POSITIONING CHINESE PRACTICES IN GLOBAL INNOVATION STUDIES: A LITERATURE REVIEW ON SYSTEM OF INNOVATION RESEARCH

BY

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THESIS

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ABSTRACT

This thesis offers a systematic review of the system of innovation (SI) literature, to bridge between Chinese innovation practice and global studies on innovation systems. It is developed from the standpoint of how to understand and evaluate innovation systems in China based on current wisdom. First, the Chinese innovation system, like its global counterparts, is a product of the concept that innovation is the major tool for development. As innovation becomes the center of development studies and globalization process intensifies competition between regions, places rely on SIs to stay competitive. Second, however, rationales of neoclassical and evolutionary approaches still compete within SI research, that it fails to provide with a set of concrete recommendations for Chinese policymakers to build innovation systems, and the Chinese environment in terms of culture, firm and governance structures challenges several key assumptions in SI literature. Third, the thesis categories three deficiencies in the current SI research: 1. Failed to incorporate innovation systems at different scales; 2. Very limited studies on experience outside of technologically advanced countries; 3. Overlooked the negative effect of SI development, such as the growing inequality. Then, it argues how studies on Chinese innovation systems would complement current studies.

Keywords: System of innovation; Economic development; China

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INTRODUCTION

Innovation and system, both terms are not new, even, as old as mankind itself. They seem to be the nature inherited from Homo sapiens with the tendency of working cooperatively and creatively to improve the living condition (Harari, 2014). Even when organized innovations have largely accelerated the development of the human world since about 500 years ago during the Scientific Revolution, they did not catch enough attention in academia. For a long time, capital and labor were regarded sorely as sources for development. Both theories and Chinese practices of innovation systems, the two objects of this thesis, only emerged in the last few decades.

Studies on Innovation started in the 1960s, represented by the establishment of the Science Policy Research Unit at the University of Sussex. From then, research on innovations booms, a significant number of scholar articles entangle with the concept of innovation (Figure 1) (Fagerberg, 2006). China Tried to transfer experience from Silicon Valley and Other regions to develop its own innovation systems to spur innovations for “modernization” on May 20, 1988, the day of the promulgation of *The Provisional Regulations of Beijing Municipality Concerning the New Technology Industry Development Zone* (Chen, 1980).

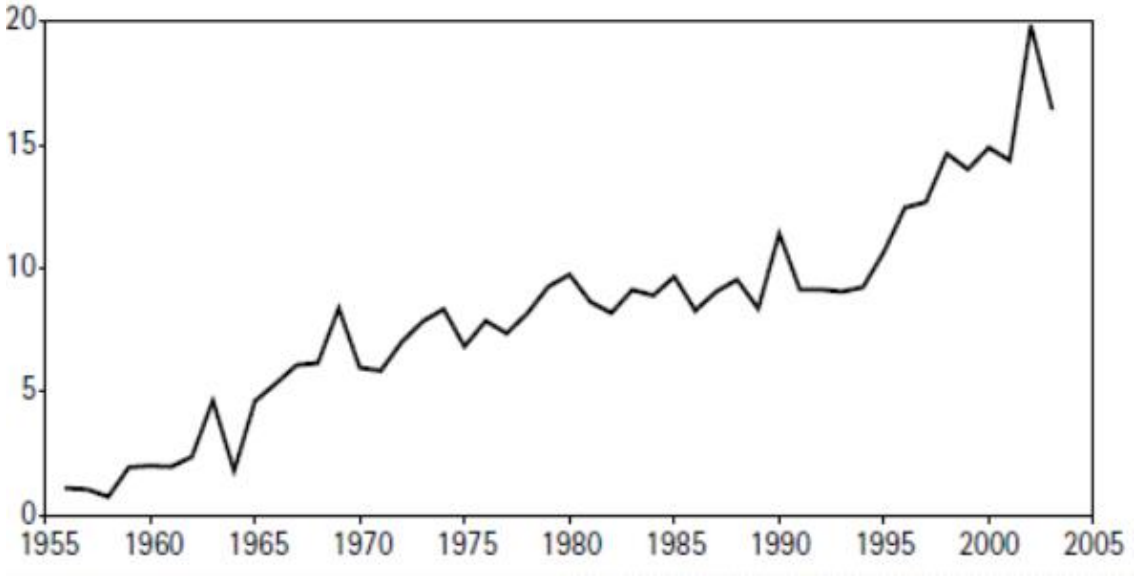

Figure 1. The number of articles titled "innovation" in per thousand social science articles
From: Fagerberg, 2006

The Chinese innovation system represents the country's rapid development. Forty years after its emergence, the national program of innovation systems (let along innovative clusters at levels of province, city, and county), High-Tech Industrial Development Zones (HIDZs), has produced 169 zones throughout China, incubated diverse high-tech industrial clusters such as information, biotechnology, and new industrial materials, and accounted for 45.1% of Enterprise R&D investment and 11.5% of national GDP. Addressing existed theoretical progress in SI studies is the first step to understand and theorize the Chinese experience of innovation development.

According to Schumpeter, "Innovation" takes the broad meaning referring to all product and process innovation, including improvements in goods and services, as well as technological and organizational advancement (Equist, 2006). The terminology, "system of innovation" or innovation system (SI) is from the evolutionary innovation theorists, that all determinants of

innovation including economic, social, institutional, technological, and historical are interconnected and influence the innovation process (ibid.). The systematic approach reflects the rise of development studies as opposed to the previous view of linear technological change, which regards innovation as the direct result of the causal relationship with the increase in scientific input. On the contrary, from SI's perspective, innovation is the result of a complex interaction between actors and institutions in the system (OECD, 1997).

This thesis dissolves the inquiry of how to understand and theorize Chinese experience based on current SI research into three smaller questions: 1. What environment in which global and Chinese SI studies and practices arise? 2. How Chinese SI may learn from recommendations SI researchers have made? 3. Will Chinese experience complement global SI studies?

CHAPTER 1. INNOVATION AS THE TOOL FOR DEVELOPMENT

It is commonly recognized that the primary driver of economic development in today's world is not capital accumulation, according to classic economists, but the innovation (Johnson, 2008). Innovation researchers do not talk about how this consensus was made, rather, directly place the practical needs at the forefront of their research (Doloreux & Porto Gomez, 2017).

The urgent needs for innovation link closely to the overwhelming pursued of "development," the concept originates from the development of capitalism in the historical process, and then refers the process through which the "Third World" try to catch up with the "First World" (Hart, 2001). The spread of the development concept relates to the colonial period (Mohan, 2010), during which the foreign concept of social development represented by material prosperity was implemented in countries like China.

Innovation was gradually introduced to be the "golden" prescription towards higher development. Economists studying development, for over a century, overlooked the role played by innovation, rather, it is regarded as something actors can buy from somewhere, and what they need to think about is to maximize the use of capital and labors. After Schumpeter in the 1940s pioneeringly finds the innovation as the mean and end of economic development, the innovation ability is regarded as to reflect the developmental potential of the place and determine its economic development, especially in the long-term (Carlsson & Stankiewicz, 1991). Facing similar development pressure, in the 1980s, China starts to develop innovation systems to spur economic development

1. The constructed concept of "Development"

Originally, the word development in the West describes the process in which an organism grows to its mature form, it could be either "successful" or "failure" form. It was in 1774, that Herder first applied the evolved biologist notion of "development"— the transformation process that results in an ever more perfect form of a creature, in into interpreting different stages of human society. The concept of development as the pattern of societal development of Western countries began to be a part of ordinary language in the 19th century. It set up a ranking for all countries according to their civilization and production levels. It travels to other cultures during the colonization period and once the concept was implemented there, the indigenous were deprived of defining their forms of social life (Sachs, 2008). Now, we are living in the age of "development" (Esteva, 1997), in which the reason behind every effort paid towards a "better life," a higher position in the ranking, was self-evident.

In the West, increasing productivity is a traditional solution for "development" that through "production" and then "distribution, and consumption of resources, and the management of state income and expenditure" the well-being and economic capabilities of a nation's residents will be improved (Oxford Reference, 2020). Western economists offer standard models to achieve development.

For Adam Smith, in his seminal book *The Wealth of Nations*, the wealth of a nation depends on its level of labor specialization.

> *"First, to the increase of dexterity in every particular workman; secondly, to the saving of the time which is commonly lost in the passing from one species of*

work to another; and lastly, to the invention of a great number of machines which facilitate and abridge labor, and enable one man to do the work of many."

(Smith 1776)

Marshall (1920) summarizes Smith's argument that the society benefits from the specialization through "differentiation" and "integration" process

"This increased subdivision of functions, or "differentiation," as it is called, manifests itself with regard to industry in such forms as the division of labor, and the development of specialized skill, knowledge and machinery: while "integration," that is, a growing intimacy and firmness of the connections between the separate parts of the industrial organism, shows itself in such forms as the increase of security of commercial credit, and of the means and habits of communication by sea and road, by railway and telegraph, by post and printing-press."

(Marshall 1920)

Development economists followed Smith expanded on his work emphasizing the division of labor to considering the improvement of "allocative efficiency," the way to produce more goods under the resource constraint (Libenstein et al., 1988). For instance, David Ricardo (1815) theorizes the production function as evidenced by English social-economic classes: working-class, aristocracy, and merchant class. Hence, effectively allocating resources of labor, land, and capital would increase a society's production.

Schumpeter brings a paradigm shift to the economic development study. Schumpeter draws a different picture of economic development—Economic development does not mean more production due to more input or intenser competition, rather, it is a fundamental transformation of an old model of economy to a new one. Schumpeter's theory is based on the modern capitalist economies, which is different from classical economists' competition theory that views the development process statically (Ziemnowicz, 2013). Schumpeter reckons that "the history of capitalism is studded with violent bursts and catastrophes" (Schumpeter, 1939) that capitalist economies evolve discontinuously. This disruptive innovation process is named as "creative destruction" in his book *Capitalism, Socialism, and Democracy*

> "*process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one*."
>
> (Schumpeter, 1942)

By observing the way in which businesses conduct that how individual entrepreneurs and corporate managers work for this dynamic economy Schumpeter found that innovation stimulus to economic development and without innovation, business survival and success are unattainable (Brouwer, 1991). For Schumpeter, innovation is the reason that opens new opportunities to take the economy to a higher growth trajectory.

> *"[I]n capitalist reality as distinguished from its textbook picture, it is not [price] competition which counts but the competition from the new commodity, the new technology, the new source of supply, the new type of organization (the largest-scale unit of control for instance) – competition which commands a*

decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives.”

(Schumpeter, 1942)

As the method towards development has been offered, The term ‘development’ is finally and firmly constructed on 20 January 1949, when Harry S. Truman, in his inauguration speech, declared the South as ‘underdeveloped areas’ and the United States as the most developed nation, standing at the top of the ladder where other industrialized nations follow (Esteva, 1997).

“We must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas. More than half the people of the world are living in conditions approaching misery…The United States is pre-eminent among nations in the development of industrial and scientific techniques…our imponderable resources in technical knowledge are constantly growing and are inexhaustible…Such new economic developments must be devised and controlled to benefit the peoples of the areas in which they are established. Guarantees to the investor must be balanced by guarantees in the interest of the people whose resources and whose labor go into these developments. The old imperialism--exploitation for foreign profit--has no place in our plans. What we envisage is a program of development based on the concepts of democratic fair-dealing.”

(Truman, 1949)

The dichotomy between developed and underdeveloped regions is created, and any democratic countries should escape from the undignified underdevelopment condition, to climb the ladder through development. Development stands as a lighthouse guiding people and governments, especially in the South, to put every effort towards and sacrifice for the only and ultimate goal of development (Esteva, 1997).

The way to achieve development was also advertised to the rest of the world.

After the above statement, Truman continued:

> *"Greater production is the key to prosperity and peace. And the key to greater production is a wider and more vigorous application of modern scientific and technical knowledge."*
>
> (Truman, 1949)

Since 1949, the message containing the relationship between technology, production, and prosperity, and the European modernity model, has been proclaimed in countless statements by both North and South nations. To innovate in science and technology promises the development and superiority over other lagged countries. By bringing innovation and development altogether, the model suggests that by the conquest of nature and persistently increasing productivity to restructure the underdevelopment areas into a predictable, and scientifically manipulable society, human happiness would be automatically produced (Ullrich, 1997). Now, governments around the world all regard economic growth, mainly means material prosperity and high quality of life, as major priorities, established a significant number of public policies stimulating innovation to promote regional economic growth (McCann & Ortega-Argilés, 2013).

2. Harmony as the Chinese traditional way of "Development"

In contrast to the idea of becoming more materially prosperous, Chinese society for thousands of years praises values such as peace, harmony, and order. At least from the Zhou Dynasty (B.C.1046), the mainstream political philosophy emphasizes much on the order and morality, saying *cultivating moral character is much more important than acquiring professional skills for the individual to be successful* (德成而上, 艺成而下). Zhou dynasty established a set of manners and rules (礼/Li) guiding towards the ideal individual, gentleman (儒士/Ru shi, Confucian scholar), and ideal society, a society with peace and order.

This system of rules encourages people to learn humanity knowledge and serve the society, otherwise, to diligently work on the farmland and raise their family. The businessman's character of chasing profit and the craftsman's skill of creating sophisticated techniques are regarded as *unique but useless* (奇巧淫记) that would possess people's minds. Thus, these two professionals rank at the lowest in society according to the traditional hierarchy based on the occupation, while the Gentleman (士/shi, refers to Confucians with willing to serve others) and the Farmer receive higher respect. In traditional Chinese society, nearly all talents work hard to be a part of the bureaucratic system, leaving really few people to become scientists or businessmen (Table 1).

