

The Economic Geography of Urban Water Infrastructure Investment and Governance

– A Comparison of Beijing and London

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ABSTRACT

Urban infrastructure is the key physical asset for successful functioning of modern cities. Yet the building and maintaining infrastructure networks require robust institutions, either expressed explicitly in rules and regulations or implicitly in social norms and mutual expectations, which are crucial for governing the complex relationships among all stakeholders including governments, regulators, investors, utilities and consumers that underpin the production of infrastructure services. Although there are more and more studies focusing on infrastructure, the underlying institutions that sustain the ‘sink’ of long-term accumulation of finance, technology, organisational and geopolitical power for shaping urban landscape have often been neglected. In particular, few studies have investigated the uneven geographical phenomenon of urban infrastructure investment and governance. As such, this thesis compares and explores how and why political, institutional and governance frameworks in Beijing and London influence urban water infrastructure investment and service delivery differently. The findings from the comparative study of the thesis should assist better understanding of ‘variegated capitalism’, especially state capitalism versus liberal capitalism.

Through case study and close dialogue methodology, this thesis compares and investigates the investment models, governance frameworks, pricing systems and infrastructure contracts for urban water infrastructure in Beijing and London from the perspective of economic geography. Based on the theories of institutional and relational economic geography, this thesis organizes the study into four substantive chapters: Chapter Three compares the investment models employed in Beijing and London for water infrastructure investment and the underlying institutions; Chapter Four explores the effects of different governance frameworks on urban water infrastructure investment and service delivery in Beijing and London; Chapter Five investigates the effects of different pricing systems in the two cities for coordinating the intrinsic, market and investment value of urban water infrastructure; Chapter Six analyses different infrastructure contracts for financing large-scale water infrastructure projects in the two cities. The thesis finds that institutions are embedded in time and space for harnessing the flows of capital and producing the configurations of infrastructure provision, thus shaping the heterogeneous landscape of the material, economic, social and geopolitical fabric of contemporary cities. Therefore, in contrast to the statement ‘form follows function’, this thesis argues that infrastructure functions are inherently geographical in nature.

The thesis has made the following contributions: firstly, it has compared the various trajectories of urban water infrastructure investment and governance in different political economic contexts, especially the dialogue between Global North and South, making original contribution in the ‘geography of infrastructure’; secondly, the thesis employs cases studies to compare and investigate institutions empirically – issues that have been neglected for much too long in mainstream economic geography, contributing to ‘variegated capitalism’; finally, in practical terms this research provides information for governments, regulators, investors, infrastructure providers and other stakeholders on in-depth understanding of urban water infrastructure investment and governance in different institutional and relational contexts.

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Weston David Reading Room of Bodleian Library, University of Oxford
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CHAPTER ONE: INTRODUCTION

“The test of a first-rate intelligence is the ability to hold two opposed ideas in mind at the same time and still retain the ability to function.”

F. Scott Fitzgerald

“It is my great honor and privilege to be selected as the President-designate of the Asian Infrastructure Investment Bank (AIIB). ... The Bank that we are establishing is unique in many ways. This will be a financial institution for infrastructure development with the 21st century governance. It will be an organization that fully reflects the views, voices and values of all its shareholders. It will strive to combine the many strengths of the existing multilateral development banks with best practice from the private and commercial sector. ...I have set myself two overarching priorities: The first is to develop a strong institutional culture that is grounded in the highest principles and ethical standards. ...The second is to deliver financing and services to clients that is catered to their needs. ...”

Statement by Jin Liqun at a Press Conference in Tbilisi, August 24, 2015

1.1 Introduction

Few issues can cause global attention and require concerted effort worldwide, and infrastructure is one of the few exceptions. It was estimated that by 2030 more than \$53 trillion (OECD, 2006) or \$57 trillion (McKinsey Global Institute, 2013) in global infrastructure

