Entrepreneurship and Technological Change

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Preface

Innovation and entrepreneurship are regarded by many economists as key sources of economic growth, although it is difficult to measure precisely the private and social returns to these activities. There is also a strong need for additional research on the interaction between innovation and entrepreneurship. We have also recently witnessed a rapid increase in entrepreneurial activity in many advanced industrial countries. National governments have provided support for numerous entrepreneurial initiatives and programs to support innovation, via legislation to facilitate technological diffusion from universities and national laboratories to firms (e.g., the US Bayh-Dole Act of 1980, which was widely adopted throughout the world), subsidies for research joint ventures involving universities and firms (e.g., the European Union's Framework Program and the US Commerce Department's Advanced Technology Program – ATP), public support and financial assistance to firms during the initial stages of their development (e.g., the US Small Business Innovation Research Program), and shared use of expertise and laboratory facilities (e.g., the US National Science Foundation's Engineering Research Centers, Science and Technology Centers, and Industry–University Cooperative Research Centers).

National, state, and regional government authorities have also provided substantial financial support for entrepreneurial initiatives and programs to promote investment in innovation. Innovation is critical, since entrepreneurship is often defined on the basis of innovation (e.g., Davidsson, 2005). These government programs have influenced agents such as individual academic and industry scientists and entrepreneurs, as well as key entrepreneurial institutions, such as universities, incubators/accelerators, and science or technology parks. Many of these initiatives were launched to promote technology-based economic development at the regional and national levels.

The growth in private and public investment in innovation and entrepreneurship (Siegel and Wessner, 2011) has also raised important public policy questions regarding the impact of such investments on individuals and institutions engaged in innovation and entrepreneurship, not to mention their

ultimate affect on society. These efforts have influenced individual scientists in firms, universities, and national laboratories; entrepreneurs; and those providing financial capital to entrepreneurs, universities, firms, incubators, and science parks. There is also growing interest in assessing the impact of technological change and entrepreneurship on regional economic development.

Given that many of these initiatives are relatively new, managers and policymakers seek guidance on 'best practices'. More specifically, we need more comprehensive theoretical and empirical evidence on specific organizational practices relating to incentives, strategic objectives, and measurement and monitoring mechanisms, which might enhance performance. We also need to identify optimal public policies in this arena. There is also considerable interest in understanding the financial and managerial practices of early-stage companies and those organizations in embryonic industries. The recent global resurgence of entrepreneurial finance, via venture capital, leveraged buyouts, and the concomitant rise of 'private equity' markets have also heightened interest in innovation and entrepreneurship. Accordingly, there is a strong need for evidence on this phenomenon, especially from non-US institutions and agents.

The rise of entrepreneurial initiatives and policies to promote technology-based economic development has also stimulated considerable interest among academics, since this trend raises a series of interesting research questions (see Poyago-Theotoky, Beath and Siegel, 2002). Some authors assess the institutions that have emerged to facilitate commercialization, such as universities, technology transfer offices, industry–university cooperative research centers, science parks, and incubators. Others examine the agents involved in technology commercialization and technological entrepreneurship, such as academic and industry scientists (see Siegel (2006) and Rothaermel, Agung and Jiang (2007) for comprehensive reviews of this burgeoning literature). Despite these excellent studies, there is still a strong need for additional evidence on this phenomenon, especially from non-US institutions and agents.

I am pleased to report that this excellent volume fills this gap. A novel feature of the book is its interdisciplinary approach, which is entirely appropriate since research on innovation and entrepreneurship spans a variety of fields in business administration (management, strategy, marketing, finance, accounting, and operations), sociology, psychology, engineering, and geography. The papers also reflect the use of 'mixed methods', i.e., the use of both quantitative and qualitative evidence. Inductive, qualitative research is also useful in this context, since notions of 'performance' are likely to vary across different types of initiatives (e.g., academic entrepreneurship vs. corporate entrepreneurship) and for different players involved in these activities (e.g., industry scientists, university scientists, venture capitalists, angel investors, and technology managers at corporations

and universities). I encourage you to incorporate the theoretical and empirical insights of this volume into your own research.

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Foreword

Global economy has never been more competitive and open than today. Globalization has leveled the economic landscape in a way that potential competition can emerge almost everywhere and easily cross market, industry and geographic barriers to challenge dominant positions of current leaders. The instability of the economic scenario makes competitive advantages linked to positional rents less and less defendable and forces companies to engage in a difficult race in which only the most innovative players increase their chances of survival. In such a scenario innovation is the only strategy left to companies to create and defend their competitive advantage and to nurture sustainable growth. Increasingly, innovation and the consequent creation of business opportunities are technology-based.