Table 1. The statistics of ancient Chinese scientists from B.C. 1000 to A.D. 1840 (From Du, 1993)

Science sector	Scientist Number	Science sector	Scientist Number
Astronomy	56	Natural Geography	33
Math	36	Chemistry	6
Medicine	62	Physics	12
Agriculture	35	Engineering	45

This traditional system creating thousands-of-years stableness and prosperous, but eliminated the long-term development of innovation, collapses from the middle of 19 Century, when China's whole coast defense system faces threats from only three British warships, and its capital surrenders to 2,000 British and French soldiers. China uses the next entire century to find its modernity and most of trials fail. In 1910, an extreme and powerful revolution in thought spurred by the breaking homeland and aggressive invaders, crashed Chinese's minds, especially among educated people, that *Do not read Chinese traditional books* (Lu, 1925) and *Only science and democracy can save China* (Xu & Wang, 2015).

Innovation is perceived as a tool for development by the new republic established in 1949. China takes the USSR as the developmental model, which emphasizes the importance of innovation but performances much less innovative than western models (People's Daily, 1948-2017). Scientists were lifetime employed by the state-owned institutes and were responsible for working full-time on tasks assigned by its upper authority, that the research system has a high transaction cost as institutes' leaders is the only center of exchanging information between sectors, making plans, and assigning tasks to proper researchers. Research may be affected by political movements as well (Luo, 1981).

The Sino-U.S. technology cooperation gives China opportunities to adopt a new model, to diffuse innovation to society rather than "being locked by the institute's walls" (Zhao, 2018). When Chinese scientists were allowed to visit Western labs, they found Chinese scientific achievements lags a lot behind the global progress in the 1970s (Simon & Rehn, 1987). China starts to learn from innovation clusters to "unleash the potential of the density and quality of local talents to achieve modernizations of industry, agriculture, national defense, and science and technology" (Chen, 1980).

CHAPTER 2. INNOVATION AT THE CENTER OF A COMPLICATED SYSTEM

When the idea of "technology diffusion" was introduced to China, Chinese actors read it from a relatively simple perspective—to develop industrial districts(People's Daily, 1948-2017), because once firms clustered the positive external effect will be naturally created due to enhanced technological spill-over effect (Marshall, 1919), diversity (Jacobs), and competition (Porter, 1990). Chinese policymakers may learn from the SI approach based on its three distinctions.

"Systems of innovation" framework reads innovation as the product of interactions between institutional and organizational elements, that are related to three burgeoning research areas (OECD, 1997). First, economists' inquiry into the role played by innovation, the extent to which innovation concentrated and innovative agencies compose a regional system (Cooke et al., 1997). Second, institutional analysis, research highlighted the function of institutions in economic systems surges, 'Institutions' have also become increasingly important in innovation theory. Institutions regulate innovations' process and result, and innovations reinforce institutions or introduce new norms to existing institutional context (Cooke et al., 1998); Third, The systematic view on innovation. Different from the previous view on innovation that adopts an input-output method explaining the innovative performance as the direct result of the number of inputs, The SI approach emphasizes the innovation output depends on the performance of a networked and dynamic innovation system including actors and their interactions (Edquist, 2006).

1. Innovation: from periphery of production to the center of economic development

The innovation factor is gradually introduced to economic development theories. Initially, development is regarded as can be easily achieved by using capital more smartly. Then, Schumpeter's reframing illustrates that drastic innovation destructively leads economies to a new stage that sharply different from the former in terms of a group of indicators including productivity, average income, and the quality of goods, services, and life.

During the late 19th century, post-Smith economists further developed production function where they first addressed fixed capital-to-labor ratios to explain the relationship between input and output. In 1888, American economist John Bates Clark discovered marginal productivity theory in which the capital-to-labor ratio varies and the marginal return diminishes when one input increases (Gordon & Vaughan, 2011). This is very close to the famous Cobb-Douglas function (1928): $Y=ALK$. In their paper, although allocation between capital and labor remains their major concern. What they discovered as the constant "A" in their function, indicates that the productivity relates to, besides labor and capital, the technology that is applied. Technology consisting of the knowledge to transform primary inputs into final utilities could directly increase the final output.

In the 1950s, neo-classical economics regards innovation as an exogenous indicator, that firms take given technologies in production. In the Solow Model, increasing capital to labor or labor to capital will result in consecutively smaller increments in output, while the cost of capital or labor will rise (Solow 1957). The model implies that the long-run growth cannot be sustained by capital accumulation alone. Also, the constant pressures of equalization of product prices and factor incomes among regions will easily enable poor countries to grow faster to catch up with

their richer counterpart But this cannot explain the growing global inequality, where the richer countries become richer, and the poorer become the poorer.

The next generation neo-classical economists, represented by and Lucas, Romer, and Krugman develop Solow's model by adding technology as a former element in the model. They emphasize that technology act as a distinct form of capital which leads to a permanently higher rate of productivity growth (Howitt & Aghion, 1998). Lucas (1988) regards technological progress as an unforeseeable factor, resulted from the external effect of human capital, and functioning on firms' overall productivity. Romer's (1990) AK model deals with innovation as an indigenous variable. There is a "learning-by-doing" process in the AK model that innovation comes from firms' operation, firms can use knowledge to raise efficiency and raise the marginal product of capital. Krugman (1995) further relaxed assumptions to model the growth of agglomeration in terms of disequilibrium and cumulative causation. However, these models although pioneer by quantitatively incorporating innovations in theory but fail to account for firms' institutional, technical, and investment change over time (Freeman 1994).

Schumpeter views innovation sharply different from the above economists. For him, it is the entrepreneur that sits at the center of his innovation and economic development theories, who challenge the existing system and create a new by destroying the old (Foster & Kaplan, 2001). The daring entrepreneur produces economic development and the quality of entrepreneurship that define the quality and speed of innovation and growth. In his book published in 1934, "The theory of economic development," Schumpeter described entrepreneurs as "the agent of innovation" and "the pivot on which everything turns" (Schumpeter, 1934).

In Schumpeter's view, entrepreneurship and innovation are two sides of a coin. Entrepreneurs find opportunities and innovate, and innovation commercializes the new idea and

defuse the benefit to the whole system (Feldman, 2016). He seminally establishes a text-book definition of innovation that broadly refers to new production processes, new products, new materials or resources, new markets; new forms of organizations (Schumpeter, 1934). Either one or the combination of them could be regarded as an innovation.

Based on this approach, entrepreneurs are not only motivated by the innovation's profitability but more importantly "the joy of creating" that takes them to a new and "private kingdom" (Schumpeter, 1934), and entrepreneurial firms do not compete through price and quantity, but improving technology, finance, and organization, seeking profits from a new boom of their products in the market (Leonard, 2009). All firms organize and finance to produce products for their target market, but there are sharp differences between strategies of *optimizing firms* and *innovating firms* (Lazonick 2006). In the past, theories mainly focus on optimizing firms which operate under the principles of traditional economic theories that seek the maximization of profits based on given constraints, including applicable technologies or market conditions. In contrast, innovating firms look for "historical transformations" to change those conditions that optimizing firms regard as constrains, by seeking opportunities for organizational or industrial innovations (Lazonick, 2002). Penrose (1959) argues that it is the innovative experience accumulation that enables innovating firms to have the expertise of reshaping productivity and taking advantage of new opportunities to avoid cost increasing and profit decreasing that limit the firm's growth. The concept of "core competence" lies at the center of innovating firm's capability of achieving its intended result. Innovating firms would have over five "core competencies" backed by distinct "hard" technologies to stay competitive (Prahalad & Hamel, 1990).

For societies entering the era of "New Economy" from the "Old Economy," Innovation is playing a more significant role. In the new economy, technology is both means and ends for production, since the development of a firm or society is not based on the use of scientific and technological knowledge, but the exploitation of old knowledge to create new knowledge (Norton 2000). The production process is decentralized and networked (Castells 1997), as the economic return for firms depends on invention and information sharing which Johnson (1992) calls 'creative forgetting', to leave the old knowledge and welcome the new. Keller (1998) distinguishes rules for old and new economies (Table 2).

Table 2. Rules of Old and New Economies
Source: Kelly (1998)

Dimensions	Old Economy	New Economy
Production	Centralized	Decentralized
Firm's strategy	Maximize firm value	Maximize network value
Innovation	Incremental innovation	Disruptive innovation
networks	Place proximity	cyberspace
Technology	Machine-focused technology	human-focused technology
Profit	Constant return	Increasing return
Cost of improvement	Rising price	Falling price
Value	Value Scarcity	Value Abundance

2. Institution: informal conventions become more important

Early evolutionary theorists who introduced the SI approach such as Freeman (1987), Lundvall (1992), Nelson (1993), and Edquist (1996), all identify the innovation-supportive environment as an important factor that helps innovation actors interact with each other and plays a key role in enabling firms to be innovative and systems to stay competitive over time (Uyarra, 2010).

The performance of an economic system rests upon the set of distinct institutions that jointly or individually "contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process" (Metcalfe, 1995). SIs should develop their institutions along with the following three dimensions: 1. Stronger absorption of new knowledge and innovation to reach the local demand; 2. More efficient diffusion of innovations throughout cooperative work among all actors; 3. Greater capacity in new knowledge generation (Nelson & Winter, 1992). Archibugi and Filippetti (2015) summarize critical institutions in an innovation system as six indicators: innovation and technological capabilities, openness, infrastructures, education, political institutions, and social cohesion.

It is well recognized that informal channels play an important role in strengthening formal collaboration in and economic performance of an innovation system (OECD, 1997; Hawkins et al., 2016). In the knowledge economy, the speed of communication determines the competitiveness of the system (Cooke, 2002). Thus, the highly frequent interactive learning among actors in an innovation system requires minimal transactional cost (Lazaric & Lorenz, 1998). The spatial proximity offers one solution that start-ups choose to stay in the industrial cluster as an incubator (Cooke, 2002). The institutional change is another, for reducing the uncertainties involved in interactions (North, 1990). As a complement to the formal institution, the informal institution, the reciprocative and cooperative conventions supported by trust and social capital plays a key role in successful regional development (Martin, 2000).

The use of social capital composes a significant shift. It facilitates a more comfortable environment in an interaction comparing with the antagonism under the regulation of "formal politics" (Cooke, 2002); It also alters the centralized and vertically integrated interaction mode to

a more decentralized and networked mode (Henton et al., 1997). The encouragement of horizontal interactions between different professionals acts as the catalyst for innovation and economic development (Jacobs, 2000). In high-tech industries, such as telecommunications, biotechnology, ICT, and new media, where the production primarily relies on synthetic knowledge, firms cooperate at a large scale and production is achieved through temporary networks, in which actors work on each piece of out-sourced projects and cooperate via the internet. It requires a set of more efficient informal rules within the network (Cooke 2002).

3. System: the Complexity of the Innovation Process

The term system refers to "complexes of elements or components, which mutually condition and constrain one another, so that the whole complex works together, with some reasonably clearly defined overall function" (Fleck, 1992). The system has three characters: the system's function, its components and relations among them, and a boundary to discriminate it from the outside of the system (Ingelstam, 2002; Asheim et al., 2011). It is clear that the function of SI is creating innovation. SI researchers study the complexity of different types of actors and their relationships in an innovation system mainly at the national and regional levels.

3.1 Networked Actors in the System

SI approach first comes up with the argument that there are actors and factors other than firms that play vital roles in the generation and diffusion of innovation. The pioneering SI researcher, Freeman (1987) Freeman reviews components of Japan's SI, and identified four agents involved in the production of innovation: The Ministry of International Trade and Industry (MITI), company R&D, social innovations, and the structure of the industry. Lundvall (1992) theoretically classifies all elements supporting firms' innovation in the NSI, including

financial and legal agencies, research and education systems, administrative branches, innovation policies, physical infrastructures et al.

SI approach also reads the innovation process in a complex way. The linear view on innovation adopts an input-output method—standardizing the innovative outputs and inputs as indicators such as number research expenditure, and explaining the innovative performance as the direct result of the number of inputs. It just snapshots two stages of the whole innovation process and thus the plain explanation of innovation and development is unconvincing. "Innovation nowadays is an assemblage, including the new knowledge emergence and diffusion, as well as commercializing it into new valuable products" (Edquist, 1996). Autio (1998) divides an "SI" into to subsystems: knowledge generation subsystem including actors such as vocational training organizations, laboratories, and technology transfer agencies; and knowledge exploitation subsystem which commercializes new knowledge through firms.

Beyond the complexity of the innovation process of each innovator, they also innovate in a networked form. As the growth of knowledge-intensive industries, sources of knowledge are widely distributed that no single entity has the capacity to have all knowledge to innovate and stay competitive. Because innovation is still crucial to improve competitive position, collaborative networks become the major mean of innovation (Powell & Brantley 1992). "Firms almost never innovate in isolation. but through a network involving multi firms, or even more institutes such as universities, governments" (Edquist, 1996). Also, "innovation occurs at the boundaries between mindsets, not within the provincial territory of one knowledge and skill base" (Leonard 1995). The diversity of collaborators in a firm's network allows it to have a wide range of knowledge stock, which added opportunities for the firm to innovate that it will have a better chance to survive in the rapidly changing industry (Beckman and Haunschild 2002).

Actors networked in various ways as well. Asheim (1998) distinguishes three types of SI at the regional level. The first type of SI is *territorially embedded regional innovation systems* or in Cooke's terminology, "grassroots SI" (Cooke 1998), in which firms' innovation comes from localized learning from other firms in the cluster, but the interactions with knowledge organizations are limited. The second type of SI, *regionally networked innovation system* has a more planned character— policy interventions intentionally strengthen the region's institutional infrastructure and encourage collaboration to increase regional innovation capacity, and both firms and organizations characterized by localized and interactive learning are embedded in the region. The regionally networked innovation system results from policy interventions and is the ideal type of SI, regionally clustered firms surrounded by supporting regional and institutional infrastructure, such as vocational training organizations or local R&D institutes (Asheim & Gertler 2006). This "network SI" is most typical in Germany and Nordic countries (Cooke 1998). The other SI type is called *regionalized national innovation system*, where the SI is integrated into national or international innovation systems that interactions with exogenous actors play a larger role in regional innovation. "Science parks" exemplifies this type of SI, where innovation is based on interactive learning within science parks themselves but rarely with local firms (Asheim & Cooke 1998).

