

Cai, Yuzhuo

Article

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RESEARCH

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Implementing the Triple Helix model in a non-Western context: an institutional logics perspective

Yuzhuo Cai

Correspondence: yuzhuo.cai@uta.fi
Higher Education Group, School of Management, University of Tampere, Tampere 33014, Finland

Abstract

While there is a common belief among policymakers and academics around the world that Triple Helix relationships between university, industry and government provide optimal conditions for innovation, it should be noted that the Triple Helix concept has been developed from the experience of advanced economies in the West. There is a lack of theoretical considerations and empirical evidence on whether the Triple Helix model is applicable in non-Western contexts. Following the understanding that the evolution of an ideal Triple Helix model is facilitated by certain institutional logics in Western societies, this paper takes China as an example to examine how the institutional logics in China are different from those of the West and how the institutional logics in China would promote or impede the development of the Triple Helix model in China in light of an extensive review of the relevant literature and policy documents. The study suggests that to optimise the Chinese innovation policies, China needs on the one hand to adjust some elements of its institutional environment to facilitate the interactions between key innovation actors and on the other hand to be innovative in developing its own Triple Helix modes given the unique Chinese institutional environment which will persist in the foreseeable future.

Keywords: Triple Helix; Innovation system; Institutionalism; Institutional logics, China

Multilingual abstracts

Please see Additional file 1 for translations of the abstract into the six official working languages of the United Nations.

Background

The model of Triple Helix interactions between university, industry and government (Etzkowitz and Leydesdorff 1997, 1995), alongside its variations such as the Quadruple Helix (Carayannis and Campbell 2009) and Triple Helix twins (Etzkowitz and Zhou 2006), has been commonly used as a normative framework among researchers for understanding interactions between key actors in innovation systems. It has also become a common strategy of many governments in developing innovation policies. One central claim of the Triple Helix thesis is that the interrelations between academia, industry and government

provide the optimal conditions for innovation (Leydesdorff and Etzkowitz 1998; Etzkowitz and Leydesdorff 2000).

In spite of the popularity of the Triple Helix model, it has not been without problems. Among many other criticisms, one is that the Triple Helix model pays little attention to national contexts (Balzat and Hanusch 2004; Shinn 2002) and other social settings (Cooke 2005). Therefore the Triple Helix model can hardly provide appropriate rationales on which systematically structured criteria and indicators may be developed for researching, measuring and comparing different empirical cases (Mowery and Sampat 2004), especially when they are in different national and cultural contexts (Eun et al. 2006).

This implies that the Triple Helix model has not been fully developed to take into account the context effect, which is defined as “the set of factors surrounding a phenomenon that exert some direct or indirect influence on it” (Whetten 2009, p.31). It should be noted that the formation of the Triple Helix model is a result of inductive theorising mainly in the contexts of Western countries. The developers of the Triple Helix model, Etzkowitz and Leydesdorff, as well as their followers, do indeed acknowledge the differences between Western and non-Western countries and even notice the variations among Western societies. They have empirically examined Triple Helix models in different national contexts in the special issues of some journals (See examples: Saad and Zawdie 2008; Leydesdorff and Meyer 2003). Nevertheless, there is still a lack of united analytical frameworks to study the Triple Helix development in different national contexts.

Instead of calling for alternative theories for non-Western contexts (Liu and Jiang 2001; Williams and Woodson 2012; Eun et al. 2006; Zawislak and Dalmarco 2011; Bernasconi 2005), Cai (2013) attempted to enhance the context sensitivity of the Triple Helix by using insights of institutional logics, following the understanding that an innovation system is not only about complex functions and interactions among various organisational actors, including government, enterprises, universities and research institutes, but also interplays between these actors and institutions which may include, governmental policies and social norms (Edquist 1997; Lundvall 1992; Kumaresan and Miyazaki 1999; Nelson 1993; OECD 1999). Cai’s (2013) paper identified the institutional logics in which the Triple Helix model is grounded in Western societies and anticipated that these could be used as a basis to develop a benchmarking framework for understanding to what extent the Triple Helix model can be developed in other contexts, particularly non-Western ones. The author argued that, on the one hand, the different, sometimes even contradictory, institutional logics in a non-Western nation compared to the “ideal” in the West may cause barriers to implementing the Triple Helix model, and, on the other hand, the competing logics may also provide dynamics for social change as well as opportunities for innovation.

However, Cai’s (2013) framework has not so far been tested in any non-Western contexts. This paper will fill the gap by taking China as an example and examine how the institutional logics in China are different from those in the West, and whether the institutional logics in China (would) facilitate or impede the development of the Triple Helix model in China? The study is heavily based on review of the existing literature on the topic but interpreted following the framework.

Regarding the implementation of the Triple Helix model in China, there have been a number of studies since the Triple Helix concept was introduced into China for analysing innovation systems by Zhou (2006) and Zhou and Peng (2008). These studies include, for example, descriptions of Triple Helix relations between university, industry and government

(Xue and Zhou 2011), the development of the Triple Helix model in a specific industrial field (Zhang et al. 2013) or a specific region (Cai and Liu 2014), and some specific issues within the Triple Helix framework, e.g. the technology transfer between university and industry (Tang 2008; Rao 2013). These authors shared the view that the Triple Helix model is indeed the solution for China, but to achieve the end the road is hard due mainly to some unique characteristics of the Chinese context. However, few of them have tried to provide a systematic evaluation of the implementation of the Triple Helix model in China and especially offer theoretical accounts explaining related challenges and possible future development. This paper not only presents the status quo of Triple Helix implementation in China, but also, most importantly, contributes with an institutional logics perspective to diagnosing the problems and potentials for China to adopt the Triple Helix model. It also suggests that the differences between the institutional logics aligned with the originally Western Triple Helix model and local institutional logics in China will become a source of dynamics for innovation in China. As China is culturally and economically diverse, it is more relevant to analyse the institutional logics and compare the differences at the regional level.

