

Chapter 1

Introduction

Abstract This chapter serves as an introductory note to the research context, key concepts and primary database upon which the book develops. Situated within the context of economic restructuring around the globe, China's high-speed growth has been curtailed by both internal cost pressure and external market change. Under such circumstances, technological upgrading and innovation capabilities is the key to the successful restructuring process. The work adopts the regional innovation system approach, which proposes the institutional and organizational dimension as the supporting infrastructure that stabilizes the interactive learning process. By investigating the electronics industry in the Pearl River Delta (PRD), one of the biggest megacity regions in China, this work aims to address three primary questions. Firstly, it will explore theoretically and empirically the external channels that are able to trigger the local-scale knowledge spillover. Secondly, it aims to expand the understanding of the role of informality in reducing uncertainties and risk faced with innovation activities. Last but not least, the spatial differences and processes in regard to firm innovation is analyzed.

1.1 Research Context

Driven by economic liberalization and globalization, Chinese has grown as an economic powerhouse since the opening-up policy in the late 1970s. Yet in recent years, its high-speed growth has been substantially constrained by both internal and external factors in recent years. On one hand, the high inflation rate that leads to continual pressure of rising costs gradually erodes the competitive edge on low cost production. In the first quarter of 2011, the Consumer Price Index (CPI) hit the record of 5.4% year-on-year, and the Production Price Index (PPI) also followed the rising trend, reaching 7.3% for the first quarter¹. On the other hand, Chinese export firms are encountered with more trade obstacles in the developed market due to the protection of local employment market after the financial crisis. Firms either have to meet the high standards on safety and quality in order to maintain the market share in developed countries, or they have to exploit the new market opportunities in the domestic economy.

¹ The data is posted by China Statistical Bureau, April 2011.

In this circumstance, technological upgrading and innovation capabilities is the key to the successful restructuring process. The innovation investment cools down the fervent economic growth owing to its long period of returning rate, and at the same time ensure the sustainable growth engine in the long run. In response to the call of the innovation issue within the context of inflationary growth and competition pressure, China's innovation policy has been greatly focused on science & technology policy (SCPRC 2006), aiming to foster indigenous innovation capabilities through Research and Development (R&D) incentivized tax reduction, improving intellectual property rights and setting its own technological standards. In other words, the Chinese innovation policy follows a linear legacy, in which innovation is taken as a sequential process of discovery and direct translation into commercial value.

Nevertheless, this linear approach underestimates the interactive and systemic nature of innovation in value creation (Lundvall 1992; Cooke et al. 1997; Howells 1999; Revilla Diez 2000; Smith 2000; Asheim and Coenen 2005). The system approach towards innovation has been proposed in the innovation milieu by Aydalot (1986), in cluster theory by Porter (1990), in national innovation systems by Lundvall (1992) and in regional innovation systems by Cooke et al. (1997), all of whom have recognized the interactive learning process and the resulting distribution power of a production system as the fundamental element of economic performance. In this way, the knowledge exploitation process in the economy yields increasing returns on the generated knowledge, propelling the endogenous process of economic growth.

As a latecomer country, China has the advantage of backwardness, in which the technological knowledge is available "off the shelf" (Nolan and Lenski 1985). Consequently, knowledge exploitation is more important than knowledge generation. For latecomers, access to technology in industrialized countries as well as successful absorption and translation into market opportunities, combined with the low-cost and flexible manufacturing advantage, constitute the core elements of their competitiveness. Therefore, innovation potential in China can be at best released by implementing effective technology transfer and strengthening the distributive power of the economic system as a whole.

The distributive power of the system depends on the willingness and capability of local firms to undertake interactive learning. The regional innovation system approach proposes the institutional and organizational dimension as the supporting infrastructure that stabilizes the interactive learning process. Heidenreich (2004) defines the stabilizing factor as the regional orders, encompassing formalized rules and laws as well as informal habits and methods. The regional orders promote the interactive learning process and systemic innovation activities by reducing uncertainty, coordinating the use of knowledge and mediating conflicts.