3.2 Innovation at National and Sub-national Scales

Initially, SI researchers studied the innovation system at the national scale. Lundvall first introduces the idea of "national system of innovation"(NSI, Freeman, 1995). However, the expression was first published by Freeman in his book of analyzing the relationship between Japan's economic performance and its SI. The orientation of the NSI framework has been to carefully present and compare between innovation systems in different countries, and try to

understand before reaching a theory (Nelson & Rosenberg, 1993). The demonstration of the need for developing a new development theory centered on interactive learning and innovation as an alternative to the neoclassical economics tradition is another fact drives the emergence of the SI approach (Lundvall, 1992)

Later, concerning the complexness of analyzing SI at the national level, researchers start to study SI at the regional level to be more conceptually and methodologically accurate (Cooke et al., 1997). The regional innovation system (RIS) acknowledges the major contribution of NSI research, but derives from it to avoid the distortion and loss of information in NSI which hypothesizes a homogeneous innovation system at the national scale—the highly uneven pattern of innovation across the nation suggests a better direction of depicting innovation at a subnational level (Morgan, 2004). “Region” is a meso-level unit set between the national and local levels, which is a cultural or historical homogeneity that has statutory powers to generate innovation and support economic development within the region (Cooke, 2001).

What RIS added is the spatial proximity’s role in a SI. Because a great part of knowledge, tacit knowledge, “is best shared through face-to-face interactions between partners who already share some basic commonalities: the same language, common ‘codes’ of communication and shared conventions and norms” (Asheim & Gertler, 2005). the clustering of economic and innovation-oriented activities “the more knowledge-intensive the economic activity, the more geographically clustered it tends to be” (ibid.). RIS assesses the appropriate regional economic trajectory, compares a region’s performance among systems; and finds out a region’s structural problems to prevent lock-in effect (Cooke & Morgan, 1998).

CHAPTER 3. COMPETING RATIONALES IN SI GOVERNANCE

While the "systems of innovation" approach regards innovation as the center of a complicated network, rather than an accessional product of firms' operation in neoclassical economists' explanation. Policies get limited knowledge from SI research besides supporting individual firms in the form of R&D subsidies (Nauwelaers & Wintjes 2002). "Systems of Innovations" is a conceptual framework rather than a formal theory. The absence of well-set empirical regularities makes it hard to formulate conjectures for empirical testing. (Edquist, 1997). Much SI research just offers inventory-like descriptions of a system, focusing on existing actors and institutions (Uyarra, 2010).

A form of this theoretical ambiguity is the existence of two competing rationales supporting current innovation policies based on neoclassical and evolutionary theoretical foundations (Lundvall & Borrás 2006; Metcalfe, 1995; Verspagen, 2006). From the standard neoclassical economics on innovation, which emphases on non-interventionism, the "laissez-faire" version of innovation policies adopted by Liberal market economies (LMEs) like the U.S. and UK take build frameworks for firms to fully compete and "pick the winners" at the end. Conversely, coordinated market economies (CMEs) including Japan and Germany select the "systemic" version of innovation policy which actively involves in the innovation process to fix institutional failures and facilitate linkages between firms within the innovation system (Lee & Yoo, 2007).

For the transforming Chinese economy, from a planned to a market-oriented economy (Sun & Liu, 2010), the vague SI analysis offers recommendations going to divergent ways (Edquist, 2006). According to the classical economics tradition, government intervention can

only lead to the sub-optimize economic result, while the market mechanism leads to the optimize, that spurring innovation requires free entrepreneurs from state intervention. However, the systematic view on innovation argues for the intervene as long as systems fail to be actively open to change (Howells, 1999). More importantly, the reciprocal relationship between regional institutions and regional industries reveals the concept of co-evolution, which claims the actively evolving institution to fit the dynamism of regional economies and to prevent the region from locked-in (Nelson, 1994). This perspective echoes with the balanced growth doctrine in development planning studies (Nurkse, 1953; Mao, 1956), which requires an active state to directly participate in innovation and to regulate and intervene in the operation of SI.

Although these two theoretical perspectives have sharp differences in explaining innovation and policy implications, scholars have not fully reached the agreement that which is the way to study innovation and to propose policy recommendations. For example, evolutionary SI researchers sometimes have a neo-classical view on innovation—adopting the input-output model in analyzing the innovative capacity (Nelson & Rosenberg, 1993) or supporting market-led or incremental innovations in regional development (Lundvall, 1992).

In practice, some research reveals that regions that adopt the neoclassical approach prizing personal control and autonomy have better economic performance, compared with places that dominated by a collectivist culture (Kyriacou, 2016). But empirical studies also suggest that firms' embeddedness with the local economy through social capitals, such as family ties, have a greater chance to sustain (Polanyi, 1944; Granovetter, 1985). The explanation of innovation development patterns in different countries shows more divergence. One perspective argues that CMEs, compared with LMEs, are more likely to specialize in incremental innovation but fail behind in terms of radical innovation (Sorge, 1991; Hall & Soskice, 2001), as the government

has a strong role in organizing the research and industrial performance that suppresses entrepreneurship (Landes, 2003). Conversely, the other perspective reckons that radical innovations do not happen spontaneously in the market mechanism. Interventions, including policy support and public funding, are crucial especially in the early stages of the development of radical innovations (Edquist, 1999)

1. Producing Innovation in the Neoclassical Approach

The central of neoclassical economists' argument is against the government's intervention in firms' production process, including innovation, that nearly has never changed since Adam Smith.

1.1 The "laissez-faire" innovation creation and governance

For Smith, the innovation looks like a natural product of specialization:

> *"All the improvements in machinery, however, have by no means been the inventions of those who had occasion to use the machines…..Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by that of those who are called philosophers or men of speculation, whose trade it is not to do anything, but to observe everything; and who, upon that account, are often capable of combining together the powers of the most distant and dissimilar objects."*
>
> (Smith, 1776).

He relies on the "invisible hand," that individuals' pursuit of self-interest through the personal choice of work and capital allocation, to explain the way in which the specialization will be integrated into the beneficial outcome for society. Trading will encourage experts to produce different innovations (Smith, 1776). Thus, he opposes government interventions which, back then, refers to those mercantilist arguments, such as restriction of free trade by duties, or even the prohibition of the importation of goods from foreign countries that could be domestically produced (Sun, 2005).

> *It is the great multiplication of the productions of all the different arts, in consequence of the division of labor, which occasions, in a well-governed society, that universal opulence which extends itself to the lowest ranks of the people. Every workman has a great quantity of his own work to dispose of beyond what he himself has occasion for; and every other workman being exactly in the same situation, he is enabled to exchange a great quantity of his own goods for a great quantity, or, what comes to the same thing, for the price of a great quantity of theirs. He supplies them abundantly with what they have occasion for, and they accommodate him as amply with what he has occasion for, and a general plenty diffuses itself through all the ranks of the society*.
>
> (Smith 1776)

From Smith, the most important role of government is to maintain the reinforcement between the division of labor and the exchanges of secured property, two fundamental pillars of civilized society (Whately, 1832). Also, investment in education to increase the benefit of

specialization and cultivate martial spirit to compensate for the cost of the division of labor in commercial society (Smith, 1776).

Theorists that followed added other dimensions. Ricardo (1817) emphasizes the quality of labor. Then, Marshall (1919) points out that firms enjoy technology spill-over effect once they are in an industrial agglomeration. Innovation is treated as an ordinary exogenous variable to be easily purchased (Cooke, 2002).

Current Neo-classical theorists, represented by Arrow, Lucas, and Romer, regard the competition leading to the falling of profit rate as the driver of innovation. Firms tend to invest in R&D to offsets the decrease (Grossman & Helpman, 1991). Each of these innovations produces new knowledge available for the whole economy, which increases the overall productivity and leads to development (Romer, 1990). While this rationale characterizes the R&D process as less uncertain. They rely on a "linear" innovation which assumes the sufficient support of Firms' R&D, and the innovative input would translate into successful innovations that meet the market demands (Braun, 2008). "More tickets for the R&D lottery can be bought by doing more R&D" (Verspagen, 2006).

The neoclassical economist approach describes a simple way to advance innovation. For individuals, the locus is the adoption of a positive attitude towards novelty, and the bravery to discard past knowledge and restrictive traditions (Brouwer, 2008). For firms, Learning-by-doing should be reckoned as the central in securing the core competencies, the more learning capacity the firms have, and the more diverse skills and technologies applied production, the more competitive the firm will be (Lawson, 1999). The government should stay away from the operation of the market, once it has been created and maintained the regulation such as protecting property rights or providing infrastructure (Dixit, 2008). Government intervention is

strictly limited, being legitimacy only when the market failure needs to be adjusted and the state has the ability to mitigate it (Edquist, 1999).

1.2 Critics to the Neoclassical Approach

The neoclassical approach quantitatively models innovation in economic development. It gained strong analytical consistency while lost a significant amount of details of the actual innovation process (Verspagen, 2006). The neoclassical approach is criticized for having a static view on society, the market usually stays equilibrium and rarely fails in classical economics models. However, in reality, once adopted a historical view on economic development, the "laissez-faire" approach is questionable.

The neoclassical rationale is insufficient in three ways. First, the learning-by-doing approach they proposed defines the innovation process as cumulative and path-dependent—The routines of today are based on those of yesterday, as much as those of tomorrow are related to those of today (Nelson & Winter, 1982). It cannot explain the discontinued and radical innovations, which lie outside given trajectories but are Schumpeterian's major source of economic development (Freeman & Perez, 1988). Second, their theory leads to market failure. As a large part of the innovation's benefit goes to the public, not the private, firms will have less incentive to invest in innovation that the overall R&D investment will be low from the social perspective (Verspagen, 2006). Third, it fails to incorporate the cooperation and the complexity of relations between firms (Ahrweiler, 2010), if the competition is the sore mechanism.

It fails to explain reality as well. The equalization of regional product prices and factor incomes predicted by traditional classical theory never achieved, the poor region stays poor (Eckaus, 1987). There is no evidence to convince how poor regions can benefit from the fast

development of rich regions (Higgins, 1983), as what 'growth pole theory' expected (Perroux, 1955). The increasing returns to scale effect on the production of non-traded intermediate inputs were introduced to explain the geographically uneven development, that rich regions with better non-traded resources, such as physical infrastructure and technologies, will increasingly enjoy the goods with better quality but lower price, and the gap between the poorer regions and richer regions enlarges (World bank, 1983; Faini, 1984). To break the negative-feedback process actors of "follower regions" need to intervene in the market mechanism (Almeida et al., 2008)

2. Synthetizing Innovation in the Systematic Approach

Evolutionary scholars' research reveals that economies transit through critical "stages" (Lewis, 1956). Societies develop continuously but slowly in different stages but dramatically and quickly when a new stage is coming (Kuznets, 1966). The understanding economic development as a process requires a strong role played by the collective, or its representative the regional government (Cypher & Dietz, 2008), to assist market and society preparing for rapid social transformations (Khan, 2007), which require 'big push,' coordination across sectors, to push the economy out of old trajectory and into a 'take-off' towards the new stage (Tan, 2008). Because individual firms motived by short-term profit do not have the incentive to invest in the radical change with the highly uncertain result (Feldman et al., 2016)

2.1 Creating Innovation in the System

The evolutionary worldview opens to the complications and space-time variation in the innovation process (Cooke, 2008). Evolutionary theorists view innovative activities as being embedded in networks, in which institutions guide actors' cooperations (Block & Keller, 2009). Even in decentralized societies, innovative organizations are encouraged to in networks (Schrank

& Whitford, 2009). Evolutionary theorists first focus on two machines in the innovation process: ways that introduce novelties into the system, and give feedback to the generated innovation (Edquist, 1997; Nelson, 1987).

For the first question, the systematic perspective finds that organizational learning creates innovation by combining diverse knowledge, but the learning is difficult due to the strong resistance to change the routine (Lawson & Lorenz, 1999). Entrepreneurs gain and commercialize innovative ideas based on their access to professional and local networks (Klepper, 2002). Jacobs (1969) observed the similar observation that breakaway firms tend to be the most innovative in a cluster. For an innovative firm, apart from the important role played by the entrepreneur in the firm, the CEO (Deschamps & Nelson, 2014) its internal governance structure and outside market structure significantly affect its innovation performance (Calderini et al., 2003).

Compared with the neoclassical perspective, the evolutionary perspective argues that to be innovative, firms and regions need to augment their ability to accumulate and utilize knowledge through restructuring (Raco, 1999). This new idea links to the concept of "social capability" and "technological congruence" (Iammarino, 2005). The first concept relates to the entity's ability to participate in the innovative process in a network, and the second determines the distance of the entity from the innovation frontier, or, its capability to transfer the diffused innovation (Fagerberg et al. 1994).

The evolutionary inclination highlights concepts of relatedness (Frenken et al., 2007) and path dependence (Martin, 2010) drawn from economics theories, that significantly influence the innovation performance of a region.

Relatedness emphasizes the complexity of interrelated factors and relations between them in both innovation creation and economic development processes (Frenken et al., 2007). The belief here is that Evolutionary theorists generally consider three systemic features in a complex system: the number of inside actors, the density of internal links, and the system's connections with the external environment (Bunge, 2000), as well as to measure the interdependencies and embeddedness in the system (Frenken, 2006), such as the social and political conflicts between actors in both public and private sectors (Dutton et al., 2012).

