

Introduction

Technological entrepreneurship encompasses all the activities related to the identification of potential entrepreneurial opportunities arising from technological developments, and the exploitation of these opportunities through the successful commercialization of innovative products (goods or services). Put simply, technological entrepreneurship concerns the transformation of technological research, developments and related investments into value: economic value in terms of returns for entrepreneurs, investors, employees and taxes for governments; and societal value in terms of growth, employability and improvements in living standards.

Depending on who tackles this concept and in which context, technological entrepreneurship can have:

- different names: that is technology entrepreneurship, technical entrepreneurship, techno-entrepreneurship and technoentrepreneurship;
- different faces: that is a system, a policy, a strategy, a process or an individual attitude;¹
- different souls: an entrepreneurial soul related to the identification of opportunities to create future goods and services; a technology innovation management soul related to the planning, development and implementation of technological capabilities to exploit entrepreneurial opportunities; and a strategic management soul related to the attributes of capabilities, structural configurations and institutions that make the venture profitable.

Nonetheless, whatever the level or the perspective under which technological/technology/technical or techno(-)entrepreneurship is tackled, the central question for researchers and practitioners is: how can opportunities to make profits out of technologies be identified and exploited?

To answer this question at least two preliminary considerations need to be made. First, the above-mentioned opportunities may arise at all levels of the economy – individual, organizational and macroeconomic – and, as a matter of fact, often arise outside the economic sphere.² Second, even so, such kinds of opportunities cannot arise everywhere. They are in fact extremely contingent upon the past and present actions of a number of individuals in different organizations, well beyond single entrepreneurs. In

addition, technological opportunities depend on the specific institutional settings in which these individuals and organizations operate. Therefore, instead of being the results of prodigious leaps – often ascribed to individual genius, serendipity or even chance – these opportunities arise and are exploited rather as the results of an incremental accumulation process and a number of conscious and unconscious, planned and unintended, individual and collective efforts, which, drawn together by the mindful actions of entrepreneurs, make the *magic*. Therefore inventors and entrepreneurs in the vast majority of cases represent an inflection point in an ongoing process rather than a completely new curve.

Take for example one of the earliest precursors of the ‘information technology revolution’: mechanical movable-type printing by Gutenberg, of which the 1455 Bible printed in 42 lines per page (known as the ‘B42’) was the first revolutionary product. Although this discovery was soon to become one of the formidable weapons that was to lead Western culture to dominate the world, its basic idea – that is the replacement of handwriting with movable and reusable metal moulds for each single character – was neither new, nor Western. It came from a series of intuitions attributed to one Bi Sheng four hundred years earlier, who was engaged in block printing for years in an area where seals and incised stones for making inscriptions had already been used for centuries. However, Gutenberg may not have been aware of the original Bi Sheng clay types but of the improved Korean copper ones, perhaps in the form of whole word printing types made for the first time by Uyghurs, taken to Europe through Persia, where Chinese printing techniques were used for printing paper currency. Moreover, mechanical movable-type printing came on top of six other inventions, which, besides the movable types already mentioned were: paper, precision metallurgy, the press, ink and the alphabet, without which the ‘B42’ could not have been produced. Therefore that which the genius of Gutenberg produced was not an act of creation, but rather an act of creativity. That is, he brought about (1) fundamental improvements to some existing components, for example in the material used for movable type or ink; (2) modification of the destinations and functions of components already used for different purposes, for example, the press was derived from those used to produce oil and wine; (3) relevant changes in the production process, for example the idea of using metal moulds to melt the types; all of these making Gutenberg’s press easy to use and to be diffused. Basically he recombined these elements together in a new way – a genuine entrepreneurial act – producing the inflection point mentioned above. Last, but not least, we should not downplay the overall context in which this invention was made. It was made in a place where just a couple of tens of characters were needed to write and communicate

whatever was needed, instead of thousands of them as in China, where paper and movable-type printing were invented. Moreover, it was made in a place where cities or city-like states and a new class of merchants competed and cooperated to achieve the returns of increased production and international trade, against continuing the parallel with the motherland of paper and movable-type printing, a centrally administered empire where all that was valuable belonged to the empire and competition was directed towards gaining a rent-seeking position in the empire's bureaucracy. In other words, this highlights that context (including the formal and informal institutional environment) counts.³

