

Introduction

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1 Why a book on “perspectives on innovation”?

Innovation is nowadays a pervasive issue in both the academic literature and policy debates. It plays a central role in firms’ strategies. It is a fundamental element in public policies for growth and competitiveness. It is core to many university programs. Innovation has become a major field of study in economics, management, sociology, science and technology studies, and history. Cases, empirical models, appreciative analyses, and formal theories abound. In economics, various ways of examining innovation have been developed, ranging from the neoclassical paradigm to evolutionary theory, to more institutionalist approaches, to innovation-system views.

In a way, the breadth, length, scope, and sheer visibility of the “innovation problem” have become an issue. The need to articulate what we know about innovation has led to the publication of a variety of textbooks. Also, handbooks of innovation, each with a different twist or focus, are now abundant and well reflect the variety of approaches that scholars in different disciplines have followed to make sense of innovation.

So, why a book about “perspectives on innovation”? Because after several decades of studies on innovation, and so many different types of contribution, it is useful to take stock and ask ourselves again which the main topics of research are. Which are the main unanswered questions? What are the main challenges? It is our belief that the debate about innovation has still much to deliver. Quite simply, there are still many phenomena we know very little about, many questions without an answer, many problems without a solution. And this is precisely the sort of issue on which the work presented in this book focuses. Thus, our aim in this book is not summarizing the state of our knowledge: this is not a handbook. And our aim is not to focus on a single aspect of innovation, either. Rather, the aim is to provide, within a single book, a broad overview and a comprehensive map of frontier-research in innovation.

This means several things: to highlight those areas that we consider key to understanding innovation, and those topics that researchers are just beginning to explore, those subjects that still defy our efforts to understand and systematize.

In a way, the title of this book aims at drawing an explicit connection to Nathan Rosenberg's seminal book, *Perspectives on Technology* (1976). That book provided a fresh perspective on the study of technology, moving away from the traditional economist's view of it as a black box (a title of another book by Rosenberg) and entering in depth into the analysis of the main features, dynamics, and consequences of technological evolution. Moreover, one of the key ideas of that book was that the direction of technological change is influenced by a number of "focusing devices," which provide a target for scientists' and engineers' problem solving efforts. Similarly, in this book on innovation, we intend to identify those topics that are attracting increasing attention from scholars, researchers, and policy-makers. Many of the contributors to this book stress how rich, diverse and multiperspective the study of innovation has become, as it inexorably entails the joint analysis of institutions, organizations, business strategies, selection processes, and technologies.

This is the reason for the title "Perspectives on Innovation." However, our "perspectives" will not be oriented toward developments in technologies, operations, or engineering practices. They will refer instead mainly to the economic, organizational, strategic, and institutional aspects of innovation. As a consequence the book is organized around themes and issues of research that cut across these different approaches. The themes refer to (i) innovation and economic growth, (ii) the microdynamics of the innovation process, (iii) innovation and industrial dynamics, (iv) innovation and institutions, (v) innovation, firms' organization and business strategies, (vi) innovation and entrepreneurship, (vii) innovation and the evolution of the university system, and (viii) innovation and public policy. Some of these topics have been present for a long time, such as technology and economic growth, but have gone through a period of recent rediscovery. Others are quite new and at the center of the research and policy debate, such as the role of the university system. Having chosen these topics in a subjective way within such a burgeoning area of research, we have decided not to include – for limit of space – other topics that are also important, such as the role of finance, and labor markets and innovation.

When one looks at the themes we selected, it is evident that there is a common reference to Schumpeter's (1934, 1939, and 1950) work and to broad Schumpeterian themes. In his work, Schumpeter was

interested in a full understanding of the main drivers of change and growth: he addressed the relationship between innovation and competition, the role of entrepreneurship and new companies in innovation, the rise of R&D in large corporations, and the structural transformation of the economy as a result of the emergence of some new sectors and technologies and of the decline of others. And the Schumpeterian legacy in the last fifty years has developed these themes along several lines.

In sum, in this book we do not aim at providing a guide to the existing literature. Rather, we offer a collection of contributions by scholars engaged in asking new questions, or answering old questions in a new way, on the nature, role, and impact of innovation in firms, sectors, and countries. In this book we adopt an eclectic and multidisciplinary view, trying to put in touch approaches that come from different schools of thought or disciplines. One thing we are convinced of is that no one discipline has the magic wand for solving all issues when dealing with innovation. Accordingly, this book is organized in “pairs”: each topic is approached by two, or more, scholars who look at the same issue from different angles. Moreover, each pair of chapters is commented upon by another contributor, whose task is to highlight similarities, differences, and complementarities.