Thus, it is extremely beneficial to improve our understanding on how technological changes enable new businesses development and how entrepreneurs can be better positioned at capturing those opportunities. For such a reason Entrepreneurship and Technological Change is a greatly welcome contribution. This book provides us a valuable opportunity to increase our knowledge on the relationship between technological change and creation of new ventures. In particular the editors structured this anthology in a way that makes very clear the circularity of such a relationship: on one hand the individual action of entrepreneurs is clearly still the engine behind the creation of new business opportunities; on the other hand the giant innovation machine, made up not only by public and private research centers but also by an increasing number of independent developers connecting through the internet, incessantly create an entire universe of potential business applications of research results.

My personal position is more inclined toward a form of soft technological determinism. Even the simplest products we use everyday are extremely rich in technological contents. You may think of an intelligent balance scanning your body to detect the grass mass and other data on your physique, connecting to the internet, sending these data out and crossing them with a database to suggest you a diet, or of your jogging sneakers equipped with a sensor able to speak with your smartphone to schedule your training sessions,

registering your performances and uploading them on a website where you can track and share your improvements. There could be countless example of how our life is changed, sometime invaded, by smarter tools and new technology-enabled practices and habits.

However soft technological determinism is not meant to negate the role of individual initiative and creativity but to recognize that the exercise of entrepreneurial initiative and creativity are increasingly constrained by scientific and technological advancements. And it's about an important caveat for potential or current entrepreneurs.

In order to spot and exploit the opportunities arising from continuous innovation, entrepreneurs have to be increasingly proficient in speaking the language of technology. This is not to say that all the entrepreneurs have to be technical people. Rather, that they have to become translators between this language and that spoken and understood by the average person. Innovation studies have proved that an increasing share of new business opportunities arise from a unique combination of more or less profound technological changes and emerging needs from relatively obscure and initially marginal market niches. Increasingly, successful entrepreneurs will be those who will be able to match technology potential with new consumer needs, to reinterpret technology to the benefits of a larger audience. It doesn't matter if their background is technical or non-technical, what really counts for entrepreneurs is to be actively engaged in the ongoing conversations between creators of new solutions and producers of new problems.

Another plus of Entrepreneurship and Technological Change is the focus on the European scene. It's well known that small businesses constitute a large part of the EU economy and that they contribute strongly to EU economic activity and growth. However the potential of the European entrepreneurial capability is still largely untapped compared to other international competitors. Though the European governmental institutions are making appreciable efforts in this direction, what is still lacking up to now is the creation of truly unitary European space of economic action in which start-ups and existing companies do not have to cope with inhomogeneous institutional arrangements, rigidities and inefficiencies at the local level. The book contributes to a better understanding of the link between technological change and entrepreneurship, thus filling a gap in the debate which is rather biased by the dominance of findings coming from the US economy.

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Editing a collection of scholarly essays is undoubtedly an amazing experience. It reinforces our understanding of the research goals we intend to pursue and corroborates relationships among people sharing the same research interests, but it also requires a lot of effort and enthusiasm. In the case of *Entrepreneurship and Technological Change* all this would not have been possible without the support of many friends and colleagues who have not spared comments, suggestions and criticisms. They are so numerous that we cannot name all of them here. However, a special appreciation goes to the contributors, who have patiently shared the journey with us, accepting, among other things, to help us in reviewing and improving the various chapters through a cross-discussion process, which has added much value to the book.

We wish to express our gratitude to Donald Siegel, Andrea Salanti and Massimo Merlino for stimulating discussions on the role of entrepreneurs in society and on entrepreneurship as a scientific discipline. Additional thanks go to Ray Oakey and Aard Groen for informal and stimulating discussion that helped us to elaborate ideas on the book.

Let us also thank our student community, who have enthusiastically supported us through a valuable work of information collection, as well as have ignited our curiosity through their questions.

The book includes an unavoidable selection out of a number of contributions we received from distinguished colleagues all around the world. Such an enthusiastic reponse from the academic community has been made possible by the support obtained by some academic networks. Let us thank here ECSB (European Council for Small Business and Entrepreneurship), ISBE (Institute for Small Business and Entrepreneurship) and EITIM-Doc (Network for PhD students, post-docs and alumni of the European Institute for Technology and Innovation Management). In particular Luca Iandoli (ECSB President Elect) deserves a special thanks for his empathic support and collaboration, which were particularly tangible during all the phases of the manuscript preparation.