Technological entrepreneurship is therefore a complex phenomenon, which requires not only different levels of analysis to be investigated using different perspectives,⁴ but also a case-by-case approach for the analysis to be meaningful. There are in fact, besides the stance of this work, strong theoretical arguments that highlight the interrelationships between entrepreneurship, technology innovation, technology management and strategy.⁵ In addition there are compelling practical reasons for adopting a systemic view of technological entrepreneurship that takes into account individual, organizational and system-level factors as well as the micro–macro links and the interfaces between the different levels,⁶ and for analysing these factors *in context*. First and foremost technological entrepreneurship transcends single individuals and, as it has been demonstrated above, is inextricably linked and affected by a set of specific organizational, institutional and environmental circumstances. Last but not least, a multidisciplinary and multilevel approach to this topic is not only a long recognized necessity in technological entrepreneurship research, but is also a better response to the demand for handy research and relevant results, which in the specific case of this book, concerns the understanding of how technological entrepreneurship works in the Chinese context.

In this aim it is important to be clear on the precise meaning of technological entrepreneurship, at least in the context of this work. As a matter of fact its inherent interdisciplinary, multidimensional and diachronic nature makes the concept of technological entrepreneurship rather ambiguous. Nonetheless the penchant of relevant literature for technology (and related innovation) produced a pretty common characterization of technological entrepreneurship as being related to new and advanced technologies, hi-tech enterprises and emerging industries and, along with these, to new and often small firms and (technological) product innovations. However, technological entrepreneurship can be extended to include not only technology-related process innovations,⁷ but also organizational and marketing innovations, if these innovations are introduced into the

market in the form of new services. Take for example the cases of UPS Package Tracking, IBM Global Services or eBay stores. The literature on corporate entrepreneurship demonstrates that technological entrepreneurship is not just a matter of new entrants, and the concept of the ‘developmental state’⁸ pushes this issue even further. In addition the relevance of technological change in the so-called low-medium tech (LMT) sectors is starting to be considered.⁹ Finally, when the entrepreneurship side of the concept is taken into account, the search for promising technologies and the matching of their possible applications with potential or existing market needs transcends novelty, and places the emphasis upstream and around the design, development and commercialization of new products. The focus becomes ‘the activities to create new resources combinations that make innovation possible, bringing together the technical and commercial worlds in a profitable way’ (Burgelman et al., 2004, p. 3). In this sense technological entrepreneurship is a bridging concept that links to and adds to the concepts of technological innovation and commercialization, making it a common and difficult-to-separate whole.

Therefore the attempt to explain technological entrepreneurship, in the way it has been outlined here, requires the examination of a number of players, their roles and their interactions in the transformation of raw technologies into marketable products, as well as the specific institutional and environmental conditions that set the momentary boundaries in which such a system, here referred to as the system for technological entrepreneurship, operates. A representation of this system for China is depicted in Figure I.1. For each of the fundamental players identified the figure shows the main ones (in parentheses), their role within the system (in bold), and specific examples (in italic). The arrows indicate the relevance of the relationship in terms of influence, flows of funds or both.¹⁰

The cases reported in this book will analyse this system from the privileged positions of Chinese authors working in Chinese government agencies, research institutions and outstanding universities, and from the standpoint of European researchers engaged in multi-year working and collaboration activities with China. More specifically the cases provided will provide a number of answers to the following general questions:

- What are the roles of government, research and educational institutions, enterprises and individuals in this system? And how do they work and interact?
- What are the factors that influence technological innovation and entrepreneurship activities?
- To what extent, if any, does technological entrepreneurship differ in China as compared to the West?