Methods

The research methodology literature tends to indicate a correspondence between research question and methodological design (Johnson and Onwuegbuzie 2004; Newman and Benz 1998, p.24). This study is aimed to explore what are the institutional logics in China and how these logics may affect the patterns of Triple Helix in China in comparison with the logics aligned with the Triple Helix development in the West. As its main purpose is primarily for “the articulation of many truths in meaningful social actions, stressing how social experiences are created and given meanings” (Denzin and Lincoln 2003, p.13), thus a qualitative approach is employed in this study where the empirical work is located in theory or in an analytical framework (Thomas 1997, p. 87). The framework in this study is developed by Cai (2013) and will be introduced in the next section. The empirical data in this study include relevant literature, media reports and governmental reports, which are used as sources of evidences for the exploration.

Analytical framework

The Triple Helix model referred to in this paper mainly follows Etzkowitz’s (2008, 2002) interpretation, who distinguishes between three types of Triple Helix models. A desired or ideal model is overlapping triple helix relations between university, industry and government, but develops from two opposing standpoints, namely the statist and laissez-fair models. In the statist model, government controls both academia and industry, and is expected to take the lead in developing projects and providing the resources for new initiatives. Examples can be seen in the former Soviet Union, France and many Latin American countries. In the laissez-faire model, industry, academia and government are separate and independent from each other. These actors interact only modestly across strong boundaries. This model is typically exemplified by the USA. A global tendency is a move towards an overlapping or an ideal model, in which the three institutional spheres overlap and collaborate with each other. The model represents a change “from one of strong boundaries between separate institutional spheres and organisations to a more flexible overlapping system, with each taking the role of the other” (Etzkowitz 2002, p.2).

In Cai's (2013) study, the development towards the ideal Triple Helix model is seen from the perspective of dynamic evolution. Using the insights of institutional theory, he distinguishes four development stages in the process of the institutionalisation of the Triple Helix model. Institutionalisation is a process "by which social processes, obligations, or actualities, come to take on a rule-like status in social thought and action" (Meyer and Rowan 1977, p.341). Then the main activities for each stage are identified and aligned with a variety of ideal institutional logics, drawing on the context of Western countries (Table 1). Institutional logics can be generally understood as "the socially constructed, historical pattern of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organise time and space, and provide meaning to their social reality" (Thornton and Ocasio 1999, p.804). The institutional logics prevailing within one country will have a marked effect on how the actors communicate their interests, determine which problems are salient and which solutions are appropriate (Thornton et al. 2012).

Cai (2013) also suggests that when conducting Triple Helix analyses in a non-Western context, one must compare how the institutional logics there are similar/different to the existing institutional logics aligned with the Triple Helix development in the West. This is important for analysing how specific non-Western institutional logics may facilitate or constrain Triple Helix activities. In the next section, the institutional logics in China will be examined and compared to those of the West following the aforementioned framework. Before that, two points are worth noting.

First, the development of Triple Helix is a relatively long process. In many Western countries, it dates back to the 1980s and the 1990s. When looking at the development of Chinese innovation systems, scholars often trace back to the end of 1970s, when China initiated economic reforms together with the open-door policy (Wang and Zhou 2008; Xue

Table 1 Institutional orders in the evolution of Triple Helix model

Stages of development	Major Triple Helix activities	Favourable institutional logics
Stage 1 Realisation of the needs	Realising the importance of entering a reciprocal relationship between university, industry and government	<ul style="list-style-type: none"> Shared beliefs on knowledge as a key to economic growth (Logics of economic growth in the field of government and industry)
Stage 2 intra-organisational transformation	Taking the role of the other	<ul style="list-style-type: none"> Market oriented organisational cultures (Logics of market at the state level) Process oriented management culture in technology innovation (Logics of knowledge management in the fields of industry and academia)
Stage 3 interactions between organisations in the three sectors	Growing and innovating through cooperation with others Generating hybrid organisation	<ul style="list-style-type: none"> Effective protection for intellectual property rights and market participants (Logics of intellectual property at the field of industry) Civil society (Logics of civil society at the state level)
Stage 4	Feedback loops between policy-makers and participants	<ul style="list-style-type: none"> Competitive market environment (logics of competition in the field of university)
Institutionalisation of the Triple Helix model	Institutionalised norms of "entrepreneurial university", "knowledge-based formation and growth", and "innovation state" (Etzkowitz 2008).	<ul style="list-style-type: none"> Democratic policymaking process (Logics of democracy in the field of government)

Source: Cai (2013).

and Zhou 2011). Accordingly, here the analysis of the Triple Helix model development in China will cover the time span of the past 35 years, although the launch of an explicit policy towards the Triple Helix model was very recent, mainly reflected in the National Medium- and Long-Term Program for Science and Technology Development (2006–2020) by the State Council (2006).

Second, knowledge production organisations in China are composed of both universities and research institutes. From the 1950s to the 1970s, research institutes used to be the only sector for research, while universities' missions were primarily teaching. Being strongly influenced by the Soviet Union, the socialist government established a complex research institute system, the most important one being the Chinese Academy of Sciences. Meanwhile, higher education institutions and faculties were regrouped and aligned according to areas of specialisation. Since the 1980s, higher education reforms have adopted a model from the United States which emphasises the development of comprehensive and research universities. Thus the Chinese innovation system is referred to as a network consisting of actors like universities, research institutes, government agencies and enterprises. With respect to the Triple Helix model, both universities and research institutes (URIs) represent the spiral of knowledge production organisations.

