

## Preface

Biotechnology is globally recognized as a rapidly emerging and far-reaching technology. It is aptly called “technology of hope”, as its promising to be powerful enabling technology that can revolutionize agriculture, healthcare, industrial processing and environmental sustainability. Today when you think of biotechnology, it’s no longer just San Francisco, Boston, London and Tokyo. It’s also Hyderabad, Shanghai, and Sao Paulo. While in the emerging economies it is still in its adolescence, biotechnology is no longer the sole hegemony of the rich world. Biotechnology innovation is becoming globalized. As a consequence, governments in leading and emerging economies alike have rendered great efforts to support the development and use of biotechnology. Specifically, emerging economies view it as an opportunity to catch up to the leading countries, as this cross-cutting technology is still in the early stage of its life cycle, which may reduce the barriers to entry. Emerging country markets such as China, India, Korea, Brazil and Argentina are growing very fast, and represent opportunities for companies based in these countries to produce and commercialize biotechnology products.

Currently biotechnology, one of the most dynamic high-technology sectors in the global economy, is undergoing a series of major changes. They include, first and foremost, a major upheaval in the way biotechnology R&D is conducted. From a chemical-based industry, it is rapidly moving towards the incorporation of the new biotechnology, as well as a series of related information technologies and laboratory equipment and software. Yet, while the cost of R&D is skyrocketing, the product pipeline has become less plentiful. Biotechnology has responded to these constraints by making a series of moves, including cutting R&D expenditures in developed countries, acquiring biotechnology firms, and moving R&D laboratories to emerging countries where costs are lower and unsaturated markets may be less strict in terms of product quality and performance.

The book focuses on biotechnology from a perspective of emerging and developed economies, including a comparative study between developed countries and developing countries, as well as their respective development situation, technology and natural resources, public policies, innovation systems, competition and strate-

gies, governance and relegation patterns, marketing and growth capabilities, etc. The book presents a fully understanding on public policies and business development of biotechnology in emerging and advanced economies, and provides insight for how to manage biotechnology technology more generally so as to simultaneously leverage potential benefit and guard against potential risk. This book offers the reader a uniquely comprehensive view of the overall scheme of biotechnology in emerging and developed economies. We not only pay attention to competencies of biotechnology firms in the development of biotechnology, but also take look at their capabilities to sell their products in those countries. 95% of biotechnology firms died in the first years for the reason of marketing. Our research focuses on some key questions for emerging and developed economies: Assessing the importance of the production of biotechnology products in these countries; National strategies and public policies to support these companies; Capabilities and competencies in developing biotechnology and selling products; Competition and strategies of biotechnology firms and MNCs in these countries; Whether biotechnology producers based in more advanced nations are able to restrain the diffusion of the technology and control the new market.

Biotechnology in emerging economies and developed economies needs to be justified in our days and promoted through a multi-focus approach. The book is a leading source of information for all those interested in the comparative analysis of biotechnology between emerging economies and developed economies since it promotes scientific discussion on policies and practice of biotechnology in emerging economies and developed economies, as well as to cover the emerging research topics which are going to define the future of biotechnology development.

The book is organized into 15 chapters which provide insight on Comparative Approaches to Biotechnology Development and Use in Developed and Emerging Nations as a whole.

Chapter 1 (*Nutraceutical Industry with the Collaboration of Biotechnology and Nutrigenomics Engineering: The Significance of Intellectual Property in the Entrepreneurship and Scientific Research Ecosystems*) highlights the relevance of the nutraceutical industry and the implication of biotechnology and nutrigenomics in the field of human health, to increase the quality and range of scope of their products. People in the world take every day functional foods constituted by nutraceutical ingredients. Only in the United States, 47% of men and 50% of women take daily vitamin complexes, inorganic nutrients and other food supplements that are made from nutraceutical ingredients. This chapter analyzes the nutraceutical industry in the leading countries worldwide. The number of existing companies in this sector is examined, in addition to analyzing the intellectual property generated by this industry. At the same time, it deepens in the number of patents assigned to the enterprises and the scientific publications consigned to each author, particularly to “star scientist”,

is observed. Finally, the regulations and policies concerning nutraceuticals products of the different countries are analyzed.

Chapter 2 (*Bioinformatics: The Convergence between Biotechnology and ITC Impacts on the Productive Sector*) retraces the development of bioinformatics as a new discipline and its diffusion into Latin America. It argues that governments in the region do not pay enough attention at this fast-growing new area of the set of biotech technologies stemming from the convergence between information and communication technology and biotechnologies, and in consequence, the region is falling increasingly behind the world leader (the United States), Japan and Western Europe.