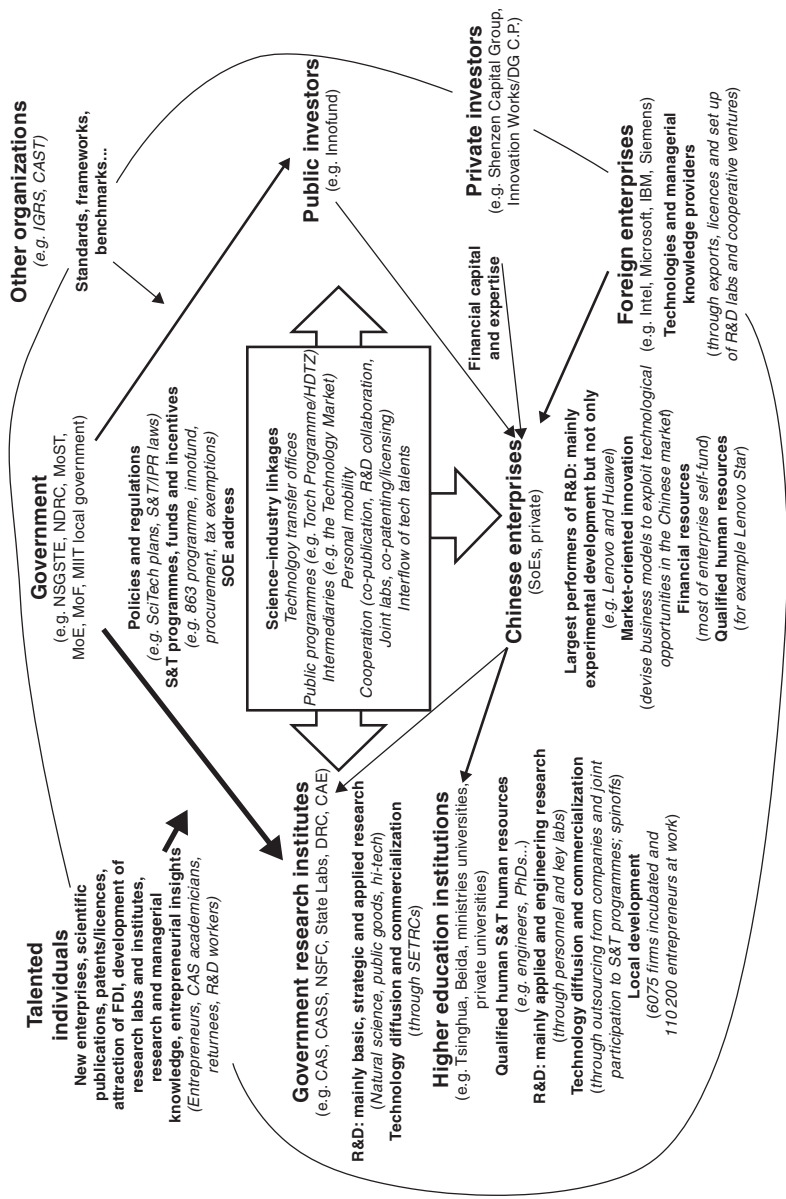


Figure 1.1 The Chinese system for technological entrepreneurship

Figure I.2 uses the system depicted in Figure I.1 to highlight the specific topics (inside the boxes) tackled in the different contributions (numbers beside the topics). Using this figure as a reference the reader can easily identify relevant issues, examples and insights related to the above-mentioned actors and questions. Nonetheless because of the way in which this figure is organized, it does not explicitly display other relevant topics that the contributions tackle. These are, more specifically: the effects of the diversity of China's regional innovation systems (see Chapters 2 and 3) and the diversity between Chinese and foreign enterprises as related to innovation activities (see Chapter 3), the Chinese triple helix (see Chapter 4), the relevance of standards (see Chapter 7), intellectual property issues, time-to-market (see Chapters 3, 4 and 9) or of particular geographical locations in terms of both physical (see Chapter 5) and the overall economic environment (see Chapters 5 and 9) for technological entrepreneurship.