investment will be required to simply keep up with projected global GDP growth. Although OECD countries have much of their infrastructure stock in place, they will require very significant amounts of investment to replace and upgrade aging infrastructure over the next two or three decades (OECD, 2006). At the same time, a rising share of global infrastructure investment will be conducted in the emerging markets and developing economies (EMDEs) to remove barriers for economic growth and enhance living standards for citizens (World Bank, 2014). The task of financing global infrastructure demands becomes more complex and challenging due to constraints on public-sector budgets and commercial debt in the wake of Global Financial Crisis (GFC), higher standards and stricter regulations for the environment, and the additional costs of adaptation and mitigation for climate change (McKinsey Global Institute, 2013). As such, infrastructure has become priority in the agenda of governments worldwide. In July 2014, the US President Barack Obama announced a new executive action to create the Build America Investment Initiative, a government-wide initiative to increase infrastructure investment and economic growth by facilitating partnerships between federal, state and local governments and private sector investors (The White House, 2014). In a statement in publicising the scheme of more than 200 infrastructure projects, the UK Prime Minister David Cameron said “Ensuring Britain has first class infrastructure is a crucial part of our long term economic plan: supporting business, creating jobs and providing a better future for hardworking people” (The Guardian, 2014). During their respective visits to Southeast Asian countries in October 2013, Chinese President Xi Jinping and Premier Li Keqiang announced the initiative to set up a new multilateral financial institution Asian Infrastructure Investment Bank (AIIB) to foster sustainable economic development, create wealth and improve infrastructure connectivity in Asia by investing in

infrastructure and other productive sectors (AIIB, 2015).

Why is infrastructure so important to modern society? How big is the contribution of infrastructure to aggregate economic performance e.g., the level and/or growth rate of GDP? The answers to these questions are complicated, partly because some of the value of infrastructure is difficult to quantify and has not been fully understood yet (Rosewell, 2013). In fact, in order to answer those questions, we need firstly get to know what is infrastructure. Nonetheless, there is no separate field of infrastructure study, and there are no settled universal theories or even definitions of infrastructure (Frischmann, 2012). Having no common definition of infrastructure makes it difficult to compare different infrastructure studies or to develop uniform policies in terms of infrastructure (Infrastructure Canada, 2007). In Black's Law Dictionary, the standard definition of infrastructure refers to the "underlying framework of a system" or the "underlying foundation of a system" (Black's Law Dictionary, 2009). Hansen (1965) distinguishes infrastructure into economic and social according to how they act on the level of economic development of a territory in direct or indirect way. Economic infrastructure, which includes road, highway, airport, electricity network, gas network, networks for water supply and sewer directly supports productive activities; while social infrastructure refers to those finalized to increase social comfort including schools, hospitals, sport structures, green areas, structures for public safety, and so on (Hansen, 1965). This thesis focuses on one kind of economic infrastructure: urban water infrastructure system providing water supply and sewerage services in cities.

There are ongoing, hotly contested debates in economics about the costs and benefits of infrastructure – for example, about the degree to which particular infrastructure investment contributes to social welfare or economic growth, and about how to prioritise infrastructure

investments in developing countries (Frischmann, 2012). The seminal work of Aschauer (1989) estimated that a 1% increase in investment in public infrastructure will result in a 0.24% increase in the output of the private sector, so he argued that the decline in productivity growth during the 1970s was largely due to a decline in public investment in infrastructure. Nonetheless, Gramlich (1994) pointed out that Aschauer's approach was defective and his work resulted in "pretty stratospheric estimates of the marginal product of government capital". Evans and Karras (1994) even arrived at the conclusions opposite to Aschauer's work that increased stocks of public capital were the result of increased productivity and economic growth rather than the cause, thus "there is no evidence that government capital is highly productive". The economics of infrastructure is so complex that economists sometimes refer to infrastructure "opaquely" as "social overhead capital" (Button, 1996). Regardless, it is widely recognised that economic infrastructure can generate significant spillovers or positive externalities that result in large social gains (Steinmueller, 1996), although the externalities are sufficiently difficult to observe or measure quantitatively, much less capture in economic transactions, and the benefits may be diffuse and sufficiently small in magnitude to escape the attention of individual beneficiaries (Frischmann, 2012).