Chapter 3 (*Influence of Star Bioscientists on Obtaining Venture Capital for Canadian Dedicated Biotechnology Firms*) examines the influence of DBF relationships with star bioscientists on their venture-capital funding. It proposes a new definition of bioscientists anchored in today's technological practices. It also classifies Canadian bioscientists into four categories to give a national overview of their involvement with DBFs. The cross-analysis of 150 Canadian DBFs active in human-health applications and 431 bioscientists confirms the positive impact of these relationships on obtaining venture capital when a star is involved because of the credibility it brings to the firm. Moreover, results show that bioscientists most often chose to establish contractual agreements with existing firms or start their own. Future research directions and implications for policy makers are discussed.

Chapter 4 (*A Romance of the Three Kingdoms-Biotechnology Clusters in Beijing, Shanghai, and Guangdong Province, China*) is a pioneer study on a comparative case study of biotechnology clusters in Guangdong province and the better documented ones in Beijing and Shanghai and Shenzhen. The experience of the government-controlled and supported 'construction' and evolution of biotechnology clusters in Beijing, Shanghai and Guangdong province is compared with high-tech clustering in the West. The paper documents the existence and performance of the hitherto largely ignored Guangzhou biopharmaceutical cluster. Despite the rapid development of biopharmaceutical activities in Guangdong province, biotechnology it is not yet a significant high-tech/high value-added alternative to Guangdong's specialization the labor-intensive export industries.

Chapter 5 (*Is Collaboration Important at All Stages of the Biotechnology Product Development Process?*) examines the importance of collaborating with firms and public institutions at various stages of product development, from research and development to clinical trials and then on to production and commercialization by using the four Biotechnology Uses and Development surveys of Statistics Canada. The models examine the propensity to have products at a particular stage of development using instrumental variables probit regressions. This chapter finds that while small firms do not benefit from collaborating with firms at the research

and development stage, during the clinical trials and in the production phases, collaborating with firms has a strong positive effect. The factors that affect the R&D phase are R&D expenditures, an important IP strategy, revenues from contracts and to some extent contracting out some innovation activities. In later stages of the development process, the number of patents and the diversity of the biotechnology employment team play a more crucial role.

Chapter 6 (*Entrepreneurial Approach to Biotechnology Policies and Development in India*) focuses on entrepreneurial approach adopted for biotechnology development. The recent advances in life sciences unfold a scenario energized and driven by the new tools of biotechnology. There are number of therapeutic biotech drugs and vaccines that are marketed and many are in clinical development. In addition, there are a large number of agro-biotech and industrial biotech products that have enormously helped mankind. Biotechnology sector in India is gaining global visibility and tracked for emerging investment opportunities. Through in depth analysis based on published reports and secondary data with grounded theory approach the chapter aims not only to trace the development of biotechnology and reviews policies but also to elucidate through cases the entrepreneurial approach adopted for biotechnology development in India.

Chapter 7 (*Institutions as Enablers of Science-Based Industries: The Case of Biotechnology in Mexico*) claims that many governments in emerging economies looking to exploit some of the opportunities provided by advances in biotechnology design institutional frameworks to cope and develop this complex science-based industry. In this context, a country's science, technology and innovation institutional structure plays a key role in shaping the outcomes, commercialization, investments, and alliance strategies of this particular industry. This chapter builds on the innovation systems perspective to describe how institutions act as enabling factors for innovation and research in biotechnology. These factors are, as defined by the Biotechnology Industry Organization, infrastructure for R&D, human capital, intellectual property protection, regulatory environment, technology transfer frameworks, market, and commercial incentives.

Chapter 8 (*A New Tool for Supporting Innovation in Biotech Co-Innovation and the Role of Economic Developers*) focuses on biotech co-innovation. Biotech companies have been perceived has the Saint-Graal for economic development since a few years. But the economic downturn and a misunderstanding of the shift in innovation process, from a stage gate process to a user driven process placed, impairs biotech companies. Economic developer, which aims is to foster innovation to induce economic development asked themselves how to help innovation in the biotech sector to reach the market more rapidly and more efficiently. This chapter presents an overview in the innovation shift from the supply side to the demand

side and propose a new model of intervention for economic developers in this new context of co-innovation.

Chapter 9 (*The Turkish Biotechnology System: Functioning or Malfunctioning?*) empirically examines biotechnology innovation system in order to present the concerns of developing countries. Even though it is not possible to create standard prescriptions across countries, this paper aims to develop a solid understanding of how biotechnology and institutions co-evolve that might shed light to innovation policy issues for biotechnology across developing countries. The immediate goal is the Turkish policy makers but it will surely have policy implications for developing countries in general. Through mapping innovation processes/functions over time, it is possible to develop insights of the dynamics of innovation systems. This mapping is carried out for the Turkish biotechnology system, and the findings are summarized.