Overall, this book aims to explore the formation process and characteristics of the regional innovation system in China, which is of great relevance to the release of innovation potential in the face of upgrading pressure. As demonstrated by Heidenreich (2004), the strength of a regional innovation system does not lie in the static set of institutions, firms and technologies, but in its dynamic ability to overcome dilemmas and meet the challenge of market change and organizational restructuring. Therefore, the dynamic and evolutionary perspective on the regional innovation system is adopted in this book so that signs of a maturing regional

innovation system can be captured, investigated and compared with regard to both the business superstructure and the governance infrastructure.

The research is supported within the framework of the Priority Programme 1233 “Megacity-Megachallenge: Informal Dynamics of Global Change” funded by the German Research Foundation (DFG). In this research program, one of the biggest megacity regions in China, the Pearl River Delta (PRD), has been selected as the research region. The electronics industry forms the particular focus of the study.

The electronics industry has been developing in the PRD for over 30 years. For strategic reasons, nearly 90% of the global lead firms in the electronics industry have located themselves in the east coastal cities of the PRD in particular, such as Shenzhen and Dongguan. The electronics industry in this region is very export-oriented. The region manufactures over 50% of the world’s desktop computers and 40% of Personal Computer (PC) components, such as PC heads, PC cases and other semi-manufactured products². Moreover, many domestic brands in the PRD have rapidly developed and taken a considerable share of the global market. However, with the increasing land and labor costs in the PRD, and the favorable policies offered by many inland governments—further buttressed by the regional bias towards central and western provinces with the 4 trillion stimulus package after the 2008 crisis, the trend of industrial shift to inland China is irreversible. Therefore, the externally-driven growth mode is no longer sustainable, and there is an urgent call for the development of regional innovation system to generate sustainable and dynamic growth paths.

Moreover, the electronics industry has a large pool of technological opportunities, which confers the great possibility of opening up numerous niche markets with new product development. Firms can profit in niche markets by minor innovation when prerequisite absorptive capability, such as the ability to understand and adjust the circuit board design, is ready. For minor innovators in electronics industry, interactive learning with users and other knowledge-intensive organizations assists in collecting market information and supported technology.

One of the Shenzhen exhibitors in “China Sourcing Fair: Electronics & Components” displayed their new product—Solar Charger Backpack. The manager told the journalist that the orders have reached over 10 million Yuan. “What we do is just to make the collection and the use of solar energy more convenient, but this minor innovation led to higher added value for our products.”

—Shenzhen News, 04.2011

1.2 Defining Innovation and Regional Innovation System in China Context

1.2.1 *What does Innovation Imply in China?*

As China is a technological latecomer, the content of innovation is more incremental than abrupt. Knowledge production activities are not dominant in these

² Source: <http://www.gdiid.gd.gov.cn/gdiid/billion/lay2-3.htm>. Accessed 15th September 2014.

countries, since the modern natural sciences, such as physics, chemistry, biology and so on, are led by industrialized countries. R&D activity, which is a main proxy of knowledge production activities, displays an unbalanced pattern between industrialized countries and latecomer countries. Although R&D expenditure has greatly increased, e.g. to 1.7% of Gross Domestic Product (GDP) in 2009, the intensity is still fairly weak compared to that of developed countries (Organization for Economic Co-operation and Development, hereafter shortened for OECD 2.3% in 2009, USA 2.9% in 2009, Japan 3.4% in 2009, Korea 3.3% in 2009; See OECD 2011). Therefore, access to advanced knowledge and dissemination mechanisms remains the key factor for successful incremental innovation in the Chinese context (OECD 2005).