Path dependence enquires the dynamic of relations within the system that is expected to change over time (Cypher & Dietz, 2008). It argues for a turbulent growth pattern because the old innovator who wants to secure its monopoly position by blocking competitions would be destroyed by the new innovator (Patel & Pavitt, 1997). Grabher (1993) comes up with three types of lock-in: functional lock-in, denotes the situation in which firms would not stow away its sunk cost, for instance, relationships with current customers and suppliers, that they resist changing; cognitive lock-in, refers to firms' bounded rationality that limit them to look beyond their current applied technology, business model or market; political lock-in, happens when the political system or policies support the firms but effectively exclude start-ups, which will bring the whole system to a dead-end.

SI researchers with the evolutionary perspective argue for solutions to prevent regions from to be trapped by lock-in (Martin & Sunley, 2006), by socially construct a more open and innovation-friendly institution (Garud & Karnøe, 2001).

2.2 Governing systematic failure

The governance concept does not only refer to a top-down regulation from the government, but more nuancedly, strategies taken by individuals, organizations, and governments to deal with innovation (Rickne & Laestadius, 2012). From the planning perspective, this section writes from the perspective that the way governance reflects the coordination between state and social actors to reach a consensus and promote policy that can be credibly taken to represent the public interest (Frischtak, 1994; Bratton & van de Walle, 1992).

Theories supporting outside interventions in the creation of innovation are clear (Evans, 1992; Wade, 2004). The Wahington Consensus highlighted the stable government, appropriate policy, and orthodoxy public management at the core of development (Williamson, 1994). Institutions and economic policies were regarded as major factors accounting for the differences of wealth among nations (Olsen, 1996), and the economic outcomes significantly depend on the quality of institutions and governance (Dixit, 2008). The close relationship between innovation and growth calls institutional factors to mitigate conflict between the actors in innovation progress and create incentives for creating and adopting new technologies (Durlauf & Blume, 2008).

The evolutionary perspective underlines systematic failures resulting in firms being less innovative and competitive. There are six systematic failures that will impede the firms' innovation process, and each of them could be mitigated by outside intervention: 1. Capabilities' failure, Lack of competencies and resources to access knowledge/information; 2. Infrastructural failure, shortage of physical and knowledge infrastructures caused by the low return of the investment for private investors; 3. Hard institutional failure, defect of formal institutions such as laws that impede collaboration; 4. Soft institutional failure, Absence of informal institutions

including social norms or entrepreneurial spirit, that impede innovation; 5. Strong network failures, Too Intensive interaction within networks leads to the lack of new idea infusion; 6. Weak network failures: Too limited interaction within networks that inhibits interactive learning (Coenen et al., 2018).

Unlike the doctrine neoclassical economic approach arguing that the only legitimate and necessary policy intervention is to adjust the market failure, the systematic approach justifies a pro-actively public intervention (Coenen et al., 2017).

The systematic view does not deny that to be more innovative means to have more chance of failure, no matter how the innovative entity is structured—while facing radical innovations, markets, systems, and states, and governance all fails (Jessop, 1998). What the system can do is to coordinate individual strategies and reduce the likelihood of failure (ibid).

Adequate "initiatives aiming at promoting innovation within the institutional context and those aiming at changing the institutional context in order to promote innovation" would solve the institutional failures and bring innovations (Lundvall & Borrás, 2006). Thus, in the systematic approach, government "hard" interventions, such as administrative directions or taxes give away to "softer" interventions, for instance, consensus building or public-private partnership. At the operational level, it is translated into a strategic mixing of policies, or "policy mix" (Flanagan et al., 2011) to encourage actors in the system to come up with an integrated development agenda (Kivimaa & Kern, 2016). The policy toolbox of "policy mix" covers regulatory, financial, and soft instruments, which are often referred to as "sticks," "carrots" and "sermons" (Bemelmans-Videc et al., 2003).

Moreover, the role of governance is highlighted by the systematic approach. Firms in the post-Fordism competition need the innovative culture supported by regional governance capacity to stay at the forefront of innovation (González & Healey, 2005). Public funding crucially supports the R&D activities in ICT and Biotech industries, and creates successful clusters such as Silicon Valley (Nelson, 1959; Saxenian, 1994). It is important to reform universities to make them key actors to support regional economic and innovation development (Pugh et al., 2016), or support industries around research institutes to increase their "absorptive capacity" and use mass media as a tool to lead public discourse and increase participants (Werle, 2012), because otherwise the innovations from universities are likely to end up in labs if surrounding regions lack the capacity (Christopherson & Clark, 2007).

OECD (2009) distinguishes the governance models of Neoclassical and Systematic approach and classifies into seven categories (Table 3).

Table 3. Role of regional innovation agencies in different theoretical perspectives
From OECD (2009a)

	Neoclassical	**Systematic**
Place of agency	Outside the system	Actor in the system
Role	Top-down resource provider	Facilitator, node in the system
Rationale for intervention	Market failure	System failure, learning failure
Mission	Redistributing funds	Identifying and reinforcing strengths in the system
Instruments	Isolated	Policy mix
Control mechanism	Administrative and financial	Strategic, goal-oriented, additionality
autonomy	Restricted to execution	Expanded to strategic decisions

Amin and Thrift (1994) introduce the concept of "institutional thickness," a framework that can quantitatively evaluate a region's development capacity in terms of its actors,

institutions, and interactions. First, the existence of a multiplicity and diversity of organizations is important (Cooke & Morgan, 1993). It is the condition of archive enough knowledge and qualified related variety for generating and absorbing innovation (Healey et al., 1995; Frenken et al., 2007); Second, the stable and high level of interactions between actors (Healey et al., 1995; Amin & Thrift, 1995) and smooth flow of innovation and people (OECD, 1997), which is both the mean and end of the social atmosphere of trust (Raco, 1998); Third, a shared imagination of the region's future developed collectively (Healey, 2002), and the existence of a leading agency to "minimize sectionalism" and facilitate coordination (MacLeod & Goodwin, 1999).

2.3 Critics of the Systematic Approach

The systematic approach argues for theorizing innovation in reality and braces the complexity of the innovation process (Nelson & Rosenberg, 1993). However, the complexity also brings ambiguity and fails to build a theoretical framework incorporating different experiences — theorists' contributions to this area are more loosely connected (Verspagen, 2006). Also, the SI approach fails to serve as a foundation in helping and guiding policymakers to develop better policies and support an innovative environment (Doloreux & Porto Gomez, 2017). Most SI researchers identify SIs' character of the regional differences and focus on detailed descriptions of the systems such as their actors and institutions, arguing there is no one-size-fits-all SI model and policy. But seldom researchers go a step further—"how can system of innovation (RIS) research handle the challenge of both developing coherent theoretical categories and developing policy strategies for building a system of innovation (RIS) (Doloreux & Porto Gomez, 2017)?" Also, if it is not followed by investigating, what are functions, roles, and relationships in the system (ibid.).

The problem can be mainly attributed to the little known about the “innovative act” itself (Cooke, 2013). It is clear innovation comes from entrepreneurs, but questions remaining such as, how do they innovate, why some organizations are more innovative than others, how to practically create an environment for innovation. Storper (1997) thinks dominated innovation research focuses much on traded relationships such as market relations (user-producer linkages) or technology transfers (university-industry relations), but overlooks untraded relationships which invisibly bond interdependencies together in a system. Thus, current policies that sought to shape a system of innovation, often success in generating economic growth, in terms of employment or income level (Castells & Hall, 1994), but fail to develop a network in which firms interactively deal with collective problems (Cooke, 2002).

In all, the systematic approach is far from a satisfactory one. Innovation policy needs an evolving SI research to help it build a strategic framework to ensure sustainable development. (Lengrand et al., 2002).

CHAPTER 4. CHINESE EXPERIENCE IN THE FUTURE SI RESEARCH

What the lack of solid SI theory in practice is: on the one hand, economic development policies have come been presented by "successive waves," each representing a distinct phase with different theoretical logics and political intentions (Blakely & Leigh, 2013). On the other hand, the translation from SI theories to practice is difficult. For example, the "institutional thickness" framework supports that innovative regions should have a thick knowledge stock. In reality, the effect of policies aiming at introducing knowledge-intensive employment (Harrison, 1978) or "creative class" (Florida, 2002) is facing great challenges (Peck, 2005). Also, public funding is commonly regarded as a key to incubate innovative start-ups. But there are various ways to fund innovation, that it could go to individual entrepreneurs, clusters, or industries (or the subfield of industries), or to subsidies the process or result of innovation (Clayton et al. 2019, Nauwelaers & Wintjes 2002). SI researchers may further ask which is the most effective mechanism?

In this section, I summarize current SI research's deficiencies into four categories: the limited scope on specific geographical scales, regions, and historical experience, as well as limitations on thinking about SI's negative effect. I think, because of the contextual uniqueness of Chinese innovation systems, the study on them may effectively respond to the above issues.

1. A boundarylessness Innovation System

I call the first limitation as the scale deficiency, referring to that SI research did not offer a "standard theory" of innovation systems, rather, stratifying systems into at different scales—levels of sectoral, regional, national, or global (Binz & Truffer, 2017).

In innovation systems, mechanisms that lead innovation are the same of different relating to the spatial scale (Lorenzen, 2005). What fundamentally differs them and by what mechanism? Iammarino (2005) argues that the innovation system at the national level cannot be considered as the simple sum of regional systems, that at least interactions between regional systems need to be included. But what are interactions/relationships between networks working at different levels remain unanswered. Empirical studies conclude that regional factors play an important role resulting in the different performance of innovation systems (Martin et al., 2017), and local governance actively promotes local economic development (Howells, 2005). Bennet and McCoshan (1993) think that the national-support system is weak at the local scale as it is centralized and deficient. But Carrincazeaux and Gaschet (2015) find that national institutions, rather than regional, play as fundamental importance in shaping regional configurations. Also, firms stably anchored in the national institutional systems are the most innovative actors (Werle, 2012). The problem is not innovation system at which scale works best, but to utilize studies on sectoral, regional, national, and global innovation system, to build an overall framework on the system of innovations (Chung, 2002).

The concept of SI does not necessary to have a spatial attribution to classify which level of SI, rather than the other, a firm is belonged to. The definition of an innovation system is defined in terms of the flow of knowledge rather than the flow of ordinary goods or services. (Carlsson & Stankiewicz, 1991).For a firm, its network refers to “a close set of selected and explicit linkages with preferential partners in a firm's space of complementary assets and market relationships” (Camagni, 1991). Organizations will connect to any actors in their network to quickly build new competencies. The extent to which they attract resources from, from the

region to the globe, depends only upon its absorptive capacity (Cantwell & Iammarino, 2003). The System of innovation should be dynamic and boundaryless.

When promoting regional development, it is challenging to consider poising local innovation systems towards a SI at a larger scale, towards regional, national, or global (Rickne et al., 2012).

Because for many firms, their markets are already international, not mention national (ibid.). Both local relationships and "global pipelines" determine firms' innovative performance (Bathelt et al., 2004). In some regions, firms tend to decouple from the local network and search for foreign complementary capabilities (Asheim & Herstad, 2005). The challenge is balancing resources that regional innovation formation process needs with what being incorporated into a larger one requires (Rickne et al., 2012). Such as to make a clear distinction between the local network dominated by local informal norms with the outside market regulated by laws—an overly strong regional network can make the region isolated from the world (Cooke, 2002).

In China, policies from the Central government play a key role in the development of different levels of SIs (Sun &Liu, 2010). While, in SI research, the relationship between an SI at regional and national scale remains unclear. On the one hand, the concept of regional innovation system (RIS) derives from the concept of the national system of innovation (NSI), defining a SI at the regional scale— "the localized network of actors and institutions in the public and private sectors whose activities and interactions generate, import, modify and diffuse new technologies within and outside the region" (Howells, 1999). On the other hand, scholars argue that an NSI cannot be reckoned as the sum of its RISs (Holbrook 2005), otherwise, the interactions between RISs would be missed, "a country's innovation performance will depend not only on how it performs on each element of the NSI, but how these separate elements interact" (OECD, 2003).

Global, national and regional elements all play important roles in Chinese innovation systems' development. The development of the system starts from the 1980s, when Chinese actors try to "copy" the Silicon Valley to China and experience of science and technology cities (SNTs) across dozens of countries were drawn (Gu, 1996). FDIs and Transnational firms play a significant role in the development of Chinese technology industries (Yu & Zhang, 2006), that innovation clusters in China pay a great effort in building connections with global firms and clusters (People's Daily, 1948~2017). The state started the first innovation system program named "China Torch Program" and a governance agency was formed at different administrative levels to coordinate innovation projects, including developing national innovation clusters. Initially, the state plays a significant role in the system and it is gradually giving control of the system back to firms, but it still takes the charge of making policies and measurements for the system and firms in the system (Sun &Liu, 2010). But the performance of innovation systems varies dramatically in different places, although they are all regulated by the same national policy. Regional institutions determine the regional innovation system's innovative outputs (Li, 2009).

Research on China's innovation systems would complement the research to break boundaries between different scales of innovation systems. We may ask what global, national, and regional elements that influence specific innovation processes, and how could the system of innovation utilize all these factors? Hsing (1996) finds that local authorities have great flexibility to negotiate with small foreign firms and attract them with competitive institutional and physical advantages. While the national influence usually works with giant transnational companies.

2. Innovation system that is developing

Current SI research selected a very limited number of cases. First, empirical studies have been focused mostly on innovation systems advanced economies (Nelson, 1993), and two-thirds of the published SI research articles focus on regions in Europe (Doloreux & Porto Gomez, 2017). I call this the horizontal deficiency that the selected cases are limited to a small fraction of all regions. Second, SI research statically analyses "full-blown systems" without providing how the system developed and evolved (Asheim et al., 2011). I name it as the chronic deficiency that researchers did not further enquire about the mechanism that drives the development of innovation systems.