The rise of China as a technological power is attracting the attention of policy-makers, scholars and practitioners everywhere in the world. The contents of this book are crafted to appeal to a primary audience made of scholars and policy-makers. For the former in particular, the cases presented, as well as the strong connections with theoretical matters, can be a useful source of findings and teaching materials in the fields of technology and innovation management, economics of innovation, strategic management of technology and innovation, especially as related to China.

OVERVIEW OF CHAPTERS

This volume is a collection of nine contributions. The contents of each contribution are summarized below.

In Chapter 1 Huijiong Wang, Shantong Li and Yan Hong discuss the creation of the Lenovo Group and the development of China's High Speed Railway (HSR). More specifically the authors illustrate the role of the government in the creation of new high-tech firms and industries: in the case of Lenovo the government's role in stimulating (with its policies) and supporting (with its structures) technological entrepreneurship is emphasized, and in the case of HSR, the leverage of technology transfer coupled with local re-innovation efforts is illustrated. More specifically the first case illustrates how the interaction between individual entrepreneurship – that of Mr Liu Chunzi – and government regulations and support, transformed an initial 200 000 RMB investment into a powerful global business able to buy, 20 years later, the IBM PC division. The second case reports the development of the longest high-speed railway in the world. Besides the detailed account of how all this has happened, the *entrepreneurial* role

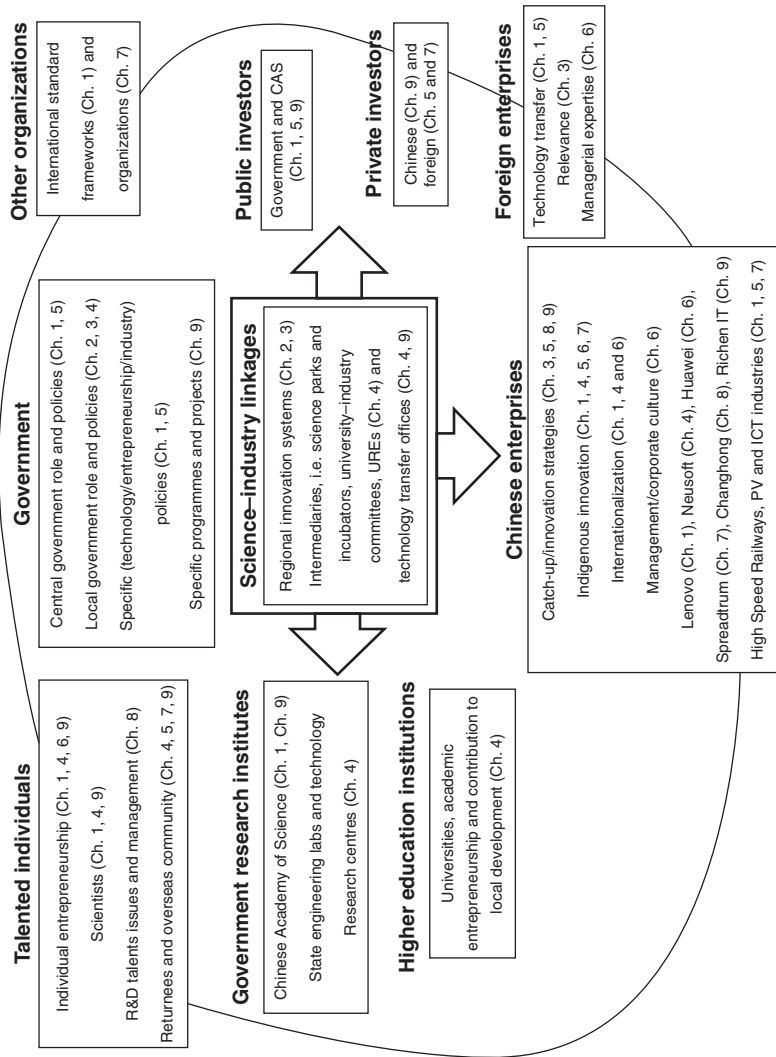


Figure 1.2 Topics map

featured for the government in defining, organizing and combining international technology transfers (from Bombardier, Kawasaki, Alstom and Siemens) with the contribution of various departments of the Ministry of Railways (planning, science & technology institutions, manufacturing units) in the effort to create an indigenous industry, is definitely a distinctive feature emerging from the case.