Overall, innovation in China is characterized as:

1. Resource restriction of firm-level innovation. Because of the low entry barriers to simple assembly processing tasks, small and medium-sized firms are dominant in latecomer countries. The lack of economies of scale leads to resistance to conducting high risk innovation activities at the firm level. Furthermore, the underdeveloped financial system provides weak financial support for firms to invest in innovation.
2. Unbalanced knowledge base and weaker regional innovation system. The industrialization process only began in China some 30 years ago. The industrial knowledge base is weak and unevenly distributed among firms in the region. As a result, the mismatch of absorptive capability among firms in the region can hardly generate knowledge spillover to stimulate the cross-fertilization among the firms. Furthermore, the linkages between universities, research institutes and business firms are fairly weak.
3. Reliance on external sources for innovation. The globalization process is transforming from vertical disintegration within a lead company to organizational fragmentation, which spreads more widely into low-cost regions, and thus exerting hierarchical network control on the upgrading and innovation of firms in China. Codified technology transfer embedded in import goods as well as codified and tacit technology transfer from multinational corporations is, therefore, a fundamental source of innovation.
4. Unstable institutional system. In transition China, the market mechanism is not fully developed and the institutional environment is undergoing a continual transition and reform process. In this context, firms face unexpected costs and risks which inhibit them from engaging in long-term innovation activities. Moreover, local protectionism undermines the economies of scale and expected innovation return, which reduces to a certain degree the incentive of firms to innovate.
5. Informality. In the uncertain environment in China, firms tend to apply an informal network-based strategy. The informal relations among firms, which are mostly sustained through *Guanxi* networks with relatives, friends and business partners, have contributed to the flexible and responsive production which has further strengthened China's low-cost manufacturing strategy. Provided a maturing and balanced development of the absorptive capacity for Chinese firms,

informal networking is likely to play a more important role than the formal institutional framework in constructing regional orders that facilitate the distribution and exploitation of external advanced knowledge.

1.2.2 What does Regional Innovation System Imply in China?

The term ‘regional innovation system’ is widely understood as “interacting knowledge generation and exploitation sub-systems for commercializing new knowledge” (Cooke 2004, p. 3). Braczyk et al. (1998) proposed a two-dimensional structure for understanding the function of this territorial sub-system, consisting of the governance infrastructure and the business superstructure. The governance infrastructure supports the competitiveness of firms’ business performance and linkages towards each other and with the outside world, and stabilizes the interacting process of knowledge generation and exploitation with established orders, encompassing physical organizations such as research competence, education, funding and technological transfer agencies as well as socio-institutional rules and norms.

As indicated in the above discussion on the characteristics of innovation in China, the regional innovation system is still weak due to the scarcity of innovation-related resources, capabilities and institutions. As the production activities are highly dependent on the foreign direct investment (FDI) in the developed coastal regions of China, the prospect of a well-functioning regional innovation system lies in its capacity to capitalize on the external linkages for commercializing new knowledge. Figure 1.1 graphically demonstrates the implication of a well-functioning regional innovation system within this context in China. It consists primarily of two general aspects: the exploitation by firms of both the external knowledge (mainly from foreign investment) and the local interdependency for enhancing the competitiveness (Asheim and Isaksen 2002).

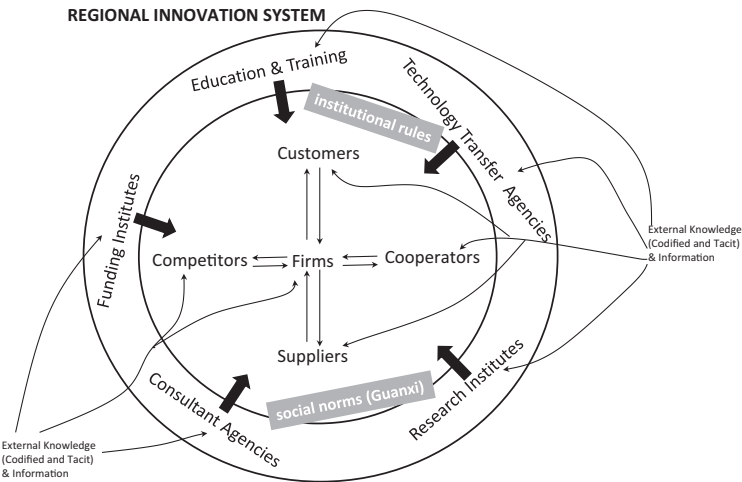


Fig. 1.1 Conceptual regional innovation system

Firstly, the regional specialized clusters in China should consistently source codified and tacit technological knowledge from the distant parent companies and foreign customers, feeding the regional innovation system with new knowledge and information. Therefore, the strategies of foreign affiliates of upgrading the value chain and introducing advanced technology, as well as the local firms' capacity to capitalize on organizational proximity with global lead firms in order to foster innovation, come into the center of the investigation.