There is indeed no "one-size-fits-all" innovation policy—no single model or "policy mix" available and suitable for every region (Morisson & Doussineau, 2019). Because effective policy instruments are sensitive to context (Tödtling & Trippl, 2005), and regions with different institutions, industrial base, and innovation capabilities require the design and implementation of place-based policies addressing the specificities (Barca et al., 2012).

Researchers have analyzed innovation systems in many regions. For example, experience from Swiss highlights the innovation policy of providing high-level infrastructures of education and research institutes, that offer human capital to innovation systems (Hotz-Hart, 2012). In Germany's SI, where medium-tech industries clustered, its government focuses on developing high-skill labor force (Prais, 1981; Orlowski, 2012), while also actively work with industries through establishing industrial regulations and coordination towards a new form of policy network (Lang & Mertes, 2012; Fuchs & Wassermann, 2012). In the U.S., scholars link the countries' high innovation performance in history and recent weaker performance to the

historical multifaceted government support on innovation and the absence of national innovation policy recently (Bauer, 2012).

To include more regions especially those with weak innovation capacities benefits these "follower" regions (Almeida st al., 2011) and SI research itself as well. First, it helps with solving practical issues in "follower" areas. These regions face intense pressure to "catch-up" with the innovation frontier (Lundvall et al., 2009). In this context, followers need radical innovations in policy to promote internal interactions and external connectivity to cope with global competition (Almeida st al., 2011).

Second, given the broadly accepted academic recommendation of place-sensitive policies and the absence of solid insights into how to design these policies (Morisson & Doussineau, 2019), investigating more innovation systems help with testing extant hypnosis and introducing new alternatives. Policy recommendations from SI research should be concrete enough to tell policy-makers the effectiveness or limitations of model policies when they were applied in their regional environment (Dixit, 2009). Although arguments state that innovation systems differ based on innovation itself, rather than the geographic places they locate in (Trippl et al., 2009), its reliability counts on being tested in more regions.

Moreover, taking different regions and industries into account in SI studies consolidates its statement about the way in which institutions co-evolve as the economic dynamics. Current SI research developed from the experience of technology-advanced nations in the 1980s, when they are entering to the post-industrial stage (Bell, 1973). SI theories that focus on the complicated organization of advanced technology industries (Saxenian, 2007), provide limited knowledge on ways of innovation governance rested on different historical conditions (Rickne et al., 2012).

On the one hand, SI research should consider the real system in which some parts are highly advanced and the other use low-tech components as complementary, because the distinction between high-tech and other industries is unclear (Bauer et al. 2012). On the other hand, for SI research on less developed regions, it should echo with the reality that innovation must take place in traditional manufactures and a new way of developing technology-intensive firms would be different from the experience of developing countries (Fiore et al., 2011). As new industries, that interact with regions differently from old ones, introduced to the system, SI research may need to think about a compatible institution. This is a part of how to deal with time deficiency.

China offers a unique context for innovation systems research (Sun & Liu, 2010). First, Chinese SI can offer an experience where innovative practices are not rooted in a traditional market economy. China distinctions for its "highly capitalistic market economy regulated by a Communist party funded on Marxist ideas with a population that is mainly influenced by Confucianism" (ibid.). The context difference may help with filtering or testing what formal or informal institutions work or fail in innovation processes.

Second, China is the only country that has the simultaneous development of industries of labor- capital- and technology-intensive at the national scale (Williams et al., 2011). As stated above, how Chinese innovation systems address industries' different needs is off the topic of global SI research. Many Chinese regional innovation systems develop based on labor-intensive or "low-tech" industries such as wood, seed, agriculture, ceramics. In order to increase the efficiency in its production, and regions' income level (People's Daily, 1948~2017).

Last, during the past decades, the nature of Chinese innovation change at an ever speed, Chinese entities applied for 781 patents in 2000, accounting of 2% of patents the U.S.

organizations applied, and in 2019, the number went to 58,990, ranking the first among the number of patents application received from other countries (Zhang, 2018; Chinese Central Government, 2019). Along with the evolution, institutions of Chinese SI transform from a planned to a market-oriented economy (Sun & Liu, 2010). This experience may help to reflect on the way in which the institutions of SI change to fit with the market change, and what mechanism allows the flexible institutional changes that happened just in a few decades.

3. Addressing the effect of innovation system development

Most SI research theories have a value-neutral position, but when the innovation process involves urban governance, it cannot be value-neutral (Pierre, 1999). SI research needs to discuss more the imbalance relationships among actors in the system and the imbalance effect the innovation development result in to harness the innovation for sustainable development (Cash et al., 2003). There are three aspects related to this topic that has been discussed.

First, the power within the regional innovation system is noted but insufficiently theorized by SI researchers (Christopherson & Clark, 2007a).In a territorial innovation system, a value-neutral transnational corporation (TNC) contributes to the whole region through two mechanisms: taking the leadership to organize and sponsor the innovation initiatives, and acting as antennas to introduce global partners into the system (Kramer et al., 2011). But this promise rarely reaches, according to empirical studies, and even worse, TNCs lead to the “creation of volatility” and “destruction of skills” (Kristensen & Zeitlin, 2005). The goal of TNCs is to suppress innovations from others to sustain their own comparable competitiveness, and they have the extra and extraordinary power, compared with other firms in the network, to influence governments to set agenda and control innovation resources such as the access to research

institutes and high-skill labor (Christopherson & Clark, 2007b). They could either be innovative through selectively uniting regional firms to compete on the global stage, or reversely, to squeeze competitive small or middle-sized firms out of the region (ibid.).

Thus, if power and relationship are overlooked by SI research, the result of its policy recommendations would be divorced from the positive track predicted by policy designers. A value-neutral perspective could overlook small firms' needs and overly prize the role played by TNCs in an innovation system, due to their greater amount of innovative resources. And in reality, it is, policies usually prone to TNCs (Feldman et al., 2002), and over-subsidize these large firms and under-subsidize small firms (Harrison, 1994). But it is the small or medium-sized firms that make regional development innovative and sustainable (Clark et al., 2010). To be competitive, small or middle-sized firms are able to advance their technology and keep ahead of the markets (Pyke et al., 1990; Cooke & Morgan, 2000).), But they lack the resources to cash in their innovative advantages that make them vulnerable in market competition, (Crouch &Voelzkow, 2004).

Few SI researchers discuss the social impact of innovation development. It seems the innovation would increase inequality rather than diminish it. In twenty years from 1960 to 1980, the economic gap between Northern and Southern countries doubled, as the more advanced the technology they have and apply, the quicker growth they will have (Sachs, 1997). The effect of innovation development on regions is unclear. To be more innovative may help the region with less absolute poor people, but may increase the income inequality that the quality of life for all people could be a problem (Chapple et al., 2004). Innovation studies have been mainly considered the development approach of using innovation to produce economic growth, while

little from the distributive perspective—whether the innovation will hamper or encourage the supports civic participation and representation (Clark & Christopherson, 2009).

Research on Chinese innovation systems may first echo with the current debate on the imbalance power that firms have. Uniquely, one of the Chinese major actors in the innovation process is state-owned enterprises (SOEs) (Liu & Ren, 2007), which is often regarded as inefficient or underperforming in production with a complicated corporate governance structure (Liao, 1009). Comparing with private enterprises, they are better subsidized by public funding and have a higher level of R&D investment (Dai & Cheng, 2015). How SOE's roles differ from TNC's in an innovation system, and how did the Chinese system incorporate with SOEs are open to further SI researchers.

What Chinese experience opens the door for global studies is the use of innovation and development as the tool to treat inequality. Many developmental policies in China have the orientation of diminishing inequality, such as the Central-to-Local Governments' Transfer Payments aiming at funding towards poorer provinces (Yeoh, 2009), or the project of "Characteristic Towns" that develop rural towns through transferring innovative resources from the urban and cultivating distinctive rural innovation systems (Sheng & Zhang, 2016). Studies on Chinese systems whose fundamental goals including promoting regional equality will complement SI research about the compatibleness of current theories in addressing the issue of inequality.

CONCLUSION

This literature review writes from the perspective that how Chinese SI experience could be incorporated into the global innovation study, in terms of how global and Chinese SI practices initiated; what lessons Chinese SIs can learn from SI research; and how Chinese SI development cases may complement current theories.

Once the concept of "development" was spread around the world, regions especially those "followers" who stay far from the development and technological levels of the frontier regions, restructured their government and institutions to foster innovation and increase productivity (Almeida st al., 2011). This is also the historical background of Chinese SI development. In the 1980s, the national SI program started to catch up with world scientific progress and spur local economy. The globalization has drastically changed the competitive environment, in which both firms and regions have to confront intensive price, time and quality competition in international as well as domestic market (Teece, 2007), and once prosperous places struggle to redefine themselves on the global stage (Christopherson et al., 2010). Thus, the cognition of developing through innovation becomes widespread to all regions, both developed and developing economies, to stay competitive, develop sustainably, and face future economic turbulence. (Cooke et al., 1998; Feldman et al, 2016). The major responsibility of SI research is to find innovation recommendations to address practical needs (Doloreux & Porto Gomez, 2017).

SI research may help Chinese policymakers to understand the complicated innovation process, in which: 1. Innovation is at the center of the system, the function of SI is to innovate. Especially in the current "New Economy" era, innovation becomes both the mean and end of

development; 2. institution plays an important role. The SI researchers regard the environment that supports actors in an innovation system to be a crucial factor determining the system's performance. Social capital that closely links actors together enables the SI to function more effectively; 3. Innovation is created through networked actors. Countless human and non-human actors involve in innovation, and they have worked in various forms and on different scales.

However, SI researchers fail to offer a formal theoretical framework to guide policymakers. This thesis writes about two competing rationales in current SI research. One roots in traditional classical economics, arguing the innovation is produced by organizations' daily operation (learning-by-doing), that firms especially CEOs in the firm should have full autonomy in their business and the system will have the best innovative result (Deschamps & Nelson, 2014). The other one, systematic approach develops from the evolutionary perspective, arguing that characters of the innovation system, such as its stock of innovation resources, its relatedness with other systems, and its ability to incorporate and diffuse innovation, influence the production of innovation. A governance body may actively evolve with the economic dynamics, to intervene in the SI once it faces system failure that it fails to fully use its innovative capacity. This theoretical ambiguity provides the transforming Chinese SIs a contradict recommendation: To keep opening-up and have a stronger market, or to maintain a strong government cultivating local innovation environment and keeping reform to push the market to a higher trajectory.

Finally, incorporating Chinese cases, SIs from a distinct context may complement deficiencies of scale, selected cases, and considering the negative effect of SI development in SI research. First, compared with current SI research that breaks innovation systems according to their scale, and into categories of sectoral, regional, national, and global, Chinese SIs have clear connections with elements at all spatial scales. Theorizing Chinese experience may help SI study

to develop a more general framework explaining how SI at different levels interacts with each other. Second, current SI research gain theories from technologically advanced regions, such as Europe, U.S., and Japan. The fast-growing Chinese SIs from a unique cultural and institutional background would shed light on how SIs and the economy they locate in co-evolve from a lower level to a higher level of technical advancement status. Third, the Chinese experience could open a discussion about how to use innovation to create equality, while SI research is criticized to have overlooked what left behind the innovation development.

REFERENCES

1. Aghion, P., Alesina, A., & Trebbi, F. (2004). Endogenous political institutions. *The Quarterly Journal of Economics*, 119(2), 565-611.
2. Ahrweiler, P. (Eds.) (2010). *Innovation in complex social systems*. Milton Park, New York.
3. Almeida, A., Figueiredo, A., & Rui Silva, M. (2011). From concept to policy: Building Regional Innovation Systems in follower regions. *European Planning Studies*, 19(7), 1331-1356.
4. Almeida, A., Santos, C., & Silva, M. R. (2008). Bridging science to economy: The role of science and technologic parks in innovation strategies in "follower" regions (No. 302). *Universidade do Porto, Faculdade de Economia do Porto*.
5. Amable, B. & Petit, P. (2003). The diversity of social systems of innovation and production during the 1990s, in: J. P. Touffut (Eds.) *Institutions, Innovation and Growth*, pp. 206–244. Edward Elgar, Aldershot.
6. Amin, A. & Thrift, N. (1995). Globalization, institutional "thickness" and the local economy, In Healey P, Cameron S, Davoudi S, Graham S and Madani-Pour A (Eds.) *Managing cities: the new urban context* (pp.91-108). John Wiley and Sons, Chichester.
7. Amin, A. & Thrift, N. (1995). Living in the global, in: A. Amin & N. Thrift (Eds.) *Globalization, Institutions, and Regional Development in Europe*, pp. 1–22. Oxford University Press, Oxford.
8. Amin, A. & Thrift, N. (Eds.) (1994). *Globalisation, institutions and regional development in Europe*. Oxford University Press, Oxford.
9. Antonelli, C., Patrucco, P. P., & Quatraro, F. (2008). The governance of localised knowledge externalities. *International Review of Applied Economics*, 22(4), 479–498.

10. Archibugi, D. & Filippetti, A. (Eds.) (2015). *The handbook of global science, technology, and innovation*. John Wiley & Sons, Hoboken.
11. Asheim, B. & Gertler, M. (2006). The Geography of Innovation: Regional Innovation Systems. In: J. Fagerberg & D. C. Mowery (Eds.) *The Oxford Handbook of Innovation*. Oxford University Press, Oxford.
12. Asheim, B. & Herstad, S.J. (2005). Regional innovation systems, varieties of capitalisms and non-local relations: Challenges from the globalising economy. In R .A. Boschma & R. C. Kloosterman (Eds.) *Learning from Clusters: A critical Asessment for an Economic-Geographical Perspective* (pp. 169-202). Springer, Dordrecth.
13. Asheim, B. (1998a). Territoriality and Economics: On the Substantial Contribution of Economic Geography, *Svensk Geografisk Årsbok*, 74, 98-109.
14. Asheim, B. (1998b). Localized innovation networks in a global economy: A comparative analysis of endogenous and exogenous regional development approaches. *Comparative Social Research*, 17, 199-240.
15. Asheim, B., Lawton, S. H., & Oughton, C. (2011). Regional innovation systems: theory, empirics and policy. *Special Issue of Regional Studies*, 45: 875–891.
16. Barca, F., McCann, P., & Rodríguez-Pose, A. (2012). The case for regional development intervention: place-based versus place-neutral approaches. *Journal of regional science*, 52(1), 134-152.
17. Bauer, J. M. (2012). Entrepreneurship and government in US high-tech policy. In: J. Bauer, A. Lang, & V. Schneider (Eds.) *Innovation policy and governance in high-tech industries* (pp. 103-125). Springer, Heidelberg.