In Chapter 2 Ulrike Tagscherer, Henning Kroll and Xin Luo analyse the performance and the industry–science linkages of the Bohai Bay area – a newly designed planned region with ambitions to compete with China’s leading industrial regions, the Yangtze River Delta and the Pearl River Delta – from the perspective of the main actors comprising the regional innovation system. The results of the study undertaken show that, while Beijing hosts a large number of China’s leading universities and research institutes, their capacities are not yet being broadly leveraged to help upgrade the innovation capability of the regional enterprise sector. As a matter of fact the innovation capability of the local enterprise sector keeps lagging behind that of the Yangtze River and the Pearl River Deltas. A number of explanations for this situation are presented through the voices of the area’s universities, research institutions, local industries and local government. On the other hand a number of promising starting points that may provide a basis for future development are identified. Overall this case gives a clear idea of the regionalization of China’s innovation system and the internal diversity in terms of technological innovation and entrepreneurship activities. In addition it closely analyses the networks and the patterns of cooperation between universities and (large vs. small and medium) enterprises.

In Chapter 3 Henning Kroll and Daniel Schiller, starting from the same perspective as the previous chapter, but analysing the Pearl River Delta, focus their attention on the enterprise component. More specifically, after setting the scene by describing the overall characteristics of the Guangdong innovation system, the authors analyse in detail the innovative behaviour of electronic firms as a result of a large-scale survey conducted in the region in 2008 and 2009. In so doing, the authors take a further step in highlighting the intra-regional diversity in technology and innovation activities among mainland Chinese, foreign-owned and Hong Kong, Macao and Taiwanese enterprises. Against this background they adopt a counterfactual approach analysing two case studies of Hong Kong firms which have chosen to locate their operations in the Pearl River Delta. Their results highlight different strategic orientations, as well as the effectiveness of those strategies, among different kinds of firms related to the Pearl River Delta innovation system. Overall this case highlights the relevant roles of government support and foreign-owned enterprises in

Chinese technological and innovation activities and, once again, on closer inspection of the data from the field, demonstrates a slightly different picture to that which might seem crystal clear to a secondary observer.

In Chapter 4 Chunyan Zhou offers another analysis of the science–industry interaction, adding to the previous two chapters’ system and enterprise perspectives, by taking a closer look at the role of universities, introducing university-run enterprises (UREs) as a special feature of university–industry collaboration. The contribution also highlights the coordinating role of local government in the regional innovation system and its support of university entrepreneurship, advocating the concept of the ‘government-pulled’ triple helix perspective. Besides this it also provides insight into China’s north-east province of Liaoning, usually overshadowed by Beijing, Shanghai and Guangdong, but actually very relevant. In this province, the Northeastern University of China gave birth to Neusoft, the largest Chinese information technologies solutions and services provider. More specifically through the illustration of the Neusoft development, the case highlights the roles played by the combined efforts of local Liaoning and Shenyang governments, the Northeastern University of China and Jiren Liu, CEO of Neusoft. Also featured are the roles of foreign direct investment at its inception, the company’s subsequent internationalization, as well as the intellectual property-based strategy set for the company. All the above-mentioned factors contribute to provide an alternative explanation of how a three person, three PC and 30000 RMB company could have developed into the multi-billion dollar leading Chinese provider of IT solutions.