Secondly, supported governance infrastructure (which Storper 1995, also refers to as one of the sources for untraded interdependency) should be established to shape the localized cross-fertilization process, tapping into the increasing return on the knowledge spillover sourced externally. Because most of the import technology is concerned with complex products and processes, such as in the electronics and machinery industries, interactive and systemic actions should be in place to ensure fruitful knowledge exploitation. Fromhold-Eisebith (2002) calls it the "regional cycles of learning" that promotes the dissemination of know-how from foreign multinational branch plants. The interactive learning takes place either through vertical linkages (between customers and suppliers) or through horizontal linkages (with cooperators or even competitors). In general, the physical organizations in the governance infrastructure interact with the business sector and support them with necessary information and knowledge. Therefore, the formation of interactive learning activities in the sub-system is crucial for the distribution and joint-exploitation of external knowledge. Moreover, the informal *Guanxi* networks play a role as part of the social rules promoting the interactive learning activities.

In summary, three key terms can be derived from the discussion of the implication of regional innovation system in the Chinese context: linkage to external knowledge, interactive learning process and supported governance infrastructure. In Sect. 1.3, the research questions will be formulated to tap into these issues.

1.3 Aims and Research Questions

OECD (2005) points out that the innovation process, rather than innovation results, should become the analytical focus of the innovation studies in developing countries. Based on the previous discussion, innovation studies in China should have a systemic perspective instead of a linear one, which focuses on the distributing and exploiting process of the regional innovation system. Following the previous line of argument, this book aims to contribute to the existing literature on regional innovation systems in three respects:

Firstly, the study aims to explore theoretically and empirically the channels of external knowledge spillovers that are able to trigger the local-scale knowledge spillover. As defined by Cooke (2004, p. 3), a regional innovation system is an open system linked to global, national and other regional systems, and is conducive to knowledge generation, exploitation and commercialization. As stated previously,

it is assumed in this study that the formation of a regional innovation system in latecomer regions depends on the regional capacity to disseminate and exploit the external knowledge. Therefore, a starting point in the territorial innovation studies in latecomer regions is an analysis and investigation of the possibility of the triggering effect from the inflowing external knowledge that creates dynamic externalities in the region, on which increasing returns are achieved through interactive learning and systemic innovation.

Secondly, the study aims to expand the understanding of the role of informality in reducing transaction costs further, through to its role in reducing uncertainties and risk faced with innovation activities. Especially in the context of China, the *Guanxi* network, which is widely applied in Chinese business modes, has been proved by many studies to have a positive role in reducing transaction costs (Luo 2002; Zhou et al. 2003; Wu and Choi 2004; Meyer et al. 2009). However, a dichotomous pattern in the application of informal *Guanxi* networks in China might exist. On the one hand, *Guanxi* networks are applied by the local suppliers to sustain reliable supplier-customer relationships as well as to achieve flexible and responsive production. On the other hand, innovation activities are kept within the formal hierarchical framework in the global production network, i.e. the innovation ideas and resources rely heavily on the parent companies or foreign customers. In this study, it is only when the informal *Guanxi* network serves as an important aspect of “regional orders” to incentivize and promote the interactive learning and systemic innovation, that it is considered to contribute to the emergence and performance of a regional innovation system in China.

Finally, this study aims to explore the spatial differences in the pattern of innovation activities. The degree and characteristics of a regional innovation system depend on a specific set of institutions and organizations. Therefore, spatial heterogeneity in the provision of governance infrastructure results in different patterns of innovation activities, which refer to the scope and effect of interactive learning. Moreover, an evolutionary perspective will be applied in this investigation, as the regional innovation system is viewed as an evolving process in which dynamics and inertia consistently emerge with the changing market and technological environment.