The preparation of this collection suggested us, among others, the creation of a research center on entrepreneurship at the University of Bergamo. Editors are grateful to Miro Radici, President of the Board of Trustees, and to all the Board members of CYFE (Center for Young and Family Enterprise), since its establishment would not have been possible without their understanding and support. Tommaso Minola owes particular thanks to Giampio Bracchi and Giacomo Zanotti for the rich experience they have been so kind to share along the years.

Finally, we dedicate this book to Marisa, Francesca, Fabiola, and the other members of our families, for their patience without which finishing this work would have been nearly impossible.

It goes without saying that we are grateful to the publisher, for recognizing the value of the relevance of the theme of technology entrepreneurship. Every effort has been made to trace all the copyright holders: if any have been inadvertently overlooked, the publisher will be pleased to make the necessary arrangements at the first occasion.

Introduction

Change has often been recognized as a focal component of economic development. Starting from Schumpeter's celebrated contributions it has been embedded in economics and management science, as a factor promoting wealth and allowing opportunities to flourish. This book tries to delineate the peculiarities of change in the technological domain as mutually linked with entrepreneurship development. Technology as an agent of change generates opportunities that can be taken by an entrepreneurial organization. In that sense technology can support entrepreneurship, while, at the same time, through change, taking an entrepreneurial attitude may enable the generation of significant technological advancement and innovation.

Entrepreneurship and Technological Change includes a set of chapters that results from a collaborative process intended for collecting fresh empirical evidence to be interpreted according to the most recent theoretical advancements. This book has been developed in response to a growth of interest from academics, practitioners and policymakers in technology-based entrepreneurship as a source of firms' and regions' competitiveness. We try to put forward an original perspective: entrepreneurship is seen here as an act of newness as evoked by Davidsson et al. (2002) and a process of new entry (Lumpkin and Dess, 1996). The various essays in the book concentrate on the explanation of entrepreneurial initiatives, at both firm and collaborative level. Substantial space seems to be left in literature for such an approach (centered on tools, organizational implications, analysis of the challenges for the firm) based on the mutual links that entrepreneurship is claimed to have with technological change. A secondary but equally relevant purpose of this book is the diffusion of stimuli and thoughts for the practitioner community, that may benefit from a deep understanding of the dynamics and implications of entrepreneurial innovation and technological change.

The book collects contributions on technology entrepreneurship at a European level. This seems particularly important in the challenging present contingency of European economies, where such a topic is invoked as an agent of strategic renewal. A policy perspective, focused on the design of

proper technology entrepreneurship practices, institutions and agents (such as technology transfer by universities, incubator and other infrastructures; for a comprehensive review see Rothaermel et al., 2007), seems more appropriate in regimes of business and social continuity. In the present conjunctures our attention has been directed towards entrepreneurship as a factor at the epicenter of the hoped renewal.

In a previous editorial project (Cassia et al., 2006) we suggested entrepreneurial dimension can promote uncommon growth even in mature industries. Under the same perspective, the present book extends the perspective of analysis, hypothesizing that entrepreneurship itself can be fostered by technological change and progress.

EMERGENCE OF TECHNOLOGY ENTREPRENEURSHIP

Audretsch (2009) hints at the role of technical advancement and knowledge accumulation within different approaches in economic modeling. In the 'Solow economy' technical change is mainly ignored by analyses focused on productivity factors, and its role remains to be more to be inferred by unexplained residuals. The advent of the 'Romer economic regime' suggested the relevance of knowledge capital in globalization processes, yet routinized technological regimes seemed to dominate, with inevitable disadvantages for small firms and entrepreneurial ventures cannot rely on large-scale R&D expenditure. It is only in the context of an 'entrepreneurial economy' that these firms can benefit from knowledge input deriving from spillover phenomena and integration capabilities; in such a context, technology entrepreneurship plays a role in connecting the dots, exploiting knowledge and transforming it into opportunities. Byers (2010) provide a useful definition in this respect:

> Technology entrepreneurship is a style of business leadership based on the process of identifying high-potential, technology-intensive business opportunities [...]. An attractive business opportunity consists of a great value proposition, technically feasible products, strong intellectual property, a sustainable competitive advantage, a large potential market, and a proven business model. It can be based on either a revolutionary breakthrough in technology or an evolutionary advancement; and it can target an existing market or create an entirely new one. This entrepreneurial process is relevant for both independent start-ups and within established corporations.