Results and Discussion

Stage I: Realisation of the needs

Triple Helix activities and aligned institutional logics in the West

In the first stage, as suggested by Etzkowitz (2008, p.8), "a Triple Helix regime typically begins as university, industry, and government enter into a reciprocal relationship with each other in which each attempts to enhance the performance of the other". It has been commonly acknowledged that single organisational sectors alone can no longer respond to changes and uncertainties unless they cooperate with each other. In this stage, the collaboration between university, industry and government for enhancing the local economy is mainly through their traditional roles. For example, universities produce and transfer more knowledge to industry and society, while gaining additional funding sources from industry and government to strengthen the performance of research. The institutional logic aligned with the first stage activities is the social belief shared by government and industry that knowledge production and technology advancement are the key to economic growth and success in economic competition. While government and industry are motivated by the belief, the university's involvement in technology transfer in the initial stage is mainly driven by public policies and financial incentives.

Due to such belief, although many Western universities have suffered governmental budget cuts since the 1980s, the actual public funding spent on higher education has not declined but is being directed through more diversified channels. For instance, some public funding has been used to provide incentives and to promote university and industry cooperation for knowledge generation and knowledge transfer. Nowadays, one common governmental strategy is to concentrate funding on supporting research and development (R&D) in fast-growing or high-potential areas with the expectation that the investment will eventually pay off through economic growth led by the companies that benefit from cutting edge knowledge. For their survival or sustainable development, firms firmly believe, too, that innovation is the key (Cefis and

Marsili 2003) and in so doing they seek cooperation with universities in strengthening their R&D.

The logic concerning beliefs on knowledge as a key to economic growth and its impact on the Triple Helix development in China

Since the Chinese economic reform started in the 1978, Deng Xiaoping, the former national leader, had repeatedly stressed that progress in science, technology and education was fundamental to economic development and modernisation. When Jiang Zemin came to power in 1992, he addressed in the 14th National Congress of the Communist Party claiming that the emphasis of the economic construction should be placed on the track of depending on science and technology progress and people's improved culture and knowledge. In 1995, the strategy of "Invigorating the Country through Science and Education" was announced by the Chinese government (The Central Committee of the Chinese Communist Party and The State Council of China 1995) and since then it has been set as a basic State policy. The State has also earmarked funding for this strategy ever since it was included in the five-year plan for 1996–2000 (The State Council of China 1996). In spite of such a strategy endorsed by the central government, only in recent years did a shared belief develop among local governments and firms that technology advancement and innovation are the key to economic growth.

In the first 30 years of the economic reforms in China, local governments' main concern was how to maintain high GDP growth but by other means than taking effective measures to ensure technology advancement. This is to a large extent caused by the "local officials" promotion tournament, which was considered by Zhou (2007) as a model to explain the incentives for China's economic growth in the three decades since 1978. The promotion tournament was one kind of administrative governance model. It was designed by the upper level government to select the chief officials of the lower level based on competition, where the GDP growth rate was a key factor, along with others such as foreign direct investment, employment rate and social stability (World Bank and Development Research Centre of the State Council of China 2013). During the period from 1992 to 2000, the local governments found that the most effective way to maintain GDP growth was to control the land (Cao 2010): by acquiring rural land at lower prices and selling at higher prices in the market for urban use. They could easily shed their burden of the cost to promote economic growth and to strengthen their position in regional competition. "Supposing local governments have monopolistic control over the bulk of local resources, which is the case in China, and that they profit simply by selling off land. What incentive do these local governments have to develop an environment that fosters innovation and a knowledge based economy?" (Guo 2010). The competition did ensure the economic growth at a fast speed for 30 years, but at the cost of over-exploitation of natural resources and environmental degradation (OECD 2007).

Chinese industry is still dominated by manufacturing. Many of manufacturing companies' main concern for growth used to be in reducing production costs instead of seeking for value added products through technology advancement. Some studies in the late 1990s reported that Chinese firms were either reluctant to or less capable of technology innovation (Suttmeier 1997; Gu 1998). It was reported by the OECD (2007) that by the mid-2000s the positive contribution to the manufacturing trade balance came overwhelmingly from low-technology exports. Meanwhile, the high technology industries

were primarily under foreign control. The lesser demands from domestic firms for innovation also impeded Chinese universities' incentives to commercialise their knowledge and technology.

However, the situation is changing. While China has maintained very rapid economic growth over the past three decades, the low-wage and labour-intensive manufacturing as a main driver of economic growth has been challenged by emerging competitors in South East Asia as well as by China's domestic environmental degradation. To ensure sustainable development in the future, China has recently shifted its economic priority from labour-intensive production to capital-intensive and technology intensive production (The State Council of China 2006). In the new waves of reforms, the GDP growth is no longer a key factor in the promotion of local government leaders. Rather, local governments must be accountable for economic and environmental sustainability (Organization Department of the Central Committee of the Chinese Communist Party 2013). Since the export oriented manufacturing industry was seriously hit by the 2008 financial crisis, the pursuit of technology innovation has not only been the cry of the central government but also become important for enterprises and local government (Chen 2008; Wang and Li 2013). China is striving to find its own way to transform its economy by focusing on indigenous R&D, in contrast to the previous approach of relying on imported technology and equipment (Guan et al. 2009).

The rising awareness of technology and knowledge innovation as a key for sustainable economic growth may enable the "Triple Helix impetus" as labelled by Etzkowitz (2008), meaning that university, industry, and government realise the need to develop a reciprocal relationship. Although such a belief has just started to grow and it will take more time until it is deeply rooted in society, China is turning to gain a stronger normative basis for developing the Triple Helix. To strengthen the motivations of both URIs and enterprises to cooperate with each other, the Chinese government has also provided financial incentives and regulatory mandates. Both the normative and regulative drivers lead to the second and the third stages of Triple Helix evolution.