In order to achieve the research aim, the following key research questions will be addressed:

Theory-guided questions:

- T1: How and under what circumstances do knowledge spillovers sourced externally trigger knowledge spillovers on the local scale, enabling the formation of regional innovation systems in latecomer export-oriented regions?
- T2: Why do firms undertake interactive learning with external partners in the decision-making and implementing process of innovation activities?
- T3: What is the role of social proximity and organizational proximity in interactive learning activities in latecomer export-oriented regions?
- T4: What leads to the dynamics and inertia of regional innovation systems under different governance infrastructures?

Empirical-guided questions:

- E1: Have local-scale knowledge spillovers come into being to sustain long-term development in the face of a changing and fragile post-crisis global market in the export-oriented Guangdong Province, China?
- E2: Which aspects of absorptive capacity enable the electronics firms to undertake interactive learning with external partners through strategies of using organizational proximity and social proximity in the product innovation process?
- E3: How is interactive learning organized in the burgeoning regional innovation system? To be more specific, does interactive learning embed more in socially proximate networks or in organizationally proximate networks?
- E4: What is the effect of interactive learning in general on innovation outcomes? And what is the effect of interactive learning embedded within socially proximate networks and organizationally proximate networks on innovation outcomes respectively?
- E5: How do regional innovation systems in Shenzhen and Dongguan, China, differ from each other in the scope and effect of interactive learning, considering that the two cities are evolving towards regional innovation systems under different governance infrastructures in the initial industrialization phase?

Policy-guided questions:

P1: What policy implications can be drawn from the previous answers from the theoretical and empirical perspectives in order to enhance the innovation capability of firms and regions in China?

1.4 Outline

The book is organized according to three dimensions: the meso-level investigation, the firm-level investigation and the firm-regional level investigation. Table 1.1 displays the overall layout of the book. Chapter 2 provides a theoretical framework for analyzing the overall impact of knowledge spillovers—within the same industry locally, across different industries locally, and through global linkages—on the performance of innovation and technological upgrading within the context of a latecomer export-oriented region. Based on the stylized facts on technological upgrading in one of the most export-oriented areas, Guangdong Province of China, this chapter further collects empirical evidence of the triggering effect of external knowledge spillover on the local-scale knowledge spillover by applying a meso-scale secondary data set in Guangdong Province.

In order to reveal the pattern of local-scale knowledge spillover, Chap. 3 further explores the micro-firm-level evidence of the upgrading and innovation activities among the electronics firms in the PRD, China. It elucidates the logic behind the interactive process of innovation activities and discusses the role of informal *Guanxi* networks on interactive learning in China. In this chapter, the empirical investigation focuses on whether a wider scope and higher intensity of interactive learning

Table 1.1 Schematic overview of chapters

Chapter 1 Introduction: Research context, key concepts and aim	
<i>Empirical investigation</i>	
Meso-level evidence	Chapter 2 Knowledge spillovers and regional innovation: The case of Guangdong Province, China
Firm-level evidence	Chapter 3 Interactive learning and systemic innovation: firm-level evidence from the electronics industry in the Pearl River Delta, China
	Chapter 4 Absorptive capacity, proximity and innovation: Linking up the intra-firm characteristics with Inter-firm linkages
Firm-regional insights	Chapter 5 From globalized production systems to regional innovation systems: Governance and innovation in Shenzhen and Dongguan, China
Chapter 6 Conclusions: Answers, limitations and policy implications	

activities would promote the innovation outcomes. Moreover, initial insight will be provided on the application of informal *Guanxi* networks when electronics firms undertake interactive learning activities in the PRD region.

Chapter 4 is the second study at the firm-level, further strengthening the argument in Chap. 3 on the role of interactive learning for electronics firms in the PRD, China. It extends the understanding of interactive learning within the proximity concept and further investigates the capacity of electronics firms in the PRD to capitalize on social proximity and organizational proximity respectively in the process of product innovation. As technology transfer and learning has relied heavily on organizational proximity to leading global firms ever since the initial industrialization in the PRD, insights into the burgeoning regional innovation system are expected, as firms are gradually taking the initiative to capitalize on social proximity with many other business partners in the process of interactive learning and systemic innovation.

