

1. Introduction

WHY A BOOK ON KNOWLEDGE DIFFUSION AND INNOVATION?

Economists, scientists, policy-makers and, more and more often, common people refer to modern economies as knowledge-based because of the growing relevance knowledge is acquiring in everyday life. Indeed, institutions, firms and individuals progressively rely on knowledge as a key component for individual and collective growth. This calls for a clear understanding of knowledge and its sharing patterns.

While attempting to define knowledge and investigating the complex process which determines its sharing patterns, we agree with Grant's (1996) concern that these are long-standing questions which have intrigued some of the world's greatest thinkers from Plato to Popper without the emergence of a clear consensus. Hence, in this book the focus of the investigation is restricted to the type of knowledge used by firms in the production process and, more importantly, in innovative activities.

A firm's ability to innovate depends largely upon its ability to capture and nurture human intellectual capital effectively. One important part of this process is research and development (R&D), which represents a fundamental activity for creating new knowledge for production and innovation. However, the simultaneous ongoing processes of knowledge deepening and knowledge widening – which leads to a general expansion of the range of available technologies, as well as to a growing specialization of competencies – calls for new, interactive patterns of learning.

Individual learning activities – as they are conceived in an R&D laboratory – are no longer sufficient to put together all the required knowledge it takes to be competitive. Innovative firms need specialized knowledge, as well as more types of knowledge, which increasingly lie outside the firm itself. However, because of its tacit

component,¹ knowledge, and especially new knowledge, can be difficult to acquire in the market, so firms seek some form of collaboration with other firms and/or institutions that possess the required knowledge and, on a reciprocal basis, are keen on sharing it. Hence, firms act to create links through which to access disparate and specialized resources of knowledge needed to innovate. The emerging configuration and reconfiguration of social networks of all types should then reflect the shifting demand of the knowledge economy.

This ongoing process makes it increasingly relevant to investigate the dynamics through which firms share knowledge, and calls for a thorough understanding of knowledge diffusion patterns. This entails understanding the processes through which external-to-the-firm knowledge is acquired and integrated with internal knowledge, a process which might turn out to be complex and hard to manage.

WHY THIS BOOK ON KNOWLEDGE DIFFUSION AND INNOVATION?

Now that we have explained the need for a book on knowledge diffusion and innovation, we should clarify how this book should serve the purpose of bridging the gaps in the existing understanding of knowledge diffusion and innovation. In the field of knowledge-related studies complexity arises at several levels. First, knowledge should be understood as a complex system which goes well beyond the dichotomous nature of information. Acquiring knowledge, from whatever sources, entails cognition and complex integration processes: as pointed out by Ancori et al. (2000), the economics of knowledge differs from the economics of information in the sense that knowledge is no longer assimilated to the accumulation of information in a stockpile. The distinction between these two concepts has been repeatedly ignored by a certain branch of the economic literature (economics of information), which does not consider the cognitive structure that agents use to elaborate knowledge.

Following this distinction, Ancori et al. developed a theory in which knowledge is acquired 'by a backward process through which the new knowledge is confronted and articulated with previous experience . . . The appropriation of crude knowledge – i.e. its integration in one's cognitive context – is not the result of a transmission, but rather the result of a re-engineering process' (2000, p. 267). Hence

knowledge is a complex phenomenon which requires a complex and costly cognitive process in order to be acquired. However, knowledge diffusion is not the only possible way of sharing competences. For instance firms can pool together their specialized knowledge on specific projects. Such a knowledge integration mechanism does not entail knowledge transfer.

This being said, the main elements of novelty of this study rest precisely on the complex approach undertaken to study the phenomenon under investigation. In this book we provide a definition of knowledge which is grounded in recent studies on complexity theory and, subsequently, use an agent-based social simulation methodology to address the issue of innovation – as we believe that there is great potential in addressing studies on complex social systems employing agent-based simulation models. In areas dominated by complex phenomena (such as modelling social systems) agent-based models represent, in the authors' view, a new and promising tool for scientific computational studies.

THE BOOK STRUCTURE

The book is structured in two parts. In the first part the existing literature on knowledge economics is reviewed and the issues of knowledge complexity, and knowledge and innovation, are introduced. Specifically, we first review the main literature on the knowledge-based economy, focusing on the important link between knowledge and innovation. We focus our attention on various definitions of knowledge (distinguishing between knowledge and information, as well as between tacit and codified knowledge), on the relevance of the geographical dimension for knowledge diffusion, and finally on various patterns of diffusion associated with knowledge flows (distinguishing among various forms of voluntary and involuntary-based knowledge-sharing patterns) (Chapter 2).

Subsequently, we introduce the issue of modelling knowledge and its sharing patterns. We depart from classical studies on social learning, where the patterns of information and knowledge diffusion are explored with respect to innovation adoption dynamics, and proceed to review more recent models where knowledge is considered and modelled as a complex concept (Chapter 3).

This literature review leads us to the core idea of the book, that

knowledge, and the learning processes associated with it, needs to be modelled using complex representations and appropriate tools. Critical factors in formal modelling concern the representation of knowledge (for example whether as a scalar or as a vector), the characteristics of the network structure upon which knowledge interactions (and innovation) take place, and also the temporal aspects of knowledge diffusion – simulations being sensitive to initial conditions and to the application of specific updating mechanisms.

All these factors are explored in Chapter 4 of the book, where we present an original agent-based model of knowledge diffusion, grounded in complex definitions of knowledge and network relations. In addition, the diffusion model is related to innovation processes where innovation stems from the recombination or integration of knowledge by means of a cognitive process which could be conducted either individually or collectively.

The second part of the book is dedicated to applications and empirical studies. This part opens with a chapter (Chapter 5) in which several empirical studies on the measurement of knowledge flows are reviewed. Subsequently, Chapter 6 presents a methodological investigation which first examines two alternative ways of doing research with agent-based modelling. These are theoretical and applied studies, incorporating agent-based models as a means of investigation through simulation. This is followed by a closely related discussion of validation of agent-based models. Here, validation is considered quite broadly, encompassing both inputs and outputs to the modelling as well as all stages of the model building and analysis.

In Chapter 7 an applied version of the knowledge diffusion model developed in Chapter 4 is presented. This is a calibrated model which makes use of data collected from field work conducted in Italy. The aim of this chapter is to test the validity of the model against a real-world case study, providing at the same time an exemplification of how validation of an applied model can be conducted. Chapter 8 concludes the book and presents several ideas for future research.

NOTE

1. Tacit knowledge is a type of knowledge that cannot be codified and, therefore, requires direct experience and personal interactions in order to be communicated. We will return to this concept in Chapter 2.