach has not yet been fully developed and its limits are still somewhat blurred. In this paper, we propose to explore this idea by identifying the theoretical backgrounds and the policy recommendations of different groups of neo-Schumpeterian evolutionary authors. We propose that backgrounds focused on different attributes of complexity lead to different development policies recommendations.

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## 1. Introduction

In recent years, complexity has emerged as a general framework within which different concerns of evolutionary neo-Schumpeterian economics have found a place. Several authors (Dosi et al., 2010; Saviotti, 2001; Metcalfe, 2010a; Antonelli, 2011; Foster, 2005; Arthur, 2009; Arthur

et al., 1997; Durlauf, 2005; Potts, 2000, among others) have identified in complex systems a common framework for accounting for a range of different attributes they have been claiming are present in economic systems: from path dependence and positive feedbacks to micro-heterogeneity, emergent properties, and self-organization. Several of these attributes have been mentioned at some point in the history of economic thought by different authors, but modeling and computational capacity in the past constrained these ideas to appreciative theory. Since this constraint began to be loosened up by the development of ICT, the complexity approach has been used as an inspiring modeling toolbox (Frenken, 2006; Durlauf, 2005; Ciarli et al., 2010). Nevertheless, it has also triggered deeper discussion regarding the ontological bases of the evolutionary theory of innovation (Hodgson and Knudsen, 2008;

\* Corresponding author. Tel.: +54 1149511721.

E-mail addresses: [vrobot@ungs.edu.ar](mailto:vrobot@ungs.edu.ar) (V. Robert), [gyoguel@ungs.edu.ar](mailto:gyoguel@ungs.edu.ar) (G. Yoguel).

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Hodgson, 2004; Witt, 1997, 2008) and an epistemological debate on issues like indeterminacy (Hodgson, 2009) and intentionality (Antonelli, 2011).

As a general framework, complexity is broad enough to accommodate very different positions. Fontana (2014) and Davis (2008) point out that complexity is driving innovation economics into becoming a pluralistic research field. Among neo-Schumpeterian evolutionary authors, complexity might even be seen as a unifying approach, since evolutionary theory is made up of different sets of contributions that are loosely coupled with each other. This is possible because the complexity approach has not yet been fully developed and its limits are still somewhat blurred (Rosser, 1999; Colander, 2002; Day, 1983). Definitions of complex systems tend to offer a list of features that systems must fulfill in order to be considered complex, but such lists not always contain the same elements, beyond certain obvious overlaps.

This pluralism is reflected in the fact that many evolutionary and neo-Schumpeterian authors draw upon complexity ideas like feedbacks and divergence or micro-heterogeneity and self-organization in order to make contrasting policy recommendations. The scope of those recommendations includes from selection of sectors under a vertical approach or mission-oriented (Ergas, 1987) through promoting bottom-up processes under a horizontal perspective or diffusion-oriented policies that provoke emergence of variety.

As long as the complexity approach has not yet been fully developed and its limits are still somewhat blurred, this heterogeneity of policy recommendations coexists within the evolutionary economics. Even more, recommendations often combine both types of intervention instead of choose one or the other type. In these cases complexity can provide a common theoretical framework that integrates both perspectives. In this paper, we propose to explore this idea by identifying the backgrounds and the type of policy interventions of different groups of neo-Schumpeterian evolutionary authors. We propose that backgrounds focused on different attributes of complexity lead to different policy recommendations within a framework of epistemological and methodological pluralism (Dow, 1997).

After defining complexity and describing its main dimensions, in Section 3, we identify two possible paths for complexity ideas in the history of economics. The first one was pointed to by Metcalfe (2010a) and others (Beinhocker, 2011); it starts with Smith and ends with Hayek. The common threads of this path are self-organization and emerging novelty, and their focus is on problems of coordination and transformation. The second path also starts with Smith but ends with structuralism and the development school. In this case, the common threads are non-linearity, path-dependence, and divergence. As such, they are focused on aspects like cumulative causation and structural change (Robert and Yoguel, 2011).

In Section 4, we propose that different groups within neo-Schumpeterian evolutionary thinking are followers of one of these two traditions or of a mix of the two. In this section, we propose a possible taxonomy of evolutionary and neo-Schumpeterian authors around five

key concepts: Habits and Routines, Self-organization/Self-transformation, Innovation Systems, Cumulative Causation, and Positive Feedbacks (Robert and Yoguel, 2015). At one extreme, the contributions of Metcalfe (2010b), Dopfer (2004), Potts (2000), and Foster (2005) explain coordination (self-organization) and the emergence of novelty (self-transformation), without resorting to the notion of equilibrium. These contributions are closer to the historical path traced by Metcalfe (2010a). At the other extreme are the contributions of those analyzing Innovation Systems at the national (Freeman, 1995; Lundvall, 1992), sectoral (Malerba and Orsenigo, 1997; Pavitt, 1984) and local (Boschma and Martin, 2010; Antonelli, 2011) levels, as well as those considering Cumulative Causation processes between innovation and demand (Dosi et al., 2010; Saviotti and Pyka, 2004; Llerena and Lorentz, 2004; Dosi et al., 1990), all of which are focused on feedback dynamics and path dependence. They have relied on an argumentative line connecting Smithian growth with increasing returns and are closer to the development school. In an intermediate position, there are Habits and Routines (Nelson and Winter, 1982; Hodgson, 2009; Teece and Pisano, 1994; Cohen and Levinthal, 1990, among others) and Positive Feedbacks (Arthur et al., 1997; Axelrod, 1997; David, 1985) groups. While the former is closer to the first tradition, the latter is related to the second one.

In Section 5, we show how each group's policy recommendations are also linked to the historical tradition they belong to. The two paths lead to divergent interpretations of intervention in the economy, and this situation is reflected by the diversity of the policy recommendations made by neo-Schumpeterian groups. They include bottom-up policies such as capacity building and the development of institutions that promote innovation and economic development, and top-down policies such as the selection of specialization sectors and the fostering of structural change. We show that top-down and bottom-up policies are complementary, but they should be promoted to different degrees according to how developed the country in question is. In developed countries – i.e. those that already have diversified and complex productive structures – bottom-up policies make more sense than top-down ones, while in less-developed countries, where production structures specialize in a few commodities, structural change policies must include top-down interventions leading to the generation of new sectors, and, according to Saviotti and Pyka (2004), related and unrelated variety. All the same, in this case, top-down policies should be complemented with bottom-up ones oriented toward improving individual agents' capacities.

Finally, in Section 6, we discuss our main conclusions.

## 2. Defining complexity

Several authors propose definitions of complexity (Rosser, 1999; Colander, 2002; Kirman, 2010; Foster, 2005) that list the attributes a system must fulfil in order to be called complex. In this article, we stress four attributes included in those definitions because there are clear theoretical backgrounds to them, and they are useful for linking with the policy implications set out by the

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