Stage 2: intra-organisational transformation

Triple Helix activities and aligned institutional logics in the West

In the second step, internal transformation is characterised by "taking the role of the other" (Etzkowitz 2008, p.9). This means that, in addition to performing its traditional tasks (as primary activities), each takes the role of the other (as secondary activities), but meanwhile university, industry or government respectively maintain their primary roles and distinct identities. In this stage universities engage directly in business activities, such as selling education and research services; companies further strengthen the R&D activities and even establish corporate universities to develop the skills of their professionals and managers; government also provides venture capital to help start new enterprises to promote potential economic growth. The supporting institutional logics for these activities are the cultures of 1) market orientation and 2) process management.

Taking the role of the other can be perceived as both organisations learning from each other and a way of organisational innovation. One of the main drivers for organisational learning and innovation is market orientation (Hurley and Hult 1998), which is defined as "the organisation culture that most effectively and efficiently creates the necessary

behaviours for the creation of superior value for buyers and, thus, continuous superior performance for the business” (Narver and Slater 1990, p.21). Adopting a market orientation approach in an organisation is about how the organisation is oriented to the market, paying more attention to consumers’ needs, competitors’ advantages, and inter-functional coordination (Narver and Slater 1990). Market oriented culture has been considered to be a key to enhance competitive advantages for organisations to best pursue interest and profit (Liao et al. 2011).

One competitive advantage that organisations are striving for is knowledge or technology innovation. “The innovation process is highly dependent on the knowledge accumulation and learning processes in the organisation” (Lopperi and Soininen 2005, p.4). To ensure knowledge accumulation and learning from existing knowledge, it is important to apply “process management” which “involves adherence to routines through the adoption of standardised best practices throughout an organisation” and “ensures that organisational processes are repeated, allowing for continued efficiency improvements” (Benner and Tushman 2002, p.678). In this light, innovation is more incremental and exploitative in nature rather than explorative. As distinguished by Benner and Tushman (2002), exploitative innovation builds on an existing technology trajectory, while explorative innovation involves a shift to a different technological trajectory. They further note that “organisations will innovate more rapidly as they incrementally improve innovation processes, yet the variance in the resulting innovation and/or new product development outcomes will be reduced” (Ibid., p. 680).

Lang (2009), a Hong Kong-based economist, observed that the success of technology innovation in the West is largely attributed to the culture of process management. The ethos of process management can also be reflected in research activities in the West. In a Western conception, research is basically about knowledge accumulation and transmission through the “trial and error” method and by following a rigid academic protocol (Lang 2009). It follows that new knowledge is always generated from existing knowledge and the process of knowledge generation is well-documented. Following the logic of process management, organisations’ competitive advantages when “taking the role of the other” are based on their existing know-how. Thus the Triple Helix model enables knowledge and technology organisations to contribute to innovation through incorporating existing knowledge/technology (Marques et al. 2006).

The logic of market orientation and its impact on the Triple Helix development in China

Although China has introduced market mechanisms since the end of 1970s, more profound development in market economy only commenced after Xiaoping’s call for accelerating economic reform and opening up of the economy to the outside world during his publicised tour to southern provinces in early 1992. Since then, organisations in both industry and university sectors have tended to be more market oriented. For instance, Liu et al. (2003) first comprehensively investigated to what extent Chinese state owned enterprises (SOEs) were market oriented and how this was related to the performance of the enterprises. The study found: 1) SOEs were relatively market oriented; 2) the higher market-oriented organisations tended to be more learning-oriented, reported more entrepreneurship in organisations, and achieved a higher level of organisational performance. It was also reported that the level of market orientation was high in companies in economically developed regions in China (Kaynak and Kara 2004). However, another empirical study on

one less-economically developed province in China showed that only under seven per cent of the sample firms could be considered to be truly market oriented by Western standards (Bathgate et al. 2006). The studies indicate an imbalanced development of market orientation.

It was argued by Qu and Ennew (2005) that it was the heritage of the socialist regime such as the stringent government regulations, ownership structure, and resource availability that greatly impeded market orientation in China. Indeed, China is in the process of transformation to a market economy, and the market system is still incomplete in many aspects, including a mix of market and non-market measures that shapes incentives for producers and consumers, a lack of clarity in distinguishing the individual roles of government, state enterprises and the private sector (World Bank and Development Research Centre of the State Council of China 2013) as well as the governmental “orientation towards control over resources” (Cao 2010, p.3). While acknowledging the relatively poor market orientation in the business sector, a bigger gap can be assumed among universities and research institutes in spite of a scarcity of research on the topic. While China is continuously making its economy more market oriented, the logic of market will be foreseeably more embedded in the organisational culture of both URIs and enterprises.

The logic of process management and its impact on the Triple Helix development in China

Regarding the culture of technology and innovation management, the Chinese practices are more goal oriented rather than process oriented due to the country's inherent cultural constraints (Lang 2009). Ignoring process management is associated with the Chinese mentality of being pragmatic. In other words, the Chinese are inclined to find short-cuts to outcomes (Lang 2009). Thus sometimes the Chinese prefer pragmatic half solutions over finding the root cause of failures, and technology companies are keen to reverse engineering as this is an easy way to get rich (Someren and Someren-Wang 2013).