In Chapter 5 Marco Andreozzi tackles the issue of technological entrepreneurship at the industry level, analysing the key factors behind the Chinese Solar Photovoltaic (PV) industry’s staggering growth. In particular he highlights the industry’s historical role of relying on different actors and factors at different times. More specifically he examines the role of central and local government’s infrastructural and policy support, the roles and activities of Chinese enterprises during the different development phases, as well as the role of returnees in launching the industry. Once again the relevance of openness to the external world, foreign direct investment and international technology transfer is tackled. In addition the contribution also highlights the positive influence of the economic and physical environment in the growth of a successful indigenous industry. Finally the contribution gives an alternative perspective on the derogatory low-tech and labour-intensive image of Chinese industry and unveils, among others, the haves and have-nots for the development of genuine ‘independent innovation’, at least in the industry analysed. Overall the case gives the reader a general perspective of how a hi-tech industry can

be born, grow and change, as well as giving an unbiased evaluation of the level and perspective of China's scaling up in a strategic, hi-tech and capital-intensive sector.

In Chapter 6 Yingying Zhang and Yajun Wu tackle the issue of technological entrepreneurship at the firm level and below, discussing the case of Huawei and its founder and leader Zhengfei Ren. Huawei is one of the leading Chinese multinationals and one of the most technologically innovative. The case, after introducing the company's hi-tech and overall performance, describes the role of the leading and entrepreneurial role played by Zhengfei Ren, from the company's foundation to its growth. The case also discusses the role of the management culture created and some interesting anecdotes behind its development, with particular reference to the internationalization process of the company. Quite differently from what one would expect from the analysis of a big Chinese company, the role of the government is not so evident in this case and internationalization is this time discussed in the opposite direction: not towards, but from China. Moreover it should be considered that many of Zhengfei Ren's speeches at Huawei have become classics in the Chinese technological industry, so a view on modern Chinese management culture is also provided. Overall the case shows China's capabilities in producing world-class technological entrepreneurs and innovations and, maybe, a model for indigenous innovation that combines authentic, but not autarchic, Chinese leadership and corporate culture with Western management style.

In Chapter 7 Yan Wan and Shi-ji Gao take a different angle in describing the outset and development of Spreadtrum, a venture founded by two Chinese engineers who had returned to China from Silicon Valley. More specifically Spreadtrum is a key chip-design company operating in China's fast-growing information and communication technology market. In this market Spreadtrum quickly became a key competitor, supplying increasingly more sophisticated chips and chip-sets for both the Chinese and the international markets. As a matter of fact the company has set several records, such as the first GSM/GPRS (2.5G) baseband chip with integrated multimedia and power management functions or the first single chip dual-mode TD-SCDMA/GSM baseband chip, making it a champion of China's home-grown TD-SCDMA industry and one of the leading examples of China's indigenous innovations. Through the discussion of this case, the case displays not only the company's advanced technological capabilities but also the positive influences of China's investment environment and fast expanding domestic market for technological entrepreneurship activities. Nonetheless operating this business was not as easy as one might think. In this regard the difficulties

encountered over the company's path towards becoming a world-class chip company are described and the ways in which they have been overcome are discussed.

In Chapter 8 Chaoying Tang and Jiannong Shi tackle the issue not from the perspective of the entrepreneur, but from that of the R&D worker, in particular in relation to that which is referred to as the talent management dilemma. Talent management is a very serious matter everywhere, but especially in China. There the challenges of harmonizing managerial expectations for efficiency against the R&D worker's expectations for a creative role and employability may become a real problem. This is especially true in manufacturing firms, where the strategy is more cost-oriented than innovation-oriented, particularly when catching up. More specifically, relying on analyses of interviews and archival data, the chapter discusses Changhong Group's efforts (as well as the challenges faced) to foster an enabling internal creative climate and establish its external cooperation R&D network. Overall the contribution tries to disentangle the issues of the talent management dilemma in Chinese companies, analysing the combined effects of the company's competitive strategy, R&D personnel creative requirements, talent market and creative role identity. The latter is the main argument of the case and a fundamental antecedent to unleashing employees' creativity and therefore the company's innovation capabilities. In addition, the analysis of how R&D is organized within the company's Beijing R&D centre offers readers a detailed account of how R&D management is undertaken in a Chinese enterprise.