Despite the contested debates on infrastructure outlined above, those arguments are focused on the functional role of infrastructure. There are two fundamentally different frames of reference for analysis of infrastructure: the institutional perspective versus the functional perspective. Too often the institutional roles underlying the functional roles of infrastructure across space are ignored. A case in point is that the International Monetary Fund (IMF) and the World Bank do not claim to know the local circumstances of their borrowers, and exhorted all countries to undertake similar policies without properly analysing the likely effects of them (Woods, 2006). By using

water utility as an example, Atif Ansar (2010) distinguishes that the functional perspective places emphasis on the supply of water and why anyone might want to consume it while the institutional perspective concerns about ownership of infrastructure assets, market structure, internal efficiency and regulation. The US National Research Council (NRC) proposed a more comprehensive notion of infrastructure that included “the operating procedures, management practices, and development policies that interact together with societal demand and the physical world” to facilitate “the provision of a range of services including the transport of people and goods, provision of water for drinking and other uses, safe disposal of society’s waste products, provision of energy where it is needed, and transmission of information within and between communities” (National Research Council, 1987). The NRC recognised three conceptual needs that are central to the research undertaken in this thesis: first, the need to look beyond physical infrastructure facilities; second, the need to evaluate infrastructure from a systems perspective; and third, the need to acknowledge and more fully consider the complex interactions between institutional role and functional role of infrastructure in different geographical contexts. As such, this thesis diverts attention from ongoing debates on infrastructure from the functional perspective, and focuses on investigation of the infrastructure landscape from the institutional perspective. The thesis chooses Beijing and London to analyse heterogeneity in the political, institutional and governance frameworks underlying urban water infrastructure investment and service delivery in the two cities. In particular, this thesis challenges the statement “form follows function” proposed by Robert C. Merton and Zvi Bodie (2005). By proposing a functional approach to designing and managing the financial systems of countries, regions, firms, households, and other entities, Merton and Bodie (2005) argue that “in the longer run, after institutional structures have had time to fully develop,

the predictions of the neoclassical model will be approximately valid for asset prices and resource allocations”. This thesis, by comparing urban water infrastructure investment and governance between Beijing and London, shows that, at least in the field of infrastructure, there is no optimal form for successful function of infrastructure investment and governance in different institutional and relational contexts, and the heterogeneous landscape of infrastructure investment and governance requires a new multi-disciplinary framework taking geographical factors into account.

1.2 Comparative framework

Just like trying all means to reveal the mysteries of nature, human beings have been investigating recipes for running economic and financial systems of modern society, though the latter is no less complicated than the former. There is abundant intellectual legacy left by many renowned economists devoted to understanding and explaining the complex mechanisms underlying economic and financial systems. The most famous and controversial viewpoints among them are the “state intervention” model by John Maynard Keynes (1933) and the “free market” model by Friedrich Hayek (1944). After the World War II, many countries adopted the Keynesian model to develop their economies including infrastructure development. In the late 1970s, liberalism promoted by Hayek began to prevail in the Anglo-American world firstly, and then in other parts of the world. Since that period, many sectors including infrastructure have been privatised or franchised. After the Global Financial Crisis (GFC) in 2007, public scepticism about the free-market capitalism has led to the resurgence of Keynesian government intervention. Many governments worldwide have adopted fiscal stimulus plans to head off the worst effects of recession. Even Britain which is renowned for privatisation of its infrastructure has seen the gradual return of the state in its infrastructure policy (Helm, 2013). It seems intriguing that almost

a century has passed yet we still cannot claim that we have found the recipes for running the complex economical and financial systems of modern society.

One of the most important reasons for our failure in understanding the complex economic and financial systems is economy and finance are inherently intertwined with institutional and cultural contexts, yet unfortunately these difficult-to-quantify factors have often been neglected in mainstream economic and financial analysis. A case in point is the continuing debate over whether the Chinese model is a complement or a threat to current global economic and financial systems dominated by the West has often ignored Chinese unique institutional and cultural contexts which are different from the West. It was perhaps a historical coincidence that, when Ronald Reagan and Margaret Thatcher promoted neoliberalism across the Anglo-American world in the 1980s, China's Deng Xiaoping initiated 'reform and opening up' (改革开放) for the fundamental restructure of China's economic development model, which essentially shares the common neoliberal elements of marketization, privatisation, deregulation and globalization (Harvey, 2005; Lin et al., 2014; Peck et al., 2009; Wu, 2008). However, the Chinese model, which has divergent characteristics with US-style 'liberal market economies' (LMEs) and German-style 'coordinated market economies' (CMEs), has been a white space on the map of the 'Varieties of Capitalism' (VoC) debate (Peck and Zhang, 2013). Recently, however, especially after the GFC in 2007, the Chinese model has received much attention and it is labelled as 'state capitalism' which is 'the most formidable foe that liberal capitalism has faced to date' (Economist, 2012a) because it is 'governed by a system that is out of step with global norms' (Economist, 2012b). Nonetheless, this thesis argues that the comparison of Chinese model with other countries' models is meaningless if different institutional and cultural contexts are not taken into account. In contrast with the

statement ‘form follows function’ (Merton and Bodie, 2005), this thesis argues that infrastructure functions are inherently geographical in nature, and complete convergence and integration of forms are impossible. In this context, the thesis creates the comparative framework of urban water infrastructure in Beijing and London for investigating various trajectories for urban infrastructure investment and governance in different institutional and cultural contexts.