In his study Lang he found that only 15% of Chinese enterprises believed that process management was the key to sustaining competitive advantage. The primary objective in the management of Chinese enterprises is to achieve their goals (Lang 2009), without paying much attention to documenting “routines that underlie the delivery of an organisation's product or service across the organisation” (Benner and Tushman 2002, p.678). In this manner, the foundation of technology innovation, namely knowledge accumulation and knowledge transmission, is ignored. As some empirical studies demonstrated goal oriented management has a negative relationship with innovation (Harms et al. 2010).

A similar problem can be seen in individual academics' management of their own knowledge production, e.g. research and academic paper writing. Traditionally, there are few rules about citation and attribution in Chinese academic writing (Zhang 2011). Sometimes, it is difficult to figure out what are the authors' own ideas/contributions and what is existing knowledge due to inappropriate citing in Chinese academic publications. Nevertheless, a western standard of judging the quality of academic papers has gradually gained legitimacy in the Chinese academic community.

The process management in knowledge production and technology innovation is very important for both efficiency and innovation in the processes (Benner and Tushman 2002). Thus some problems like low R&D intensity and poor R&D capability in China (Wang and

Li 2013) may be explained by the lack of process management in Chinese URIs and enterprises.

Both the logics of market orientation and process management sustain one of the key features of the Triple Helix—“taking the role of the other”, meaning that while engaging in the activities of the other field, one must maintain its core missions. As stressed by Etzkowitz (2006), while universities take the role of industry, they must adapt the business functions in ways that are compatible with their primary missions, namely research and training. He further warned:

The danger of the university mining its innovation store and failing to replenish it because of dependence on short-term commercial gains. The entrepreneurial university is not the industrialised university, a “job shop” subordinated to local firms. Rather, it is a research university that translates its research findings into use through a variety of mechanisms such as liaison offices, contracts with firms, patenting, licensing, and so on, giving the university some aspects of a business, while retaining its previous classical functions. (Ibid, p.319)

In China, some research institutes and even universities may run into the danger described by Etzkowitz. These organisations do not just engage with industry but actually become part of it. Many technology-oriented research institutes have been transformed into enterprises since 1999, when the government tended to stimulate these institutes’ awareness to compete in the market. Universities are likewise keen to set up their own businesses, mainly through establishing university-owned enterprises (UREs). However, merely changing a public organisation into a commercial entity does not necessarily make the organisation more market oriented. As many URIs become businesses, “this has led to the ineffectiveness of the so-called synergic innovation” (Wang and Li 2013, p.33).

Stage 3: Interactions between organisations in the three sectors

Triple Helix activities and aligned institutional logics in the West

During the process on “taking the role of the other”, organisational actors in the three sectors have respectively realised that engaging in others’ fields is a necessary but not sufficient condition for achieving the desired goals. In addition, the intra-organisational transformation also causes new challenges and demands within and across sectors. As a solution, they need even closer cooperation and interaction with each other (Etzkowitz 2008). Thus, the third step in the development of the Triple Helix is the evolution of trilateral interactions between the three sectors, characterised by increasing interdependency between the three spirals: One spiral has a significant influence on the other’s actions, and through the interactions, organisations in each spiral are able to find new ideas from the others to solve problems and meet new needs. For instance, a university’s knowledge production cannot be carried out by itself, but needs industry not only as a source of research problems but also as a strong partner in knowledge production. Meanwhile, university technology transfer is dependent on the conditions or environments created by the government. “The firm is thus transformed from a competitive unit related to other firms solely through the market to a Triple Helix entity increasingly based on relationships with other firms as well as academia and government” (Etzkowitz 2008, p.58). The interactions also result in the creation of hybrid organisations, such as incubators, joint

research centres, science parks, etc. With respect to the third stage, the key institutional logics in Western society are 1) legal protection of intellectual property (IP) and 2) civil society.

The most crucial development in Triple Helix inter-organisational relations is the cooperation and interaction between university and industry, founded on trust between the two parties. The trust is guaranteed by a mature institutional context for IP protection. For instance, the technology transfer between university and industry in the USA has only developed at a fast pace since the 1980 Bayh-Dole Act. As required by law, universities are able to retain ownership of inventions made on federally funded research. Thus a firm that engages in productising an invention patented by a university can hold an exclusive license once this is granted by the university.

According to Etzkowitz (2008), effective interaction between the three spirals is also subject to broad social participation, including both top-down and bottom-up initiatives. As such, the Triple Helix model can be best developed in a civil society, which allows free mobilisation and organisation, debate and initiatives, and hence encourages diverse sources of innovation. He further implies that successful Triple Helix operation is not coordinated entirely by the state, but also depends on the commitment at the local level as well as the inputs of a variety of innovation actors. It has also been argued elsewhere that as policies related to innovation systems are often confronted with issues that are both complex and controversial, one attempt to deal with such a complex problem is thus via citizen involvement (Griessler 2012).

Etzkowitz's position is consistent with the ideas of Quadruple Helix (Carayannis and Campbell 2009) in which society or the public is added as the fourth helix, but Leydesdorff and Etzkowitz (2003) do not consider the necessity of transforming the Triple Helix to Quadruple Helix by arguing that civil society or the public is the institutional foundation in which the Triple Helix has evolved. Although civil society is characterised by its alleged independence from the state (Perry and Fuller 1991), it cannot live without the state. Neither can it exist without reference to a market dominated by private actors. Rather, it serves as a buffer zone between the control of authorities and private initiatives (Seppälä 1992) and thus facilitates both top-down governance and grassroots initiatives to best interact and engage with each other in innovation processes (Carayannis and Campbell 2012).