Chapter 10 (*Importance of Biotechnology in the Development of Functional Foods in Emerging Countries: The Case of Chile*) seeks to highlight the qualities of functional foods, in relation to those called traditional foods and, from this perspective, the contribution that the use of techniques based on biotechnology can provide to increase the quality of foods, while seeking to reduce diseases derived from a bad or insufficient nutrition in the population. To that end, a brief overview has been prepared on the diverse categories of healthy foods, before delving deeper into the definitions of functional foods. This paper addresses the existing relation and impact of using biotechnology for processing them and, at the same time, it provides a short description of the potential market for functional foods in Chile.

Chapter 11 (*What Influences the Growth of Canadian Biotechnology Firms?*) examines the influence of firm characteristics on the growth of all Canadian biotechnology firms. Data collected by Statistics Canada from four Biotechnology Uses and Development Surveys (1999, 2001, 2003 and 2005) characteristics the size, origin, contracts, IP, collaboration, financing, product development stage, tax credits of Canadian biotechnology firms, while employment data from the Business Register of the organization provides the size of firms beyond 2005. Results show the importance of collaboration for exploration (knowledge) purposes, the importance of alliances for exploitation (commercialization) purposes for firms with rapid growth. Furthermore, a good product development process that brings products through regulation towards commercialization has a positive impact on firm growth and so does R&D expenses.

Chapter 12 (*Corporate Social Responsibility of Pharmaceutical Industry towards Access to Medicine: A Case Study of GlaxoSmithKline*) evaluates the strategies and practices of Glaxo Smith Kline in contribution towards the access to medicines and their contribution of corporate social responsibility in India. India has changed its patent policy in 2005. It was compliance to WTO TRIPs provision and after this there was prohibition on process or generic manufacturing. India is the biggest supplier

of affordable generic medicines and this patent protection is said to be beneficial to novel drug manufacturing countries. The generic drugs can be a differentiation factor between lives starting point and the ending point for millions of people in developing countries. This remains as a as an obstacle to inexpensive generic medicines which results in devastating impact on the poorer people. These patent laws allow large MNC's to place 'profits over people'. World Health Organization report price of medicines are important for maintaining the affordability and access of the medicines. Under this background, this chapter presents an advanced research on corporate social responsibility of pharmaceutical industry towards access to medicine based on a case study of GlaxoSmithKline.

Chapter 13 (*Collaboration, Innovation, and Funding as Survival Factors for Canadian Biotechnology SMEs*) aims to determine the factors, such as collaboration, research and development, intellectual property, product management and financing, that influence the survival of biotechnology firms in Canada. The research use data from four biannual surveys on the use and development of biotechnology collected by Statistics Canada between 1999 and 2005, and following these firms in the official business register of the organization up to 2009, to build a Cox proportional hazard model of firm survival. The research finds that firms that collaborate for exploration purposes have better chances of survival than others. Results also suggest that a larger number of patents decreases the probability of survival. Investigation of the product development process shows that because of the vast resources necessary for clinical research, firms enter the production and commercialization stage in a weak position, which may then result in firm exit.

Chapter 14 (*The Competitive and Comparative Advantages Effectively Fostered by National Innovation Systems: An Exploratory Study*) analyzes and discusses the concept, its structure, configuration and prescriptive character, as well as the underlying competitive and comparative advantage assumptions. Its purpose is to provide a factual account of deployment efforts, and to highlight the challenges encountered with its implementation. To this end, an in-depth exploratory study of the berries sector in the Maule Region has been performed. Data were collected from NIS actors (academia, industry and government), inputs (funding R&D projects), outcomes of innovation activities (academic publications) and exports. The open source software VOSviewer version 1.5.4 was used to extract and analyze scientific publications on berries from Web of Science®. The relevance of links, interactions and implications are highlighted. Also, theoretical and prescriptive approaches to NIS implementation and deployment are bridged.

Chapter 15 (*Regional Innovation Pattern: A Case of Beijing Biopharmaceutical Industrial Clusters*) develops a basic framework of regional innovation for biopharmaceutical industry clusters, and proposes synergistic development strategies of Beijing north and south pharmaceutical industry clusters. Beijing biopharmaceutical

industrial base are currently still in its infancy, innovation network and collaborative innovation system within pharmaceutical industrial clusters still have many problems, and cluster-based technology innovation mechanism and pattern needs further exploration. This chapter focuses on Beijing pharmaceutical industry clusters, and industry cluster theory, learning theory, and regional innovation system theory apply to the practice of Beijing pharmaceutical industrial bases. The chapter discusses on the related concepts of technology learning, and establishes a technology learning network among industry clusters, and presents a technological learning system under the cluster network on the basis of existing learning theory.

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