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Structural Change and Economic Dynamics
14 (2003) 237–273
STRUCTURAL CHANGE AND ECONOMIC DYNAMICS
www.elsevier.com/locate/econbase

Exploitation, exploration and innovation in a model of endogenous growth with locally interacting agents

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Received 1 July 2002; received in revised form 1 January 2003; accepted 1 February 2003

Abstract

The paper presents a model of endogenous growth in which firms are modeled as boundedly-rational, locally interacting, agents. Firms produce a homogeneous good employing technologies located in an open-ended technological space and are allowed to either imitate existing similar practices or to locally explore the technological space to find new, more productive, techniques. We first identify sufficient conditions for the emergence of empirically plausible GDP time-series characterized by self-sustained growth. Then, we study the trade-off between individual rationality and collective outcomes by providing an example in which more rational agents systematically perform worse than less rational ones.

JEL classification: O30; O31; C15; C22

Keywords: Innovation; Endogenous growth; Local interactions; Exploration versus exploitation

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0954-349X/03/$ - see front matter
doi:10.1016/S0954-349X(03)00022-5

1. Introduction

The analysis of the determinants of self-sustained processes of economic growth fueled by technological advances has received an increasing attention in the past few years.

On the theoretical side, 'Endogenous Growth' and 'Evolutionary' models have been trying to explain how positive feedbacks in knowledge accumulation affect per-capita income growth (Romer, 1990; Grossman and Helpman, 1991; Nelson and Winter, 1982; Verspagen, 1993; Silverberg and Verspagen, 1994). On the empirical side, a rapidly expanding literature on the economics of technological change has been instead exploring the drivers of innovation and diffusion at the levels of firms, sectors and whole Countries (see, among others, Freeman, 1994; Rosenberg, 1994; Nelson, 1995; Stoneman, 1995).

Notwithstanding this great effort, many scholars have recently spelled out a negative assessment on the extent to which 'neoclassical', 'endogenous' and 'evolutionary' growth theories have been able to match 'old' and 'new' growth 'stylized facts' and to provide 'fresh' testable implications (cf. Durlauf and Quah, 1998; McGrattan and Schmitz, 1998; Silverberg and Verspagen, 1996). As argued by a large body of literature (cf. e.g. Nelson, 1998; Dosi et al., 1994), these difficulties are mainly due to the large gap still existing between what we historically know about the microeconomics of technical change, innovation and technological diffusion, and the ways we represent that knowledge in formal models.

For example, economic growth models do not usually account for both systematic heterogeneity observed in technological competencies and the fine details of the mechanisms governing the dynamics of interactions among economic agents. However, microeconomic diversity and institutional settings have been shown to affect in non trivial ways the properties of aggregate dynamics. Hence, any 'representative agent' reduction employed by a good deal of contemporary literature might turn out to be misleading whenever heterogeneity and interactions are important factors in explaining economic growth (see Kirman, 1992, 1998).

Furthermore, technological advances typically involve business firms whose R&D activity is characterized by routinized decisions, trial-and-error, mistakes and unexpected discoveries (cf. Dosi and Lovallo, 1998). Consequently, forward-looking rationality typically imputed to agents in standard models of growth might not be a good proxy, especially when firms face complicated environments where novelty endogenously emerges as the outcome of others' behaviors (cf. Conlisk, 1996; Dosi et al., 2003).

In economies populated by heterogeneous agents (e.g. firms) who repeatedly interact, innovate and adaptively learn about the world where they live in, observed aggregate regularities can hardly be understood as equilibrium paths (Silverberg and Verspagen, 1997).

Empirically observed properties of macroeconomic time-series might be instead more fruitfully interpreted as 'metastable' regularities emerging in a complex evolving system. For example, the observed regularities displayed by the patterns of self-sustained GDP aggregate growth may be described as emergent properties of