18. Bauer, J., Lang, A., & Schneider, V. (Eds.) (2012). *Innovation policy and governance in high-tech industries: The complexity of coordination*. Springer Science & Business Media, Berlin.
19. Beckman, C. & Haunschild, P. (2002). Network Learning: The Effects of Partner's Heterogeneity of Experience on Corporate Acquisitions. *Administrative Science Quarterly*, 47: 92–1724.
20. Bell, D. (1973). *The coming of post-industrial society: a venture in social forecasting*. Basic Books, New York.
21. Bemelmans-Videc, M. L., Rist, R. C., & Vedung, E. (2003). *Carrots, Sticks and Sermons: Policy Instruments and Their Evaluation*. Transaction Publishers, New Brunswick.
22. Bennett, R. J. & McCoshan, A. (1993). *Enterprise and Human Resource Development: Local Capacity Building*. Paul Chapman, London.
23. Binz, C. & Truffer, B. (2017). Global Innovation Systems—A conceptual framework for innovation dynamics in transnational contexts. *Research Policy*, 46(7), 1284-1298.
24. Blakely, E. J. & Leigh, N. G. (2013). *Planning local economic development*. Sage, Thousand Oaks.
25. Block, F. & Keller, M. R. (2009). Where do innovations come from? Transformations in the US economy, 1970–2006. *Socio-Economic Review*, 7(3), 459-483.
26. Bratton, M. & Van de Walle, N. (1992). Toward governance in Africa: popular demands and state responses. *Governance and politics in Africa*, 27-55.
27. Braun, D. (2008). Organising the political coordination of knowledge and innovation policies. *Science and public policy*, 35(4), 227-239.

28. Brouwer, M. (1991). *Schumpeterian puzzles – technological competition and economic evolution*. University of Michigan Press, Ann Arbor.
29. Brouwer, M. (2008). *Governance and innovation: a historical view*. Routledge, London.
30. Bunge, M. (2000). Systemism: The alternative to individualism and holism. *Journal of Socio-Economics*, 29(2), 147-157.
31. Calderini, M., Garrone, P., & Sobrero, M. (2003). *Corporate governance, market structure and innovation*. Edward Elgar Publishing, Cheltenham.
32. Camagni, R. P. (1991). Technological change, uncertainty and innovation networks: towards a dynamic theory of economic space. In: Boyce, D.E., Nijkamp, P., & Shefer, D. (Eds.) *Regional science* (pp. 211-249). Springer, Berlin.
33. Cantwell, J. A. & Iammarino, S. (2003). *Multinational Corporations and European Regional Systems of Innovation*. Routledge, London.
34. Carlsson, B. & Stankiewicz, R. (1991). On the nature, function and composition of technological systems. *Journal of evolutionary economics*, 1(2), 93-118.
35. Carrincazeaux, C., & Gaschet, F. (2015). Regional innovation systems and economic performance: Between regions and nations. *European Planning Studies*, 23(2), 262-291.
36. Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., ... & Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the national academy of sciences*, 100(14), 8086-8091.
37. Castells, M. & Hall, P. (1994) *Technopoles of the World: The Making of Twentyfirst-century Industrial Complexes*, Routledge, London.
38. Castells, M. (1997). An introduction to the information age. *City*, 2(7), 6-16.

39. Chapple, K. (2014). The highest and best use? Urban industrial land and job creation. *Economic Development Quarterly*, 28(4), 300-313.
40. Chapple, K., Kroll, C., Lester, T. W., & Montero, S. (2011). Innovation in the green economy: an extension of the regional innovation system model?. *Economic Development Quarterly*, 25(1), 5-25.
41. Chapple, K., Markusen, A., Schrock, G., Yamamoto, D., & Yu, P. (2004). Rejoinder: high-tech rankings, specialization, and relationship to growth. *Economic Development Quarterly*, 18(1), 44-49.
42. Chen, C.X. (1980), *Technology Diffusion and emerging industries*, Chen Chunxian Studio, 23 Oct 1980, http://www.chenchunxian.com/letter.htm/. Accessed 25 Mar 2019.
43. Chen, D.X. (1919), Defensing the crime of 'New Youth', *New Youth*.
44. Chinese Central Government (2019). *The number of Chinese patent applications ranks the first in 2019* (In Chinese). Retrieved March 18, 2020, from: http://www.gov.cn/xinwen/2020-04/08/content_5500058.htm
45. Christopherson, S., & Clark, J. (2007a). Power in firm networks: What it means for regional innovation systems. *Regional Studies*, 41(9), 1223-1236.
46. Christopherson, S., & Clark, J. (2007b). *Remaking regional economies: Power, labor, and firm strategies in the knowledge economy*. Routledge, London.
47. Christopherson, S., & Clark, J. (2010). Limits to 'The learning region': What university-centered economic development Can (and cannot) do to create knowledge-based regional economies. *Local Economy*, 25(2), 120-130.
48. Chung, S. (2002). Building a national innovation system through regional innovation systems. *Technovation*, 22(8), 485-491.

49. Clark, J. (2013) *Working Regions: Reconnecting Innovation and Production in the Knowledge Economy*. Routledge, London.
50. Clark, J., & Christopherson, S. (2009). Integrating investment and equity: A critical regionalist agenda for a progressive regionalism. *Journal of Planning Education and Research*, 28(3), 341-354.
51. Clark, J., Huang, H. I., & Walsh, J. P. (2010). A typology of 'innovation districts': what it means for regional resilience. *Cambridge Journal of Regions, Economy and Society*, 3(1), 121-137.
52. Clayton, P., Donegan, M., Feldman, M., Forbes, A., Lowe, N., & Polly, A. (2019). Local prior employment and ecosystem dynamics. *ILR Review*, 72(5), 1182-1199.
53. Cobb, C. W., & Douglas, P. H. (1928). A theory of production. *The American Economic Review*, 18(1), 139-165.
54. Coenen, L., Asheim, B., Bugge, M. M., & Herstad, S. J. (2017). Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table?. *Environment and Planning C: Politics and Space*, 35(4), 600-620.
55. Coenen, L., Campbell, S., & Wiseman, J. (2018). Regional innovation systems and transformative dynamics: Transitions in coal regions in Australia and Germany. In: Isaksen A., Martin R., Trippl M. (Eds.) *New Avenues for Regional Innovation Systems-Theoretical Advances, Empirical Cases and Policy Lessons* (pp. 199-217). Springer, Cham.
56. Coenen, L., Grillitsch, M., Hansen, T., & Moodysson, J. (2017). An innovation system framework for system innovation policy: the case of Strategic Innovation Programs (SIPs) in Sweden. *Lund University, CIRCLE-Center for Innovation, Research and Competences in the Learning Economy*, (2017/8).

57. Cooke, P. & K. Morgan (1993). The network paradigm. *Environment and Planning D*, 11 (5), 543–64.
58. Cooke, P. & K. Morgan (1998). *The Associational Economy: Firms, Regions and Innovation*. Oxford University Press, Oxford.
59. Cooke, P. (1998). Introduction: Origins of the Concept. In: H. Braczyk, P. Cooke, and M. Heidenreich (eds.), *Regional Innovation Systems*, (pp. 2-25). UCL Press, London.
60. Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy**.** *Industrial and Corporate Change*, 10(4), 945–974.
61. Cooke, P. (2002). *Knowledge economies: Clusters, learning and cooperative advantage*. Routledge, London
62. Cooke, P. (2013). *Complex adaptive innovation systems: Relatedness and transversality in the evolving region*. Routledge, London.
63. Cooke, P. (Ed.) (2013). *Re-framing regional development: Evolution, innovation and transition.* Routledge, London.
64. Cooke, P., Boekholt, P., & Tödtling, F. (2000). *The Governance of Innovation in Europe*. Pinter, London.
65. Cooke, P., Heidenreich, M., & Braczyk, H-J. (Eds.) (2004). *Regional Innovation Systems*. Routledge, London.
66. Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research policy*, 26(4-5), 475-491.
67. Cooke, P., Uranga, M. G., & Etxebarria, G. (1998). Regional Systems of Innovation: An Evolutionary Perspective, *Environment and Planning A*, 30(9), 1563–1584.

68. Cortright, J., & Mayer, H. (2004). Increasingly rank: The use and misuse of rankings in economic development. *Economic Development Quarterly*, 18(1), 34-39.
69. Coulson, A., & Ferrario, C. (2007). 'Institutional thickness': Local governance and economic development in Birmingham, England. *International Journal of Urban and Regional Research*, 31(3), 591-615.
70. Crevoisier, O. (2004). The innovative milieux approach: Towards territorialized understanding of economy, *Economic Geography*, 80(4), 367–379.
71. Crouch, C. and H. Voelzkow (2004) Introduction. In: C. Crouch, P. Le Galès, C. Trigilia, & H. Voelzkow, (Eds.) *Changing governance of local economies: responses of local production systems*, Oxford University Press, Oxford.
72. Cypher, J. M., & Dietz, J. L. (2008). *The process of economic development*. Routledge, London.
73. Dai, X., & Cheng, L. (2015). Public selection and research and development effort of manufacturing enterprises in China: state owned enterprises versus non-state owned enterprises. *Innovation*, 17(2), 182-195.
74. Deschamps, J. P. & Nelson, B. (2014). *Innovation governance: How top management organizes and mobilizes for innovation*. John Wiley & Sons, Hoboken.
75. DeVol, R. (1999). *America's high-technology economy: Growth, development, and risks for metropolitan areas*. Milken Institute, Santa Monica.
76. Dixit A.K. (2008). Economic Governance. In: Palgrave Macmillan (Eds.) *The New Palgrave Dictionary of Economics*. Palgrave Macmillan, London
77. Dixit, A. K. (2009). Governance institutions and economic activity. *American Economic Review*, 99(1), 3–24.

78. Doloreux, D. & Porto Gomez, I. (2017). A review of (almost) 20 years of regional innovation systems research, *European Planning Studies*, 25(3), 371-387.
79. Doloreux, D. & Porto Gomez, I. (2017). A review of (almost) 20 years of regional innovation systems research. *European Planning Studies*, 25(3), 371-387.
80. Donegan, H. (2019). *Convergence, Divergence or Lost in Translation to Sino-Capitalism? Legal Transplants in Corporate Governance in China* (Doctoral dissertation). The University of Auckland, Auckland.
81. Donegan, M., Lester, T. W., & Lowe, N. (2018). Striking a balance: A national assessment of economic development incentives. *Urban Affairs Review*, https://doi.org/10.1177/1078087419880013.
82. Dosi, G. (1988). Sources, procedures, and microeconomic effects of innovation. *Journal of economic literature*, 26(3), 1120-1171.
83. Drennan, M. (2002). *The information economy and American cities*. Johns Hopkins University Press, Baltimore.
84. Du, S.R. (1993), *Biography of Ancient Chinese Scientists* (In Chinese), Science Press, Beijing.
85. Durlauf, S. N. & Blume, L. (Eds.) (2008). *The new Palgrave dictionary of economics* (Vol. 6). Palgrave Macmillan, London.
86. Dutton, W. H., Schneider, V., & Vedel, T. (2012). Ecologies of games shaping large technical systems: Cases from telecommunications to the Internet. In: Bauer J., Lang A., Schneider V. (Eds.) *Innovation Policy and Governance in High-Tech Industries* (pp. 49-75). Springer, Berlin.

87. Economic Development. *Oxford Reference*. Retrieved 2 Mar. 2020, from https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095741341.

88. Economics. *Oxford Reference*. Retrieved 2 Mar. 2020, from https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095741255.

89. Edquist, C. & Johnson, B. (1996). *Institutions and organizations in systems of innovation*. Retrieved Mar 24, 2020, from: https://www.researchgate.net/profile/Charles_Edquist/publication/246482165_Institutions_and_Organizations_in_Systems_of_Innovation/links/54e2079f0cf296663793fc34/Institutions-and-Organizations-in-Systems-of-Innovation.pdf

90. Edquist, C. (1996). Systems of innovation approaches: their emergence and characteristics. Univ..

91. Edquist, C. (1997). Preface. In: Edquist, C. (Ed.) *Systems of innovation: technologies, institutions, and organizations*. Psychology Press, Abingdon-on-Thames.

92. Edquist, C. (1999). *Innovation policy: A systemic approach*. Retrieved Mar 24, 2020, from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.559.7157&rep=rep1&type=pdf

93. Edquist, C. (2005). Systems of innovation: Perspectives and challenges. In: J. Fagerberg, D. Mowery & R. R. Nelson (Eds.) *The Oxford Handbook of Innovation* (pp. 181–208). Oxford University Press, London.

94. Esteva, G. (1997). Development. In: W. Sachs (Ed.) *The Development dictionary: A guide to knowledge as power*. Orient Blackswan. Hyderabad.

95. Eustace, C. (2000). The intangible economy: Impact and policy issues. Report of the European high level expert group on the intangible economy. *EU Commission - Working Document.*

96. Evans, P. (1992). The state as problem and solution: Predation, embedded autonomy, and structural change. *The politics of economic adjustment*, 3(3), 138-181.