In Chapter 9 Claudio Petti, Xiaowei Hu and Shujun Zhang offer an overview of how technological entrepreneurship works in China using the case of Qrobot – a brand new product that interacts with Tencent's QQ, China's most used instant messaging service and the world's largest community. More specifically, the brief life of Qrobot is used to illustrate how government policies, government research institutes, entrepreneurs, enterprises and investors worked together, from the development of the technology to its introduction to the market, describing what has been referred to as 'technological entrepreneurship with Chinese characteristics'. In doing so a comprehensive picture of the actors, roles and dynamics of Chinese technological entrepreneurship will be offered, along with a discussion of the effects of such factors as government and its research institutions' direct and indirect support, foreign companies, transnational communities and the overall environment. In addition the differences and similarities with Western counterparts will be highlighted. Concerning the latter, conclusions will reflect on whether there is really something like a 'technological entrepreneurship with Chinese characteristics' or if the differences underlined are just the temporary effects of China's transitional

state. In this regard the study of contingencies is suggested as a viable research direction to answer this question, and some thoughts are given on how this kind of research should be crafted.

In all these cases both the differences and similarities between Chinese technological entrepreneurship and that of the West will emerge. Some differences, for example in availability of private capital or intellectual property protection, seem increasingly to be becoming similarities. Some differences, such as the strong role of the public sector, still seem to be firm. Some similarities on the other hand, such as the strong focus on indigenous technological innovation and science–industry collaboration have completely different supporting premises, visions and modalities.

So in the end the question that emerges is: will China eventually converge with or diverge from the West? Many think that China will finally converge with the way things in general are being done in the West, and this applies to technology innovation management and technological entrepreneurship as well. The argument appears to be as follows: ‘China is importing heavily from the West and not only technology and machinery, but also know-how and practices. Moreover the hi-tech sector is highly standardized around the world, so what is going on in Chinese companies is not so different from what is going on in German or American companies’. This argument, though sound and rational, is partial and biased by the underlying idea that China’s impetuous modernization process – since it is similar to what happened in the West, or closer in time and distance, in Japan – will lead China to resemble either the USA, Europe or Japan. Yet China is very different, for example in terms of continuity of its culture and substantial homogeneity of the political system and state organization, at least since 221 BC, when Qin Shi Huang unified the country, let alone its population size, especially when compared to Japan, that might allow, among other factors, for the country to climb the value-added ladder while at the same time maintaining a low-cost base. In addition, its recent emergence in a prime position on the world stage is not the one of a debutant, but the return of an old power, the oldest still on duty. Finally, the world is not the same as the one in which Europe, USA and Japan become what they are now.

In this big debate the arguments of this book offer just a very small, partial and specific perspective on just one of its aspects. Nonetheless the hope is that the insights discussed in this book will help readers to take a closer look, develop a better understanding and eventually start to build their own stance or at least take an interest in this debate, which in the editor’s view is one of the fundamental questions in the China/ Rest-of-the-World relations, the responses to which will certainly shape the future.

NOTES

1. See for example Abetti (1992) and Kenney and Von Burgh (1999) for a system perspective, Zhang et al. (2008) for a policy perspective, Gans and Stern (2003) for a strategy perspective, Antoncic and Prodan (2008) and Petti (2009) for a process perspective, Dorf and Byers (2011) for an individual attitude perspective.
2. Venkataraman and Sarasvathy (2001).
3. Example based on Runchuan (2009); Diamond (1997); Baumol (1990).
4. Shane and Venkataraman (2003); Phan and Foo (2004).
5. Hitt et al. (2001); Venkataraman and Sarasvathy (2001); Shane and Venkataraman (2003); Phan and Foo (2004); Ireland and Webb (2007); Schendel and Hitt (2007).
6. For such studies see for example Petti and Zhang (2011a).
7. Tushman and Anderson (1997).
8. See Johnson (1999).
9. Robertson and Von Tunzelmann (2009).
10. Reported in the editor's previous research, see Petti and Zhang (2011b).

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