2 The themes of this book

2.1 *Innovation and economic growth*

This is one of the oldest areas of research in economics. For a long time it has been recognized that technology is a major source of economic growth. However, after the path-breaking contributions of Marx and Schumpeter, a long time passed before this topic attracted again the attention of the economic profession. Only with the work by Christopher Freeman, Nathan Rosenberg, Richard Nelson, Moses Abramovitz, and others, followed later on by the contributions of new growth theory, has a major spurt of intensive research on economic growth taken place. However, as of today we have to recognize that we still know very little. Questions to be answered include: In which ways and through which processes innovation affects economic growth? This is an old yet always crucial question, at the base of our understanding of why some countries are ahead in terms of income levels and productivity, and others lag behind. And a related question is: Which kinds of analytical tools are needed for a full understanding of economic growth? What kinds of theory are necessary for enriching our understanding? Is modern new

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growth theory the appropriate answer? Is it correct that for economic growth we focus at the macro level without understanding better both the micro and meso levels? Or is the opposite true? Which are the new challenges for research on this topic? Which of the various approaches is better suited for advancing our understanding? These are the questions that Richard Nelson, Bart Verspagen, and Jan Fagerberg address in this volume.

2.2 *The micro dynamics of the innovation process*

Also, the analysis of the innovation process has always been at the center of scholarly attention, from the old debate on demand pull and technology push to the more recent contrast between the linear model and the chain-linked model. And over the years the analysis of the innovation process has taken into account both the incentives to innovate as well as the actual process of introducing new products and processes and the impact on the organization of firms and industries. Nowadays, however, the research questions have to become more subtle and deeper. Undoubtedly, one question regards incentives, the common factor affecting the innovation process that economists refer to. Is it correct to narrow all incentives to pecuniary ones only? Or do other dimensions (such as the psychological, social, and organizational ones) play an important role in the analysis of a broad phenomenon such as innovation? And should the innovation process be examined in isolation, or should it be linked to specific ways of organizing the innovative activity? In other words, under which circumstances is the power of creative destruction enhanced, and under which circumstances is it blocked? And which are the relevant dimensions to examine in this respect? These topics are examined in this volume by Wesley Cohen and Timothy Bresnahan. Their chapters are commented on by Ashish Arora.

2.3 *Innovation and industrial dynamics*

An area of analysis that has grown enormously in the last thirty years is innovation and industrial dynamics. Innovation has been identified as a major engine in the emergence and growth of industry, and as a key factor affecting the dynamics of industry population in terms of entry, growth, and exit. Over the years progress has involved case studies of innovation and industry evolution (following the so-called “SPRU tradition” initiated by Christopher Freeman and Keith Pavitt), with the recognition that industries have specific dynamics and life cycles. With the availability of advanced computer technology and new, firm level

data, econometric analyses have moved from cross-sectional work during the 1960s and 1970s to panel data and longitudinal analyses since the early 1990s, shedding light on some aspects of industrial demography, entry and innovation, firms' growth, stability of firms' size distribution, and persistence of firms' asymmetric performance. Also at the modeling level, the evolutionary tradition and the neoclassical approach have developed different types of models of innovation and industrial dynamics. However, there is still major progress to be made. In this book some questions are tackled. Is it possible to identify some robust regularities in industrial dynamics? Could we say something more on the relationship between innovation, profitability, firms' growth, and selection at the industry level? And what do we know about the entry of new innovators? Is it still appropriate to identify entrants as firms coming from nowhere and bearing no relationship with the existing industrial structure? Or is there a strong link between innovative entrants, established firms, and existing organizational structures? In a sense, does the existing industrial structure generate the new innovators endogenously (from within)? In this book, these topics are examined by Giovanni Dosi, Steven Klepper, and Peter Thompson. Their contributions are discussed by Luigi Orsenigo.

2.4 *Institutions for innovations and innovation in institutions*

This topic is an extremely important one, but it has been disregarded for quite some time. Nowadays, however, everybody agrees that innovation does not happen in the vacuum and that the institutional environment plays a key role. Much has been said by the national system of innovation literature, with case studies and appreciative discussion. However, the specific feedback loops between different institutions, sets of rules, governance structures, and innovation are still little understood. We do know that these connections matter, but how, and to what extent, is yet hard to tell. The key issue here is understanding the extent to which firms have their behavior determined by the institutional environment in which they are embedded, as opposed to the extent to which they are free to navigate, and influence, the dynamics of such an environment. A fundamental dimension of the institutional framework is the way intellectual property rights are managed. Another (and related) one is how the university system behaves in the modern knowledge economy. More generally, a major topic is examining not just how institutions affect innovation, but also how innovation affects institutions and what the basic mechanisms of institutional change are. In this book these issues are examined by Masahiko Aoki and

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Paul David and their chapters are commented on by Bengt-Ake Lundvall.