China has achieved phenomenal urbanisation in the past three decades with an unprecedented scale and speed (Lin et al., 2014). As shown in Figure 1.1, China’s urban population size expanded from 172 million in 1978 to 731 million in 2013 and its percentage of the total population increased from 17.9% to 53.7% during the past 35 years period (China State Statistical Bureau, 2014). Meanwhile, China lifted more than 600 million people out of poverty between 1981 and 2004, with the incidence of poverty declining from 85% in 1981 to 27% in 2004 (World Bank, 2010a). To some extent, China’s achievement in the past few decades was due to its government-led infrastructure development. Nonetheless, few studies have investigated China’s government-led model for urban infrastructure development, and how China has financed its rapid urbanisation remains rarely analysed (Wang et al., 2011; Wong, 2013). Compared with cities in Global North where the state is described either as being ‘hollowed out’ or being influenced by the pervasive and irresistible power of global finance, cities in China have been mainly shaped by domestic and local political relations (Lin et al., 2014). Although most industries have been opened up to market, some industries including infrastructure are still dominated by state-owned or state-controlled companies in China. Furthermore, despite the remarkable achievement in urbanisation and poverty reduction, China is still a large developing country which needs further infrastructure development and continued urbanisation to enrich more people (Figure 1.2). Given

the growing demand for infrastructure provision and increasing local debt risk, China has launched new initiatives to restructure its government-led model for infrastructure development to attract more private capital especially long-term institutional investors for infrastructure investment (China News, 2015).

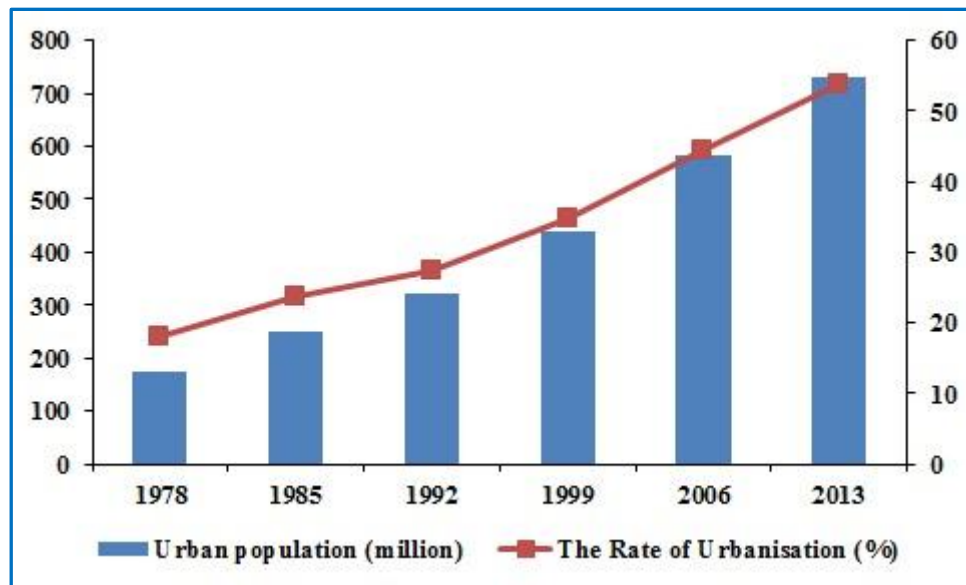


Figure 1.1 Urbanisation in China

Source: (China State Statistical Bureau, 2014)