97. Fagerberg, J. (2006). Innovation: A Guide to the Literature. In: J. Fagerberg & D. Mowery (Eds.) *The Oxford Handbook of Innovation*. Oxford University Press.

98. Fagerberg, J., Verspagen, B., & von Tunzelmann, G. N. (1994). *The dynamics of technology, trade and growth*. Edward Elgar Publishing, Cheltenham.

99. Faini, R. (1984). Increasing returns, non-traded inputs and regional development. *Economic Journal*. 94(374): 308–323.

100. Feldman, M., Hadjimichael, T., Lanahan, L., & Kemeny, T. (2016). The logic of economic development: a definition and model for investment. *Environment and Planning C*, 34(1), 5-21.

101. Feldman, M., Link, A., & Siegel, D. (2002). *The Economics of Science and Technology: An Overview of Initiatives to Foster Innovation, Entrepreneurship, and Economic Growth*. Kluwer Academic, Boston.

102. Fiore, A., Grisorio, M. J., & Prota, F. (2011). Regional innovation systems: which role for public policies and innovation agencies? Some insights from the experience of an Italian region. *European Planning Studies*, 19(8), 1399-1422.

103. Flanagan, K., Uyarra, E., & Laranja, M. (2011). Reconceptualising the "policy mix" for innovation. *Research Policy*, 40(5), 702-713.

104. Florida, R. (2002). *The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community, and Everyday Life*. Basic Books, New York.

105. Foster, R., Kaplan, S., (2001). *Creative destruction: why companies that are built to last underperform the market-and how to successfully transform them*. Currency Publishers, New York.

106. Freeman, C. & Perez, C. (1988). Structural crises of adjustment, business cycles and investment behaviour. In G. Dosi, C. Freeman, R. R. Nelson, G. Silverberg, & L. Soete (Eds.) *Technical change and economic theory* (pp. 38–66). Pinter, London.

107. Freeman, C. (1994). Innovation and growth. In: M. Dodgson & R. Rothwell (Eds.) *The Handbook of Industrial Innovation* (pp. 78-93). Edward Elgar, Aldershot.

108. Freeman, C. (1995). The national system of innovation. In historical perspective. *Cambridge Journal of Economics*, 19 (1), 5-24.

109. Freeman. C. (1987). *Technology Policy and Economic Performance: Lessons from Japan*. Pinter, London.

110. Frenken, K. (2006). *Innovation, evolution, and complexity theory*. Edward Elgar, Cheltenham.

111. Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional studies*, 41(5), 685-697.

112. Frischtak, L. L. (1994). Governance capacity and economic reform in developing countries. *The World Bank*.

113. Fuchs, G. & Wassermann, S. (2012). From niche to mass markets in high technology: The case of photovoltaics in Germany. In: J. Bauer, A. Lang, V. Schneider (Eds.) *Innovation policy and governance in high-tech industries* (pp. 219-244). Springer, Berlin.

114. Garud, R. & Karnøe, P. (2001). Path Creation as a Process of Mindful Deviation. In: R. Garud & P. Karnøe (Eds.) *Path Dependence and Creation* (pp. 1-40). Lawrence Erlbaum Associates, Mahwah.

115. Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1992). Growth in cities. *Journal of political economy*, 100(6), 1126-1152.

116. González, S. & Healey, P. (2005). A sociological institutionalist approach to the study of innovation in governance capacity. *Urban Studies*, 42(11), 2055–69.

117. Gordon, D. & Vaughan, R. (2011). The Historical Role of the Production Function in Economics and Business. *American Journal of Business Education*, 4(4), 25-30.

118. Gordon, I. (2010). Territorial competition. In: A. Pike, A. Rodríguez-Pose, & J. Tomaney (Eds.) *Handbook of local and regional development* (pp. 52-64). Routledge, London.

119. Grabher, G. (1993). The Weakness of Strong Ties. The Lock-in of Regional Development in the Ruhr Area'. In: G. Grabher (Ed.) *The Embedded Firm. On the Socio-economics of Industrial Networks* (pp. 255-278). Routledge, London.

120. Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. *The American Journal of Sociology*, 91(3), 481–510.

121. Grindle, M. (2001). In quest of the political: the political economy of development policymaking. In: G. M. Meier & J. E. Stiglitz (Eds.) *Frontiers in Development Economics: The Future in Perspective* (pp.345-380). World Bank.

122. Grossman, G. M. & Helpman, E. (1991). *Innovation and Growth in the Global Economy*. MIT Press, Cambridge.

123. Gu, S. (1996). The emergence of new technology enterprises in China: A study of endogenous capability building via restructuring. *The journal of development studies*, 32(4), 475-505.

124. Hall, P.A., & Soskice, D., (2001). *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. Oxford University Press, Oxford.

125. Harari, Y. N. (2014). *Sapiens: A brief history of humankind. Random House*, New York.

126. Harrison, B. (1978). *Job! What Kind, for Whom, and Where?*. MIT Press, Cambridge

127. Harrison, B. (1994). The small firms myth. *California Management Review*. 36(3): pp. 142–148.

128. Hart, G. (2001). Development Critiques in the 1990s: Cul de Sac and Promising Paths. *Progress in Human Geography*, 25(4), 649–658.

129. Hawkins, C. V., Hu, Q., & Feiock, R. C. (2016). Self-organizing governance of local economic development: Informal policy networks and regional institutions. *Journal of Urban Affairs*, 38(5), 643-660.

130. Healey, P. (2002). On creating the 'city' as a collective resource. *Urban Studies*, 39(10), 1777-1192.

131. Healey, P., Cameron, S., Davoudi, S. T. A. G., Graham, S., & Madani-Pour, A. (1995). Introduction: the city-crisis, change and invention. In: P. Healey, S. Cameron, S. Davoudi, S. Graham, & A. Madani-Pour (Eds.) *Managing cities, the new urban context*. John Wiley and Sons, New York.

132. Hee Lee, S., & Yoo, T. (2007). Government policy and trajectories of radical innovation in dirigiste states: A comparative analysis of national innovation systems in France and Korea. *Technology Analysis & Strategic Management*, 19(4), 451-470.

133. Henton, D., Melville, J., & Walesh, K. (1997). *Grass Roots Leaders for a New Economy*. Jossey-Bass, San Francisco.

134. Higgins, B. (1983). From growth poles to systems of interaction. *Growth and Change*. 14(4): 3–13.

135. Holbrook, J. A. (2005). *Innovation Happens in Systems: Implications for Science, Technology and Innovation Policy* (Report). Centre for Policy Research on Science and Technology, Simon Fraser University, Burnaby.

136. Hotz-Hart, B. (2012). Innovation Switzerland: A particular kind of excellence. In: J. Bauer, A. Lang, & V. Schneider (Eds.) *Innovation policy and governance in high-tech industries* (pp. 127-154). Springer, Berlin.

137. Howells, J. (1999). Regional Systems of Innovation?, In: D. Archibugi, J. Howells, & J. Michie (Eds.) *Innovation policy in a global economy* (pp. 67-93). Cambridge University Press, Cambridge.

138. Howells, J. (2005). Innovation and regional economic development: a matter of perspective. *Research Policy*, 34(8), 1220–1234.

139. Howitt, P. & P. Aghion. (1998). Capital accumulation and innovation as complementary factors in long-run growth. *Journal of Economic Growth*, 3(2), 111–130.

140. Hsing, Y. T. (1996). Blood, thicker than water: interpersonal relations and Taiwanese investment in southern China. *Environment and planning A*, 28(12), 2241-2261.

141. Iammarino, S. (2005). An evolutionary integrated view of regional systems of innovation: concepts, measures and historical perspectives. *European planning studies*, 13(4), 497-519.

142. In their original text, they use RIS which refers to regional innovation system.

143. Jacobs, J. (1969). *The Economy of Cities*. Random House, New York.

144. Jacobs, J. (2000). *The Nature of Economies*. Vintage, New York.

145. Jessop, B. (1998). The rise of governance and the risks of failure: the case of economic development. *International social science journal*, 50(155), 29-45.

146. Jiang, D. C. & Zhang, Y. (2006). Industrial Characteristics and Technology Spillover of FDI: The Empirical Evidence of Chinese High-tech Industries (In Chinese). *The Journal of World Economy*, 10(3), 21-29.

147. Jiao, H., Zhou, J., Gao, T., & Liu, X. (2016). The more interactions the better? The moderating effect of the interaction between local producers and users of knowledge on the relationship between R&D investment and regional innovation systems. *Technological Forecasting and Social Change*, 110, 13-20.

148. Johnson, B. (1992). Institutional learning. In: B. Lundvall (Ed.) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London.

149. Johnson, B. (2008). Cities, systems of innovation and economic development. *Innovation*, 10(2–3), 146–155.

150. Kelly, K. (1998). *New Rules for the New Economy*. Fourth Estate, London.

151. Khan, M. (2007). Governance, Economic Growth and Development Since the 1960s. *UN Department of Economic and Social Affairs (DESA) Working Papers*, No. 54, UN, New York, https://doi.org/10.18356/9156b122-en.

152. Kivimaa, P. & Kern, F. (2016). Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Research Policy*, 45, 205-217.

153. Kramer, J. P., Marinelli, E., Iammarino, S., & Diez, J. R. (2011). Intangible assets as drivers of innovation: Empirical evidence on multinational enterprises in German and UK regional systems of innovation. *Technovation*, 31(9), 447-458.

154. Kristensen P. H. & Zeitlin J. (2005). *Local Players in Global Games: The Strategic Constitution of a Multinational Corporation*. Oxford University Press, Oxford.

155. Krugman, P. (1995). *Development, Geography and Economic Theory*. MIT Press, Cambridge.

156. Kuznets, S. (1966). *Modern economic growth: rate, structure, and spread*. Yale University Press, New Haven.

157. Kyriacou, A. P. (2016). Individualism–collectivism, governance and economic development. *European Journal of Political Economy*, 42, 91-104.

158. Landes, D.S., (2003). *The Unbound Prometheus: Technological Change and industrial development in Western Europe From 1750 to the Present*. Cambridge University Press, Cambridge.

159. Lang, A. & Mertes, A. (2012). Governance of Large Innovation Projects: The Implementation of the Electronic Health Card in Germany. In: J. Bauer, A. Lang, & V. Schneider (Eds.) *Innovation Policy and Governance in High-Tech Industries* (pp. 245-260). Springer, Berlin.

160. Lawson, C. & E. Lorenz (1999). Collective Learning, Tacit Knowledge and Regional Innovative Capacity. *Regional Studies*, 33(4), 305-317.

161. Lawson, C. (1999). Towards a Competence Theory of the Region. *Cambridge Journal of Economics* 23(2), 151-66.

162. Lazaric, N. & Lorenz, E. (Eds) (1998). *Trust and Economic Learning*. Edward Elgar, Cheltenham.

163. Lazonick, W. (2002). Innovative Enterprise and Historical Transformation. *Enterprise & Society*, 3(1), 35–54.

164. Lazonick, W. (2006). The Innovative Firm. In: J. Fagerberg & D. C. Mowery (Eds.) *The Oxford Handbook of Innovation* (pp.29-55). Oxford University Press, Oxford.

165. Leibenstein, H. (1966). Allocative efficiency vs." X-efficiency". *The American Economic Review*, 392-415.

166. Lengrand, L. (2002). *Innovation Tomorrow: Innovation Policy and the Regulatory Framework : Making Innovation An Integral Part of the Broader Structural Agenda*. Office for Official Publications of the European Communities, Luxembourg.

167. Lengyel, B. & Leydesdorff, L. (2011). Regional innovation systems in Hungary: The failing synergy at the national level. *Regional Studies*, 45(5), 677-693.

168. Leonard, T. C. (2009). Redeemed By History. *History of Economic Ideas*. 17(1), 189-195. Retrieved Mar 3, 2020, from: http://www.princeton.edu/~tleonard/papers/redeemed.pdf

169. Leonard-Barton, D. (1995). *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*. HBS Press, Boston.

170. Lewis, A. (1956). *The theory of economic growth*. Allen & Unwin, London.

171. Li, X. (2009). China's regional innovation capacity in transition: An empirical approach. *Research Policy*, 38(2), 338-357.

172. Li, Y., Liu, Y., & Ren, F. (2007). Product innovation and process innovation in SOEs: evidence from the Chinese transition. *The Journal of Technology Transfer*, 32(1-2), 63-85.

173. Lorenzen, M. (2005). Knowledge and Geography (Introduction to Special Issue on Knowledge Geographies). *Industry and Innovation*, 12(4), 399–407.

174. Lu, X. (1925), What the youth must read, *Beijing Newspaper*.

175. Lucas, G. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22, 3–42.

176. Lundvall, B. A. & Borrás, S. (2005). Science, technology and innovation policy. In: J. Fagerberg & D. C. Mowery (Eds.) *The Oxford Handbook of Innovation*. Oxford University Press, Oxford.

177. Lundvall, B. A. (1992). User-producer relationships, national systems of innovation and internationalisation. In B. A. Lundvall (Ed.) *National systems of innovation: Towards a theory of innovation and interactive learning* (pp. 45–67). Pinter, London.

178. Lundvall, B. A., Joseph, K. J., Chaminade, C., & Vang, J. (2009). *Handbook of Innovation Systems and Developing Countries: Building Domestic Capabilities in a Global Setting*. Edward Elgar Publishing, Cheltenham.

179. Lundvall, B.-A. (Ed.) (1992) National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. London: Pinter.

180. Luo, W. (1980), The status and function of CAS in China's S&T research system. *Journal of Dialectics of Nature*, No.3, 1981, 25-30.

181. MacLeod, G. & Goodwin, M. (1999). Space, scale and state strategy: rethinking urban and regional governance. *Progress in Human Geography*, 23(4), 503-527.

182. Mao, Z.D. (1956). On the ten major relationships (In Chinese). In *Selected works of Mao Tse-tung (vol.5)*. People's Publishing House, Beijing.