Their definition is relevant for at least two different reasons: first of all because it links the definition of entrepreneurship to the dimension of opportunity, which is a consequence of change; second because it refers to

technical change in its pervasiveness, occurring also in a catching up contexts (non-breakthrough innovation), or in established firms (acknowledging the paramount role played by corporate entrepreneurship).

As already mentioned, technology entrepreneurship as an academic field stems from Schumpeter and the evolutionist school, but only recently – with Entrepreneurial Orientation (EO) and Entrepreneurial Management (EM) paradigms – has been described as a strategic posture and organizational behavior, thus embedding the individual level and more fine-grained perspectives. Covin and Slevin (1991), Lumpkin and Dess (1996) and more recently Rauch et al. (2009) for EO, and Stevenson and Jarillo (1990) for EM, represent seminal work in the field and help in understanding the constructs and their implications for firm performance and development.

THE PRESENT APPROACH

The aim of *Entrepreneurship and Technological Change* is to provide a rich description of different entrepreneurial phenomena, by shedding new light on the links they have with change in the technological domain. To be sure, we do not suggest a systemic view of entrepreneurship; as such we do not provide the systematization of the body of knowledge on technological entrepreneurship. Rather, we aim at collecting intriguing evidence on how technological changes generate opportunities that entrepreneurs or entrepreneurial organizations can properly exploit, and showing that a particular entrepreneurial behavior can be a promoter of change in both technology-intensive and technology-adopting businesses.

From such a perspective we priviledged a style for the essay mainly focused on actions and initiatives by entrepreneurial individuals and organizations, and corroborated with several empirical analyses suited to illustrate and describe powerful theoretical relations.

Contributions come from different disciplines and research domains. The value of cultural contamination coming from such a diversity is peculiar to our belief and motivation as researchers. Different perspectives (e.g. innovation management and R&D policy) collected around a common *fil rouge* (the concept of entrepreneurship as interpretative lens) gain value in a context of cultural diversity which is peculiar to entrepreneurship as a research domain as well as to entrepreneurs' initiatives as a practical actions. The collection of contributions indicates common traits, but also testifies the richness of approaches and perspectives from which it is possible a study of the entrepreneurial phenomena. Yet many views of entrepreneurship have to be discovered and we believe, due to the complexity of researched topics,

that strategies based on integration of knowledge from different disciplines may be significantly more robust than those based on specialization.

The conceiving, structuring and preparation of the book have been characterized by a collaborative nature and a spirit of continuous and highly enriching interaction among editors and contributors. Actually, the present volume is the result of a process we have been honored to coordinate, interacting with many colleagues and scholars in the field. We started launching a call for contribution through personal contacts as well as academic networks. Attendance to a number of research conferences on entrepreneurship during 2009 and 2010 allowed us to get also acquainted with other esteemed colleagues and stimulating pieces of research This process resulted in several contributions (both full paper and extended abstracts) which have been thoroughly evaluated according to the relevance of the topic and the coherence with our research perspective.

We selected ten contributions as a priority for the inclusion into the book, and then, in order to stimulate some interaction among contributors, we organized an international workshop, which took place at the beginning of May 2010 at the University of Bergamo. Each chapter was presented there and received two discussions, one from the editors and one from a different contributor. The workshop was the occasion for a very stimulating debate on different experiences and views on technology, change and entrepreneurship. It proved also a very effective way for adding value to each contribution, which benefited from specific comments and reviews, as well as from the view of the editorial project as a whole. Each contribution underwent a revision process by authors, and a second double review process with the same logic as in the workshop.

THE STRUCTURE OF THE VOLUME

The collection deals with a major research aim, that is exploring the link between entrepreneurship and technological change: how does it unravel? Which environmental as well as organizational conditions favor the fostering, in either direction? The various contributions fall into three parts which we hope suited to represents the main traits of a journey through the recent advancements in knowledge on entrepreneurship and technical change. The first part provides conceptual roots for the interaction of entrepreneurship and change in the technological domain, while the second part focuses on the notion of renewal that can be associated with entrepreneurial behavior and results from technological change, both exogenous and endogenous to the firm, either in industries or in regions. The third and last part maps frameworks which derive from innovation literature (and are normally

adopted to explain patterns of technological change), by explicitly linking them with the entrepreneurship construct. A more detailed account of the content of the single contributions is provided in what follows.