The logic of IP protection and its impact in the Triple Helix development in China

China introduced IP legislation as early as 1950, and the Chinese IP laws have been developed more in line with international standards since the 1980s. Meanwhile, there has been a growing awareness that IP protection is a precondition for both China's domestic technology development and its access to advanced technologies from the developed countries. However, the problem in China is the inadequate reinforcement of the IP laws (Wang 2004). This results in a lack of trust between knowledge production and knowledge application organisations for developing effective and reciprocal cooperation relationships (Wang 2011). Therefore, universities feel it is safe and easy to commercialise the technology in their own circle (Xue and Zhou 2011). For this reason, particularly in the 1990s and early 2000s, universities primarily transformed their research outputs into market products through university-owned enterprises (UREs) rather than going through a long and complicated negotiating process with other enterprises (Eun et al. 2006). In Western

countries, establishing spin-offs is an interplay of academic entrepreneurs, parent organisations and venture investors. Chinese UREs try to perform all three roles at once, integrating several stages of the research, development and commercialisation process into one organisational entity (Kroll and Liefner 2008).

While all these problems are undeniable, IP protection in China has recently improved at a faster pace than ever, as evidenced by the surge in the number of China's patents (Hu and Jefferson 2009), the growth of foreign direct investment (Awokuse and Yin 2010b) and imports of technology-intensive products (Awokuse and Yin 2010a). Also, URE has declined recently, and has been replaced by other forms of university-industry links, such as collaborative research between universities and firms, education and training, information exchange between universities and firms, academic research, transferring proprietary technology (patent licensing), university science parks and spin-off companies (Eun 2009). In addition, many Western companies have learnt how to protect their R&D operations by themselves in the Chinese environment (Zhao 2006; Keupp et al. 2009).

The logic of civil society and its impact on the Triple Helix development in China

Civil society is a Western concept. When it comes to how civil society has developed in China there are mixed views and contradictory evidence, but it can be generally concluded that a civil society is emerging but slowly and in a different way from that in the West (Chamberlain 1993). What is relevant for understanding the Triple Helix development is that there are no functional mechanisms that could mediate between top-down control and bottom-up initiatives. For instance, in their study, Wu and Gong (2012) reported how a bottom-up innovation was blocked by the top-down control of local authorities. The authors called for China to adopt a "co-production approach" as commonly used in European countries, which sees ordinary people as resources and contributors in social and economic development, rather than as passive service recipients.

So far Chinese economic reforms and well as the development of national innovation systems have come from top-down initiatives. To encourage university and industry cooperation, the central government has invested heavily in national science parks and national R&D programmes. In a situation where there is less trust between academia and industry sectors, such an approach is practically useful especial for national priority projects. Yet, "it can also waste resources to generate prestige-driven flops" (Someren and Someren-Wang 2013, p.31) and "may fail to ensure adequate resources for emerging technologies" (WIPO 2007, p.15).

The Chinese government does realise the need to stimulate bottom-up initiatives, but lacks of effective policy measures. Due to the absence of civil society logics and effective mechanism to coordinate between top-down and bottom-up initiatives, the development paths for bottom-up initiatives may be diversified and unpredictable, depending on the decisions of some key bureaucrats and particular local conditions. For instance, Cai and Liu (2014) identify a new path of Triple Helix development in the case study of the Tongji Creative Centre, labelled the "delayed government-led mode", representing a different pattern than any of the three models described in the classic Triple Helix literature (Etzkowitz 2002; Etzkowitz and Leydesdorff 2000) or particularly the statist model deemed by Etzkowitz et al. (2007a) as the case in China.

In the initial stage, the interactions between Tongji University and the surrounding industry (mainly the university's spin-off companies) in the cluster were spontaneous and

there was no interference from any levels of governments. While the cluster of these companies grew very fast, it gradually got special attention from the Yangpu district government where the Tongji University was located. Then the cluster entered into the second development stage, in which the relations between university, industry and (district) government closely resemble the “ideal” Triple Helix mode. Here, the district government came into the picture as a partner, performing its role through “reflective control” (Etzkowitz and Leydesdorff 2000). The local government poured financial resources to promote the cluster’s development and also matched supportive policies. In the last stage, the Shanghai municipal government and the central government got involved and took control of the overall development of the cluster. Especially, the central government played an important role in integrating the university into the national innovation system, e.g. in building cross-regional linkages among the university, industry and local government and in maximising the intangible capital of the cluster through a number of influential programmes. Although the district government is still there, its role is on the one hand outweighed by the municipal and central governments and on the other hand has been transformed to be more encompassing. Such process is illustrated in Figure 1.

Stage 4: Institutionalisation of the Triple Helix model

Triple Helix activities and aligned institutional logics in the West

The final stage is the institutionalisation of the Triple Helix, meaning that the concept together with its associated activities has become a set of routines or practices that are being reproduced over time and tend to serve as a cognitive framework structuring the actions of key actors, such as academia, industry and government. To facilitate the institutionalisation process, two institutional logics are important, namely 1) the market competition environment and 2) democracy in policymaking. Both are important in the process of collective sense-making and belief shaping.