2.5 *Innovation, firms' organization, and business strategies*

The organization and competition aspects related to innovation have gained increasing importance in recent years. Scholars of technical change have stressed that the analysis of learning processes in uncertain environments requires conceptualizing industries as made up of persistently heterogeneous organizations. At one level, firm-level heterogeneity is a requirement for guaranteeing that the economic system runs enough experiments to explore alternative technological trajectories to be selected in the market place. At the other level, firm-level heterogeneity is the outcome of a slow, incremental process of learning and competence-building in organizations. This is why we expect firms, in the same industry, to be persistently different. According to this perspective, firms are the main agents of variety generation through their idiosyncratic competences. Such an emphasis on variety generation through competence-building has, however, often overshadowed the fact that selection does not occur only in the marketplace but also within firms. Moreover firms differ not only with respect to their technological capabilities but also in terms of the selection criteria which they use. How does selection work within innovative firms? And besides, is it not too simplistic to claim that there is only one selection process at work within innovating organizations? Or are different levels – and criteria – of selection interacting at all times? Moreover, nowadays cooperation among firms has become a central focus of the analysis of innovation. But how do cooperating organizations develop joint criteria for selecting joint strategies and evaluating the outcome of joint development projects? In this volume, these questions are raised in the chapters by Dan Levinthal and by Yves Doz, Andrea Cuomo, and Julie Wrazel, and these chapters are commented on by Sid Winter.

2.6 *Innovation and entrepreneurship*

A central figure in the innovative process is the Schumpeterian entrepreneur, who plays a key role in introducing new combinations. Entrepreneurship is analyzed in a large set of disciplines, such as economics, management, and sociology. But how to analyze fully and understand entrepreneurship? One could claim that too much emphasis has been put on entrepreneurship as such, and that entrepreneurship has not been seen as an action inserted in technological, sectoral, local,

or national contexts. More specifically, much has been said about either the antecedents to entrepreneurial behavior (e.g. what kinds of person or organization are more likely to become entrepreneurs?) or its outcomes (e.g. what are the effects of entrepreneurial behavior on industry structure?). We still know relatively little about the entrepreneurial process. How does it happen? What are the key characteristics of entrepreneurial action? What is the role of human agency, of rational reasoning, and of intuition and creativity? What kinds of career paths lead certain individuals to act in an entrepreneurial way and why? It is necessary to grasp and understand these processual dimensions of entrepreneurship in order to make it amenable to policy and managerial interventions. In this book, these questions are addressed in the chapters by Piera Morlacchi and by Ulrich Witt and Christian Zellner, both commented on by Maureen McKelvey.

2.7 *Innovation and the evolution of the university system*

The critical role played by universities in the innovation process has emerged in recent years as a major stream of research. Universities have always been considered major sources of scientific advances and human-capital formation. However, a broad discussion is taking place on what different (additional?) roles universities should play in the knowledge-based society. In particular, universities are expected to be active in the creation of new “knowledge,” and also in its diffusion and application to commercial uses. It is claimed that universities should act more entrepreneurially (either directly or through spin-offs). Therefore, what could we say about university-based entrepreneurship? Is it different from other types of entrepreneurship? What distinguishes academic entrepreneurs from nonacademic entrepreneurs? How can universities nurture and retain scholars interested in disclosing their findings for commercial purposes? A related issue touches upon the question of how we evaluate university performance. What do we mean by performance in the first place (e.g. scientific publications, patents, spin-offs, trained scientists, or technologists)? What kind of data, indicators, and methodologies can we deploy to measure the output of university research? These topics are the focus of the chapters by Janet Bercovitz and Maryann Feldman, and by Gustavo Crespi and Aldo Geuna, commented on by Ed Steinmueller.

2.8 *Innovation and public policy*

Last but not least, public policy. How can one transform the broad discussion developed in this book into policies? And more importantly,

how to develop policies that take into account the dynamic and uncertain environment in which innovation takes place? These are key and still quite open issues. How does the emphasis on knowledge and the knowledge-based economy reshape our conception and the foundations of public policy? How do traditional policies – such as competition policies – interact with innovation policies and intellectual property rights (IPRs) protection? And what is really the role played by the policy-maker who acts at the interface between the domain of science and the domain of politics? What are the skills and the competences necessary to play such a role? With all the emphasis on learning and competences on the part of firms, is it necessary to use similar categories – cognition, competence, and behavior – for the policy-maker? In this book these key questions are addressed by Stan Metcalfe, Paul Geroski, and Paraskevas Caracostas.

All these issues and topics were examined at the Schumpeter 2004 international conference in Milan, organized by the Centre of Research on Innovation and Internationalization (CESPRI) at Bocconi University in June 2004. The drafts of the chapters in this volume emerged from that conference. However, the final chapters are the result of additional research and extensive redrafting and rewriting, in order to address the main themes of this volume.

3 **The contributions to the volume**

3.1 *Innovation and economic growth*

In this book, innovation and economic growth have been discussed in a broad way by two contributions that assess the progress and validity of the modern theories of economic growth, and point to the challenges of further research in these areas.