The investigation of the spatial difference with which the electronics firms undertake interactive learning is introduced in Chap. 5. In this chapter, the general regional orders, i.e. the governance infrastructure that incentivizes and supports the systemic innovation at the city-regional level, is the study focus. Moreover, an evolutionary perspective towards governance infrastructure will be taken. Adapted to the Chinese circumstance where the regional innovation system is just burgeoning, the evolutionary lens expands to the transition from governance that supports initial industrialization to the governance that supports the innovation activities. As comparative study is the most important means for fully understanding the function of regional innovation systems and capturing hidden variables that are of interest to its construction (Staber 2001; Doloreux 2002, 2004, Asheim and Coenen 2005), an inter-city comparison of the governance evolutionary paths and the resulting innovation pattern between Shenzhen and Dongguan, China, will be made in order to gain these insights.

On the basis of the previous four theoretical discussions as well as empirical insights, the concluding Chap. 6 will provide answers to the key research questions.

Furthermore, the limitations of this study and future research directions will be reflected upon. Finally, policy implications for further strengthening the innovation capability in China will be discussed.

1.5 Survey Data and Evaluation

Except for Chap. 2, which applies the secondary data in Guangdong Province, China, the empirical data for the rest of the investigation (Chap. 3–5) is a set of standardized questionnaire data on electronics firms in the PRD, China. The electronics industry was chosen because it is not only dominant in the industrial structure in the PRD (Fig. 1.2), but is also facing the greatest upgrading pressure due to rapid technological advance and market change.

The survey targeted electronics firms at three different types of locations for a deeper understanding of different phases of regional development: (1) the first ring city Shenzhen, where the share of the output value is over 47% of the electronics industry in Guangdong province, and where many indigenous firms are thriving; (2) the second ring city Dongguan, where the share of the output value is over 12% and was developing quite rapidly in the late 1990s; (3) the third ring cities represented by Huizhou and Heyuan together, where the share of electronics is smaller, but is now developing due to the expanding, relocating and outsourcing activities in Shenzhen and Dongguan.

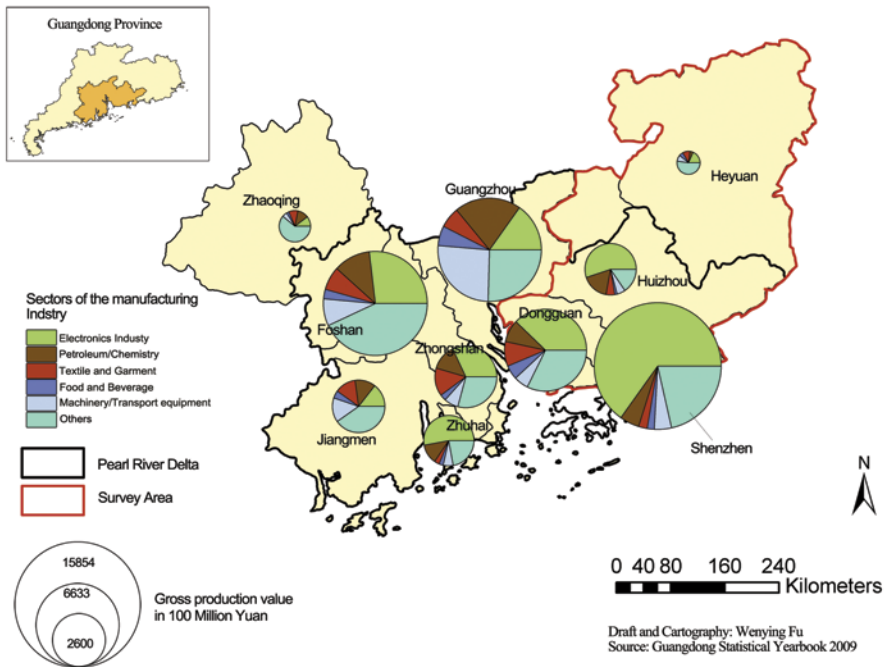


Fig. 1.2 The electronics industry in the PRD, China. (Source: Own draft based on GPBS 2009)

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Investigation into the Electronics Industry in the Pearl
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