The institutionalisation of the Triple Helix may take many rounds of revisions and adjustments based on feedback of the participants. The importance of feedback loops in the evolution of the Triple Helix has been pointed out by Viale and Pozzali (2010): When a government tries to promote university and industry cooperation by introducing financial incentives for relevant participants, the effect is determined by either positive or negative feedback generated by the incentives’ impact on relevant actors’ behaviour; While negative feedback tends to produce resistance to change and leads to inertia, positive feedback breaks

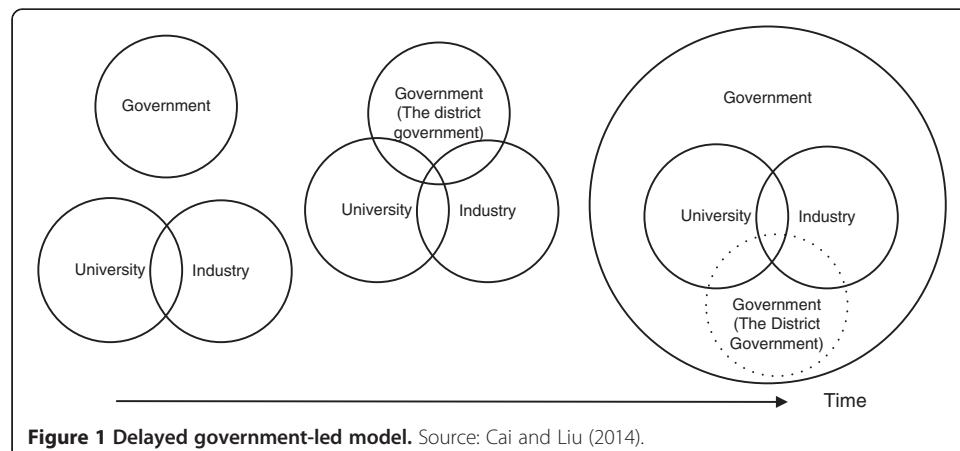


Figure 1 Delayed government-led model. Source: Cai and Liu (2014).

the stability of the status quo and catalyses change. Thus, the Triple Helix is likely to develop in competitive market systems, where feedback mechanisms are well developed.

To effectively establish the feedback from participants in the policy-making process also requires a political system in which social groups and individuals who are involved in and affected by a policy programme have a chance to influence the policymaking. As noted by Carayannis and Campbell (2012, p.3): “democracy shapes and drives government, academic, and industrial policies and practices and where a proper calibration of the issues addressed and the frequency modulation of the feedback received via [a democratic action] allows for higher order learning to impart intelligence and enact wisdom in choices and initiatives”.

The logic of market competition and its impact on the Triple Helix development in China

In China there is severe market competition, but competition mechanisms are not well developed. The market competition in China can be seen from two perspectives. First, there is a strong cross-regional competition originally driven by China’s transition to capitalism (Li et al. 2000), illustrated by the “local official promotion tournament” as mentioned early in Section “The logic of market competition and its impact on the Triple Helix development in China”. Second, there is unfair market competition between SOEs and private firms. This is because the SOEs have privileged access to business opportunities and key resources to exploit the opportunities. As documented in the report by the World Bank and Development Research Centre of the State Council of China (2013), SOEs have a close connection with the Chinese government by which the Chinese economy is controlled, occupy pillar industries where the entry threshold for private firms is extremely high in practice, and enjoy preferential access to finance and other important inputs. Hopefully such situations are going to change. In the Resolution concerning Some Major Issues in Comprehensively Deepening Reform issued by the Central Committee of the Chinese Communist Party (2013), a key message is to strengthen the role of market in allocating resources to intensify economic structural reform, e.g. by putting private firms on an equal basis to compete with SOEs in the marketplace.

While the further changes remain to be seen, currently it has been commonly acknowledged that market competition insufficiency has limited the innovation capability of Chinese enterprises (World Bank and Development Research Centre of the State Council of China 2013; Wang and Li 2013). Either being too easy or too hard to gain the necessary resources would demotivate the enterprises to engage with innovation. More importantly, due to the lack of mature market competition mechanisms, it is unlikely to develop healthy feedback loops for institutionalising the Triple Helix model.

The logic of democracy in policymaking and its impact on the Triple Helix development

Neither are the feedback loops supported by the policymaking system in China. The nature of the policymaking process in China differs from case to case. As Yuan Zhenguang pointed out, “in terms of educational policy-making process, there is no obvious model and given procedure to go by” (Yuan 2000, p.174). Some policies are based on policymakers’ occasional discoveries or subjective decisions; other policies are determined by irrational factors such as policy makers’ interests or even personalities (Yuan 1996). However, China is now trying to change its political system, though the pace is slow. Some progress can be seen in the process of preparing the *Outline for Medium and Long-term Education Reform and Development (2010–2020)*, where there was a dramatic increase in the use of social participation in the document drafting processes. Not only were hundreds of experts

involved in the policymaking process, but the opinions of society were openly collected (Cai 2011). Nevertheless, there is no institutional guarantee of democracy in policymaking.

Many studies on Chinese innovation systems (Wang and Li 2013; Wang and Zhou 2008; Liu and White 2001), Triple Helix (Xue and Zhou 2011; Zhang et al. 2013; Zhou and Peng 2008) and university and industry linkages (Chen 2012; Liu and Jiang 2001; Eun et al. 2006) have pointed out a number of challenges in China and also provided policy recommendations. Although these studies have been published in a time span of more than a decade, the challenges and suggestions identified there are very similar. The major challenges include low degree of technology transfer between university and industry, weak IP protection, insufficient competition coordination for innovation, etc. The policy recommendations are all about measures to solve these problems and improve the institutional environment for innovation. This situation shows a problem in the policymaking process: feedback can hardly be assimilated by policymakers.

Conclusions

The Triple Helix model not only serves as a framework for understanding relationships and interactions between key actors in Chinese innovation systems, but has also become salient in Chinese national industrial and science and technology policies. However, what remains unknown in the existing studies is how well the Triple Helix relationships have been developed and what affects the development of the Triple Helix interactions (Wang et al. 2013). To better understand these issues, this study identified some key institutional logics in the Chinese context and discussed their impact on the development of Triple Helix in China.

