Chapter XXI
Population Symbiotic Evolution in a Model of Industrial Districts

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ABSTRACT

This chapter considers a model of industrial districts where different populations interact symbiotically. The approach consists of the parallel implementation of the model with jESOF and plain C++. We consider a district decomposition where two populations, workers and firms, cooperate while behaving independently. We can find interesting effects both in terms of worker localization consequences and of the dynamic complexity of the model, with policy resistance aspects.By using a multiple implementation strategy, we compare the advantages of the two modeling techniques and highlight the benefits arising when the same model is implemented on radically different simulation environments; furthermore we discuss and examine the results of our simulations in terms of policy-making effects.

INTRODUCTION

In this chapter we consider a model of industrial districts where different populations interact symbiotically. According to Becattini (2003), the industrial district's "first and fundamental decomposition is to be the one between the productive apparatus and the human community in which it is, so to speak, 'embedded'." In our approach, the two populations we consider allow for this decomposition: the first one represents the productive apparatus, while the second one can be considered the human community. Several aspects about industrial districts have been examined in the literature; for an introduction, the reader can refer to Garofoli (1981, 1991, 1992), Becattini et al. (1992), or Belussi and Gottardi (2000). Carbonara (2005) analyzes some common key features in the literature on geographical clusters and in particular on industrial districts.[1] She identifies, among the others, both "a dense network of inter-firm relationships, in which the firms cooperate and compete at the same time" and "a dense network of social relationships, based mainly on face to face contact, which is strictly inter-connected with the system of economic relationships" (p. 217). The first aspect looks extremely interesting and is one of the aspects we consider in our approach. In fact, starting from the definition given by Squazzoni and Boero (2002), where "industrial districts can be conceived as complex systems characterized by a network of interactions amongst heterogeneous, localized, functionally integrated and complementary firms," we introduce and model the role of workers interacting with firms. The model of industrial district we obtain consists of two populations having different peculiarities and interacting in the same environment. In the literature, the representation of districts as communities of populations is not a new idea (e.g., Lazzeretti & Storai, 1999, 2003); nevertheless, to the best of our knowledge, studies devoted to the dynamical evolution of these populations are still limited.

Ecological models of population dynamics for different species can be found both in mathematical ecology and in computer science literature. Ecology of populations examines the dynamics of a number of organisms. In this field the use of mathematical models is quite common in explaining the growth and behavior of population; for a first introduction the reader may refer to Hastings (1997). The most famous model is probably the well-known Lotka-Volterra prey predator model (Lotka, 1925; Volterra, 1926); in this model, which is the simplest prey predator system, two species coexist with one preying on the other (for a concise mathematical discussion of the model, the reader may refer to Hofbauer and Sigmund, 1998). For more recent contributions about mathematical models of population, the reader may refer to Royama (1992). When considering different populations, cooperation has been another examined thoroughly in the literature, and specifically the evolution of cooperation (e.g., Axelrod, 1984). Most of the contributions stem from the well-known prisoner's dilemma game: for example, Flake (1998) discusses an ecological model where only a limited number of organisms can be supported and the population adopting a given of each strategy is some fractional part of the entire ecosystem; other approaches consider both cooperation and the geometry of the interaction network (see Gaylord & D'Andria, 1998, for some examples).

In the model of industrial districts we consider, cooperation is in some sense more implicit, since the structure of the model assumes that workers and firms cooperate. In fact, each of the two species (namely, the workers and the firms) is necessary to the other. In this sense our model exhibits a sort of necessary symbiotic evolution of the two species. In Frank (1997) three different models of symbiosis are considered: the first one is the interaction between kin selection and patterns of transmission; the second is the origin and the subsequent evolution of the interactions between two species; finally, the third considers symbiosis as asymmetrical interaction between species, in which one partner can dominate the other. Our model describes a symbiotic interaction that is similar to the second case, even if, when some parameters of the model are chosen appropriately, we may have a slight dominance of one species. Starting from this approach we consider the dynamics of the populations of firms and workers and their evolution. In particular, we are interested in shedding light on the emergence of industrial districts when the mentioned decomposition is considered, showing that this simple interaction is sufficient for firms to form clusters. While this cannot be an exhaustive explanation of districts' behavior, it is an interesting insight.

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