183. Marshall, A. ([1919]2006). *Industry and Trade*. Macmillan, London.

184. Marshall, A. ([1920]2013). *Principles of Economics*. Macmillan, London.

185. Martin, R. & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of economic geography*, 6(4), 395-437.

186. Martin, R. (2000). Institutional approaches to economic geography. In: E. Sheppard & T. Barnes (Eds.) *A companion to economic geography*. Basil Blackwell, Oxford.

187. Martin, R., Tyler, P., Sunley, P., Pike, A., Bailey, D., Evenhuis, E., Gardiner, B. & Swinney, P. (2017). *Cities and the National Productivity Problem: Evidence Submitted to the UK Government's Industrial Strategy Green Paper Consultation.*

188. Martin, R.L. (2010). Roepke Lecture in Economic Geography—Rethinking regional path dependence: beyond lock-in to evolution. *Economic geography*, 86(1), 1-27.

189. Mathur, V. (2004). Gauging metropolitan "high-tech" and "tech" activity: Some thoughts and commentary. *Economic Development Quarterl*y, 18(1), 30-33.

190. Mazzucato M. (2014). A mission-oriented approach to building the entrepreneurial state. *Innovate UK*.

191. McCann, P. & Ortega-Argilés, R. (2013). Modern regional innovation policy. *Cambridge Journal of Regions, Economy and Society*, 6(2), 187–216.

192. Metcalfe, S. (1995). The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives. In: P. Stoneman (Ed.) *Handbook of the Economics of Innovation and Technological Change*, Blackwell Publishers, Oxford (UK)/Cambridge (US).

193. Metcalfe, S. (1995). The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives, In: P. Stoneman (Ed.) *Handbook of the Economics of Innovation and Technological Change* (pp.409–512). Blackwell Publishers, Oxford (UK)/Cambridge (US).

194. Mohan, G. (2010). Local and regional 'development studies'. In: A. Pike, A. Rodríguez-Pose, & J. Tomaney (Eds.) *Handbook of local and regional development* (pp. 65-78). Routledge, London.

195. Morisson, A. & Doussineau, M. (2019). Regional innovation governance and place-based policies: design, implementation and implications. *Regional Studies, Regional Science*, 6(1), 101-116.

196. Moulaert, F. & Sekia, F. (2003). Territorial innovation models: A critical survey, *Regional Studies*, 37(3), 289–302.

197. Nauwelaers, C. & Wintjes, R. (2002). Innovating SMEs and regions: The need for policy intelligence and interactive policies. *Technology Analysis & Strategic Management*, 14(2), 201–215.

198. Nelson, R. P. & Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. The Belknap Press of Harvard University Press, Cambridge.

199. Nelson, R. R. (1959). The simple economics of basic scientific research. *Journal of political economy*, 67(3), 297-306.

200. Nelson, R. R. (1987). *Understanding Technical Change as an Evolutionary Process*. Elsevier, Amsterdam.

201. Nelson, R. R. (1993). *National Innovation Systems: A Comparative Analysis*. Social Science Research Network, Rochester.

202. Nelson, R. R. (1994). The Co-evolution of Technology, Industrial Structure, and Supporting Institutions. *Industrial and Corporate Change*, 3(1), 47–63.

203. Nelson, R. R., & Rosenberg, N. (1993). Technical innovation and national systems. In: R. R. Nelson (Ed.) *National innovation systems. A comparative analysis* (pp. 3–21). Oxford University Press, Oxford.

204. North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge university press, Cambridge.

205. Norton, R. (2000). *Creating the New Economy: The Entrepreneur and the US Resurgence*. Edward Elgar, Cheltenham.

206. Nurkse, R. (1953). *Problems of capital formation in underdeveloped countries*. Basil Blackwell, Oxford.

207. OECD (1996). *Science, Technology and Industry Outlook*. OECD, Paris.

208. OECD (1997). *National Innovation Systems*. OECD, Paris.

209. OECD (2009a). *Governance of Regional Innovation Policy: Variety, Role and Impact of Regional Agencies*. Paris.

210. OECD. (2003). *A Strategic View of Innovation Policy: A Proposed Methodology for Assessing Innovation Policy and Performance*. OECD, Paris:

211. Olson, M. (1996). Distinguished lecture on economics in government: big bills left on the sidewalk: why some nations are rich, and others poor. *Journal of Economic Perspectives*, 10(2), 3-24.

212. Orlowski, M. (2012). The politics of innovation: Analysing inter-organisational networks around German innovation policy advisory bodies. In: J. Bauer, A. Lang, & V. Schneider (Eds.) *Innovation policy and governance in high-tech industries* (pp. 155-173). Springer, Berlin.

213. Patel, P. & Pavitt, K. (1997). The technological competencies of the world's largest firms: complex and path-dependent, but not much variety. *Research policy*, 26(2), 141-156.

214. Peck, J. (2005). Struggling With the Creative Class. *International Journal of Urban and Regional Research*, 29 (4), 740–770.

215. Penrose, E. (1995). *The Theory of the Growth of the Firm*. Oxford University Press Oxford.

216. People's Daily (1948~2017). All reports related to innovation clusters were referred in this thesis.

217. Perroux, F. (1955). Note sur la notion de 'pôle de croissance'. *Cahiers de l'Institut de Science Economique Appliqée*, Series D No. 8.

218. Pierre, J. (1999). Models of urban governance: The institutional dimension of urban politics. *Urban affairs review*, 34(3), 372-396.

219. Polanyi, K. (1944). *The great transformation*. Beacon Press, Boston.

220. Porter, M. E. (1990). The competitive advantage of nations. *Harvard business review*, (March-April), 73-91.

221. Powell, W. W. & Brantley, P. (1992). Competitive Cooperation in Biotechnology: Learning Through Networks?. In: R. Eccles & N. Nohria (Eds.) *Networks and Organizations* (PP.336-394). Harvard University Press, Boston.

222. Prahalad, C. K. & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, (May-June), 79–91.

223. Prais, S.J. (1981). Vocational qualifications of the labour force in Britain and Germany. *National Institute Economic Review*, 98(1), 47-59.

224. Pugh, R., Hamilton, E., Jack, S., & Gibbons, A. (2016). A step into the unknown: Universities and the governance of regional economic development. *European Planning Studies*, 24(7), 1357-1373.

225. Pyke, F., G. Beccatini, & W. Sengenberger (Eds.) (1990). *Industrial districts and inter-firm co-operation in Italy*. International Institute for Labour Studies, Geneva.

226. Raco, M. (1998). Assessing 'institutional thickness' in the local context: a comparison of Cardiff and Sheffield. *Environment and Planning A*. 30(6), 975–996.

227. Raco, M. (1999). Competition, Collaboration and the New Industrial Districts: Examining the Institutional Turn in Local Economic Development. *Urban Studies*. 36(5/6), 951-968.

228. Ray D. & Bell C. (2008). Development Economics. In: Palgrave Macmillan (Eds.) *The New Palgrave Dictionary of Economics*. Palgrave Macmillan, London.

229. Reich, R. B. (1983). *An Industrial Policy for America: Is It Needed?*. US Government Printing Office, Washington.

230. Ricardo, D. ([1817] 2006). *Principles of Political Economy and Taxation*. Dover Publications, Mineola.

231. Rickne, A. & Laestadius, S. (2012). Regional governance in global innovation processes. In: A. Rickne, S. Laestadius, & H. Etzkowitz (Eds.) *Innovation Governance in an Open Economy* (pp. 15-31). Routledge, London.

232. Rickne, A., Læstadius, S., & Etzkowitz, H. (Eds.) (2012). *Innovation governance in an open economy: Shaping regional nodes in a globalized world*. Routledge, London.

233. Romer, P. (1990). Endogenous technical change. *Journal of Economic Literature*, 98(5), 338–54.

234. Sachs, W. (1997). Introduction, In: W. Sachs (Ed.) *The Development dictionary: A guide to knowledge as power*. Orient Blackswan. Hyderabad.

235. Sachs, W. (2008). *The archaeology of the development idea*. Earthcare Books, Kolkata.

236. Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Harvard University Press, Cambridge.

237. Saxenian, A. (2007). *The new argonauts: Regional advantage in a global economy*. Harvard University Press, Cambridge.

238. Schrank, A. & Whitford, J. (2009). Industrial policy in the United States: A neo-Polanyian interpretation. *Politics & Society*, 37(4), 521-553.

239. Schumpeter, J. A. (1934). *The theory of economic development. An inquiry into profits, capital, credit, interest, and the business cycle*. Harvard University Press, Cambridge.

240. Schumpeter, J. A. (1939). *Business cycles. A theoretical, historical and statistical analysis of the capitalist process*. McGraw-Hill, New York.

241. Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. Harper and Brothers, New York.

242. Shapira, P. (1998). *The Evaluation of USNet: Overview of Methods, Results and Implications*. School of Public Policy, Institute of Technology, Atlanta.

243. Sheng, S.H. & Zhang, W.M. (2016). Characteristic towns: a new form industrial space (In Chinese). *Zhejiang Social Sciences*,3, 36-38.

244. Simon, D.F. & Rehn, D. (1987), Innovation in China's semiconductor components industry: The case of Shanghai. *Research Policy*, No. 16, 259-277.

245. Smith, A. ([1776] 1976). *An Inquiry into the Nature and Causes of the Wealth of Nations*. Clarendon Press, Oxford.

246. Solow, R. (1957). Technical change and the aggregate production function. *Review of Economics and Statistics*, 39, 312–20.

247. Sorge, A. (1991). Strategic fit and the societal effect: Interpreting cross-national comparisons of technology, organization and human resources. *Organization Studies*, 12(2), 161-190.

248. Steven, K (2002). The capabilities of new firms and the evolution of the US automobile industry. *Industrial and Corporate Change*, 11(4): 645–66.

249. Storper, M. (1997). *The Regional World*. Guildford, New York.

250. Sun, G. Z. (2005). *Readings in the Economics of the Division of Labor: The Classical Tradition*. World Scientific, Singapore.

251. Sun, Y. & Liu, F. (2010). A regional perspective on the structural transformation of China's national innovation system since 1999. *Technological Forecasting and Social Change*, 77(8), 1311-1321.

252. Sunley, P., Martin, R., Gardiner, B., & Pike, A. (2020). In search of the skilled city: Skills and the occupational evolution of British cities. *Urban Studies*, 57(1), 109-133.

253. Tan, C.M. (2008). Economic Growth Nonlinearities. In: Palgrave Macmillan (Eds) *The New Palgrave Dictionary of Economics*. Palgrave Macmillan, London

254. Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic management journal*, 28(13), 1319-1350.

255. Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509-533.

256. Tödtling, F., & Trippl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research policy*, 34(8), 1203-1219.

257. Trippl, M., Todtling, F., & Lengauer, L. (2009). Knowledge sourcing beyond buzz and pipelines: evidence from the Vienna software sector. *Economic geography*, 85(4), 443-462.

258. Trippl, M., Tödtling, F., & Lengauer, L. (2009). Knowledge sourcing beyond buzz and pipelines: evidence from the Vienna software sector. *Economic geography*, 85(4), 443-462.

259. Truman, H. S. (1949). *Inaugural Speech*, Retrieved Mar 5, 2020, from: https://www.trumanlibrary.gov/education/lesson-plans/conflicting-views-point-iv

260. Ullrich, O. (1997). Technology. In: W. Sachs (Ed.) *The Development dictionary: A guide to knowledge as power*. Orient Blackswan. Hyderabad.

261. Uyarra, E. (2010), What is evolutionary about 'regional systems of innovation'? Implications for regional policy. *Journal of Evolutionary Geography* 20(1): 115–13

262. Verspagen, B. (2006). Innovation and Economic Growth. In: J. Fagerberg & D. C. Mowery (Eds.) *The Oxford Handbook of Innovation*. Oxford University Press, Oxford.

263. Wade, R. (2004). *Governing the market: Economic theory and the role of government in East Asian industrialization*. Princeton University Press, Princeton.

264. Werle, R. (2012). Institutions and systems: analysing technical innovation processes from an institutional perspective. In: J. Bauer, A. Lang, & V. Schneider (Eds.) *Innovation Policy and Governance in High-Tech Industries* (pp. 23-47). Springer, Berlin.

265. Whately, Richard ([1832]2009). *Introductory Lectures on Political Economy*. BiblioLife, Charleston.

266. Williams, R., Graham, I., Jakobs, K., & Lyytinen, K. (2011). China and Global ICT standardisation and innovation. Journal *Technology Analysis & Strategic Management* , 23(7), 715-724.

267. Williamson, J. (1994). *The political economy of policy refor*m. Peterson Institute for International Economics, Washinton.

268. World Bank. (1983). *World development report*. International Bank for Reconstruction and Development, Washington.

269. Yeoh, E. K. K., Liong, L. W. L., & Ling, S. Y. P. (2009). Fiscal Reform and Dimensions of Decentralization: Some Observations on China. In: E. K. K. Yeoh, C. S. Gee, W. C. C.

Yong, & J. H. L. Loh (Eds.) *China-ASEAN Relations: Economic Engagement and Policy Reform*. Institute of China Studies, Kuala Lumpur.

270. Zhang, X. (2018). Comparison between U.S. and China in terms of Patents. *China Merchants Securities*. Retrieved from: http://xqdoc.imedao.com/164d15c4c5788d13fe89d9dd.pdf.

271. Zhao, S.L. (2018), Chinese Silicon Valley: ZGC Chronicle, Economic Daily, 28 Nov 2018, Accessed 25 Mar 2019, from http://paper.ce.cn/jjrb/html/2018-11/28/content_378079.htm/.

272. Ziemnowicz, C. (2013). Joseph A. Schumpeter and Innovation. In: Carayannis E.G. (Ed) *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship*. Springer, New York.