The study indicates that although Chinese economic reforms have changed the policy environment in a direction that may facilitate the implementation of the Triple Helix model in China, some institutional logics at work may shape its development in a different way as seen in the West. The institutional logics that are gradually coming closer to those of the West include: 1) beliefs in technology innovation as a key to economic growth, 2) market orientation, 3) IPR protection, and 4) market competition. The other three institutional logics, namely 1) process management, 2) civil society, and 3) democracy in policymaking, aligned with the Triple Helix activities in the West are largely absent in China. The counterparts of these logics in China are deeply rooted in the Chinese traditions and political system, and are likely to persist in the foreseeable future.

The contribution of this study to the literature on the Triple Helix, particularly in the context of China, is three-fold. First, the study has primarily proved the relevance of an analytical framework developed by Cai (2013) on the context-effect of Triple Helix on non-Western countries. It shows that the seven dimensions for understanding the institutional logics aligned with Triple Helix activities in Western countries serve a relevant tool for understanding the institutional logics in China. As the study is strictly guided by the framework, however, whether there are other institutional logics that are beyond the seven dimensions, but affect the Triple Helix development in China, remains for future research to find out.

Second, with the understanding of institutional logics in China based on the study, one may better explain the reasons behind the problems in the development of Chinese innovation systems. A number of scholars (Wang and Li 2013; Liu and Jiang 2001; Liu and

White 2001) attribute the problems in Chinese innovation systems to China's institutional environment, but none of them has detailed what the Chinese context is. This study is a pioneer in decomposing the abstract concept of Chinese context into a set of institutional logics with respect to Triple Helix development. This offers the opportunity to make a more accurate diagnosis of what institutional elements of the Chinese context cause what problems. Thus, more pertinent policy recommendations can be expected. This will necessitate further in-depth analyses. Although this study addresses a number of "common" institutional logics in China, the situations may differ from one region to another. Therefore more detailed analysis must focus on regional levels.

Third, the institutional logics perspective and especially the mapping of institutional logics in China may provide a normative framework for designing Chinese innovation policies, e.g. its own Triple Helix models. To this end, a variety of models of interaction between university, industry and government at both national and regional levels needs to be examined. The empirical information gathered from these practices will be used to make two kinds of analysis: what institutional logics impede the implementation of the Triple Helix model in China? And what models of university-industry-government interactions best suit China's institutional environment.

The investigation of the first question is mainly to achieve a better understanding of how to plan institutional changes. Developing an innovation system is not merely about how to manipulate the relations of academia, industry and government for technology innovation, but is also a matter of adjusting the institutional environment or institutional innovation. Therefore, to successfully construct China as an innovative country it is about how China can manage institutional changes. Designing and making institutional changes is very complex and complicated. Among many other things, the starting point is to know what needs to change and how possibly to achieve this. In this regard, few studies and discussions exist in China. This study is indeed an attempt in that direction, but is rather preliminary.

The study of the second question might be more relevant to Chinese innovation policy-making. Given that some institutional logics are unlikely to undergo significant change in the near future, it is more relevant to think how to be effective within the current institutional constraints. As claimed by Friedland and Alford (1991), the contradictions inherent in the differentiated set of institutional logics provide individuals, groups and organisations with cultural resources for change. In this light, Liu and White (2001) further argued that when China develops its national innovation system, the differences in the initial conditions between China and the West are not the barriers to change but rather a basis on which to create a new system. In other words, China should try to be innovative in developing its own Triple Helix models, instead of simply adopting the one that has proven successful in the West. Actually, the experience of Tongji Creative Cluster in Shanghai has already demonstrated successful models, for instance the one, called "delayed government-led model" proposed by Cai and Liu (2014), but it would be useful to analyse more cases with institutional logics thinking in mind. Nevertheless, some ideas concerning an indigenous Chinese Triple Helix model can be speculated.

Given the Chinese context, particularly the political system, it is inevitable that the State has a central role in the innovation processes. Especially for profound industrial projects, it would be difficult to achieve the desired goals without the central control and coordination of the state. In spite of such fact, a statist model is not necessarily the only option, though it is more or less the case in the national innovation system in China. As China is huge and

diverse, it has been argued that provinces are the basic units for developing innovation systems in China (Chen and Guan 2011). The specific Triple Helix models for innovation may differ across regions, depending on local economic development conditions. Among those, the most successful ones must properly handle two issues: one is about the IP protection when it comes to the technology transfer from academia to industry and the other is about how to promote bottom-up initiatives. While China is still striving for building up effective IP protection system, in the current situation the companies that more effectively participated in Triple Helix interactions are the university spin-off enterprises and the firms in science parks. In a situation where there is less trust between academia and industry due to the weak protection of intellectual rights in China, establishing national science parks coordinated by the State is practically useful, especially for national priority projects.

It has been criticised that the main problem in China's innovation system development is the lack of functional mechanism mediating between top-down and bottom-up initiatives (Gu and Lundvall 2006; Etzkowitz et al. 2007b; Etzkowitz 2008). The Chinese government does realise the need to stimulate bottom-up initiatives, but lacks effective policy measures. In the Chinese context, it may be safe to say that bottom-up initiatives from universities and university spin-offs are more likely to be taken by regional governments, which have no administrative power over the universities. For instance, in the case of Tongji Creative Cluster where the Tongji university' and its spin-offs' bottom up initiatives are integrated into the district government's economic development planning, the university is under the joint jurisdiction of both the central government and the Shanghai Municipal Government. Within such an administrative framework, it is actually impossible for the district government to exercise much stronger control over the university or the university's engagement with the surrounding society. Therefore, the interaction and cooperation between the university and local government are on equal basis (Cai and Liu 2014). Such story also denotes that to best combine top-down and bottom-up initiatives, Chinese universities must be more independent from the government.

Additional file

Additional file 1: Multilingual abstracts in the six official working languages of the United Nations.

Competing interests

The author declares that he has no competing interests.

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