Part One (Understanding change and entrepreneurship in the technology domain: foundation for a mutual causality) provides elaborations at the mainly theoretical level which reinforce the initial intuition that generates the book, i.e. that entrepreneurship and technological change can be mutually fostered through specific organizational postures. Such strategic behaviors are analyzed in depth by Cassia, Minola and Paleari, through an extended literature review on most qualified academic journals in management, entrepreneurship and innovation. The contribution discusses the main dimensions of entrepreneurship under the lens of recent academic advancements on knowledge and change as agents of economic development. The chapter concludes by suggesting a framework that can help and guide the reader in the remainder of the book. In particular the framework explains how technological change, including interaction with the environment, can generate opportunities that ignite entrepreneurial actions; and how a firm's entrepreneurial posture generates innovative practices (some examples are provided, e.g. ambidexterity or dynamic capabilities as innovative responses to external stimuli) that in turn promote technical change.

Günzel and Wilker describe the opportunity recognition and exploitation process enabled by the development and use of a new technology. The chapter contributes to the understanding of the interrelationship of technology entrepreneurship and change by proposing the Business Model Dynamics Framework (BMDF); it is a dynamic design tool that enables value identification and quantification for all types of opportunities and encourages change during all stages of a firm's development.

Part Two (Technology entrepreneurship and the renewal: firms, industries and regions) highlights the renewal dynamics that are associated with contexts where entrepreneurship flourishes. Roaldsen and Borch dedicate their attention to SMEs in mature industries, where severe competition and structural constraints to innovation make renewal a particularly desirable result of firm strategies. The authors explain how strategic entrepreneurship can induce firms to engage in R&D-based alliances; they are in turn attractive means to achieve the necessary resources for technical change. In mature industries such alliances result in a strategic renewal of SMEs.

Hedner, Cowlrick, Wolf, Olausson and Klofsten analyze the pharmaceutical industry and its changing structure; costs for radical innovation are shown to continuously increase, whereas the outcomes (e.g. business survival and growth, drug delivery) do not improve correspondingly. Many large pharmaceutical companies have relied heavily on mergers and acquisitions to overcome such innovation failure. There is an

increasing focus on emerging alternative approaches, such as the creation of open models of innovation which rely more on employees' entrepreneurial engagement and focuses; thus more and more companies are reorganizing their structure into smaller, strategic core competence groups headed by entrepreneurial leaders. The chapter discusses corporate executives' perception of the importance of openness and an entrepreneurial approach to the drug delivery process for possible rejuvenation of the whole industry.

Muffatto and Giacon describe entrepreneurial behavior in high-tech investments by considering them key drivers that influence both corporate change and the regional model of industrial specialization. The exploitation of technological discontinuity, especially in traditional industries, represents a crucial and complex strategy that requires low risk aversion, entrepreneurial commitment and strategic vision. This entrepreneurial posture is detailed through dimensions such as the conceptualization and the assessment of high-tech investments, and a description of drivers of the strategic choice to invest. The chapter concludes with some considerations on how single initiatives of investment can become collective outcomes and thus influence the regional model of industrial specialization.

Svensson concludes Part Two by describing the industrial change of a Swedish urban region, which illustrates in detail how regional renewal occurs; a new knowledge base, in particular an emerging technology, in a declining industrial city can spill over into the surrounding environment. The chapter analyzes through a qualitative approach which are the actors of such a renewal process, the strategic perspective, the innovation outcomes and summarizes the main issues of the design of a regional collaborative strategy and some policy implications.

Part Three (Strategic entrepreneurship and innovation: challenges and processes) represents the final step of the journey; innovation patterns enable technological change and are linked to entrepreneurship, although this link is often implicit and taken for granted. This part aims at explaining which entrepreneurial dimensions facilitate and promote different forms of technological change through innovation; the analyses are performed at the firm level. Cassia, De Massis and Minola suggest corporate entrepreneurship initiatives are unquestionably an important element for the long-term performance of growth-oriented companies; the authors focus on corporate venturing as a specific form of corporate entrepreneurship that enables a particular type of technological innovation, i.e. the entry into a technological new business domain. An exhaustive classification of corporate venturing forms is provided, where the specific role of technological discontinuity objectives in corporate venturing is highlighted, together with a framework to assist corporate executives in selecting potentially suitable forms.