Richard Nelson in “Understanding economic growth as the central task of economic analysis”. claims that understanding economic growth should be the central focus of economics and that innovation is a major engine of growth. He focuses on the two main approaches to examining economic growth – the modern neoclassical economics and evolutionary theory – and compares their methodology and results. He concludes that evolutionary economics – by being directly focused on economic dynamics and by having long-run economic growth at the center of its research agenda – is at its core a theory of economic growth. However, Nelson notes that much of recent research within this tradition has stayed too close to certain features of the early work related to the Nelson and Winter’s book *An Evolutionary Theory of Economic Change*,

and may run into diminishing returns. He stresses that further progress in evolutionary growth theory will be significant if research is pursued in three different ways. The first one concerns the roles of cognition and conscious problem-solving in the evolution of practice, of science in the advancement of technologies, and of knowledge (with its uneven growth across different fields) in human activities. The second one is regarding the role of business practice, organizational forms, and institutions – called “social technologies” by Nelson – and their relations with technological change. Finally, the third one is related to the multisector nature of economic activity and the recognition of industry differences in the patterns of growth, industrial dynamics, and long waves.

Bart Verspagen in “Innovation and economic growth theory: a Schumpeterian legacy and agenda” discusses the Schumpeterian legacy in the modern field of economic growth, and examines first the work on economic growth during the 1950s and 1960s, in which the Schumpeterian legacy was lost, and then the work during the 1980s and 1990s, in which two competing paradigms – the neoclassical one related to endogenous growth theory with a relatively homogeneous set of inter-related models and the evolutionary one with a more loosely connected set of contributions – aimed at explaining the relationship between technology and growth. In way of conclusions, Verspagen claims that endogenous growth theory has recently shifted toward more realistic models that accommodate a range of phenomena previously introduced or examined by the evolutionary approach (such as the notion of technology as driver of economic growth, the importance of business R&D, and the stochastic nature of technological advance) so that some convergence between the two paradigms has taken place. However, the two approaches remain quite distant in terms of microeconomic behavioral patterns (optimizing agents vs. bounded rationality) and the nature of economic process (ahistorical and Newtonian vs. historical and transformational). Verspagen concludes by saying that each of the two approaches contains a range of important and interesting lines of research: for endogenous growth the direction is the development of empirically relevant models instead of new explorations motivated by technical problems encountered by existing models, while the evolutionary tradition confronts the challenge of developing models in close interaction with non formal work, stylized facts, and historical research.

These two contributions, as *Jan Fagerberg* claims in his *Comments*, in addition to providing a detailed and critical guide on the modern theory of economic growth, provide a very broad concept of it, and call for different methodological approaches and levels of analysis for a full

understanding of economic growth. In this respect, Fagerberg stresses that qualitative theory is also to be widely used, because the applications of mathematical methods to growth theories has tended to change the questions that are addressed in less-interesting and relevant directions. He finally emphasizes that growth theory has another dimension that needs to be addressed – the political dimension.

3.2 *The micro dynamics of the innovation process*

As far as the innovation process is concerned, the book concentrates on two cornerstones of the innovation process: incentives and creative destruction. The first one represents the traditional way followed by economists when they examine the forces that affect innovation: in this book incentives are seen in an original and sophisticated, pointing to their different dimensions and roles. Creative destruction represents the basic message of Schumpeter's view of innovation: in this book creative destruction is interpreted as a process that cannot be separated by the way industries are organized and by the extent of the division of labor.

Wesley Cohen and Henry Sauermann in "Schumpeter's prophecy and individual incentives as a driver of innovation" move from a view of innovation as driven by the returns earned by firms and by pecuniary benefits, to individual-level incentives to innovate and to nonpecuniary benefits. They claim that richer notions of incentives are needed in the analysis of technical advance, and that research in social psychology and organizational behavior is useful in this respect. Cohen and Sauermann propose three types of individual-level incentives: extrinsic, intrinsic, and social. Extrinsic incentives are usually considered by economists, and include pecuniary benefits. Intrinsic incentives originate within the individual or the task and are often a function of the interaction between the characteristics of the task and of the individual. Social incentives originate outside the tasks from the individual's perceived social relations. Cohen and Sauermann show that individual incentives matter for innovation, and provide a variety of examples in this respect, ranging from the innovative performance of different regions such as Silicon Valley or Route 128 to open source software or to Digital's Alpha Chip development. However, they claim that there are still few empirical studies of the impact of individual-level incentives on innovation: here the focus has to be on a finer-grained analysis of the types of incentives; the recognition of the differences of incentives across engineering and scientific fields and R&D types; the analysis of the alignment of individual incentives and firms' objectives; and the examination of the recruitment, integration, and management of different people with