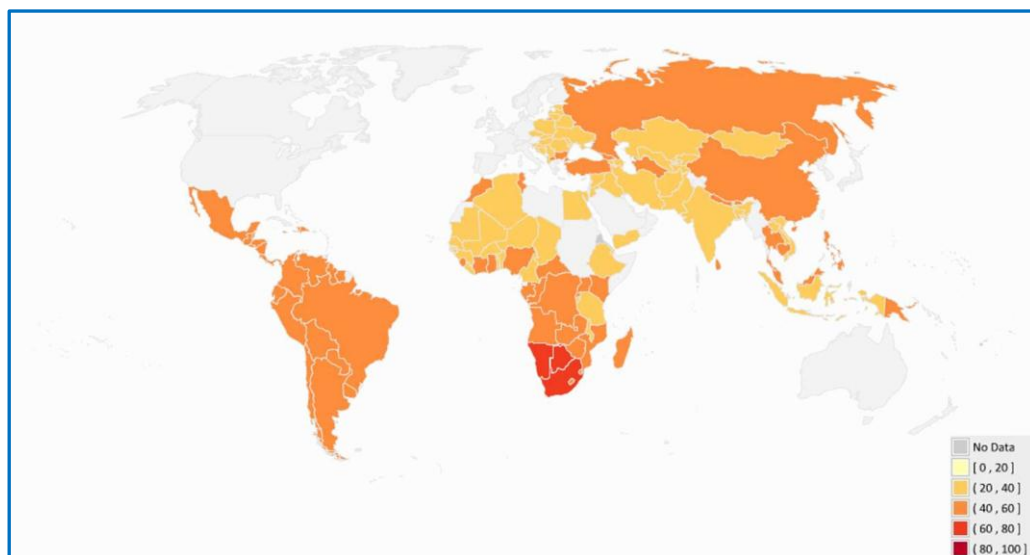


Figure 1.2 Poverty Headcount Ratio (%), at US\$1.25 a day

Source: (World Bank, 2010b)

Around the world, almost no other country like Britain has completely privatised its infrastructure sectors including water infrastructure (Bakker, 2003). Although infrastructure networks are the physical assets that bind cities together into functional economic geographies (Graham and Marvin, 2001), the core characters of infrastructure in terms of ownership, financing, regulation and use rights have varied dramatically through time (Doig, 1990, 2001; Eichengreen, 1995). Since the 1970s, there has been a shift away from integrated, bundled infrastructure networks towards privatised and customised financial products (O'Brien and Pike, 2015), with cities and regions valued merely on a quarter-to-quarter basis (Babcock-Lumish and Clark, 2005). The trend to the privatisation of ownership, financing and operation of infrastructure, accompanied by user fees and tolls, is labelled as the 'financialisation of infrastructure' (O'Neill, 2013). The changing urban infrastructure landscape which has become interlinked with global flows of finance capital has led to 'splintering urbanism' (Graham and Marvin, 2001) causing cities to splinter between those who have the private means to use the city's infrastructure and those who do not (O'Neill, 2010). Moreover, the local unbundling and global interlinking is changing the landscape of infrastructure in Britain, as arm's length regulators are created and the relationships between governments, regulators, investors and operators are defined by contractual mechanisms (Babcock-Lumish and Clark, 2005). The 'financialisation of infrastructure' has forged a new style of 'glocal' governance of infrastructure through which infrastructure is owned by global owners and regulated by local actors (Torrance, 2008, 2009). Nonetheless, this burgeoning research field still remains underdeveloped, and more empirical studies should contribute to better understanding of this changing infrastructure landscape (O'Neill, 2013; O'Brien and Pike, 2015; Sharma, 2012; Torrance, 2007).

The thesis is structured across four substantive chapters with each comparing and analysing a specific aspect of urban water infrastructure investment and governance in Beijing and London. The overarching theoretical framework for the thesis is firstly introduced in Chapter Two. Chapter Three compares the investment models for urban water infrastructure in Beijing and London. Chapter Four investigates the institutional governance of urban water services in the two cities. Chapter Five analyses water pricing systems of the two cities for coordinating the values of urban water infrastructure. Chapter Six explores the infrastructure contracts for financing large-scale water infrastructure projects in the two cities. Through a detailed analysis of these issues from institutional and relational perspectives, this thesis aims to contribute to a better understanding of the heterogeneous landscape of urban water infrastructure investment and governance in different institutional and relational contexts.

1.3 Aims and Significance of Research

This thesis has situated itself in the field of economic geography to employ a ‘geographical lens’ (Bathelt and Glückler, 2013) to analyse the uneven landscape of urban water infrastructure investment and governance in Beijing and London, and to explore the underlying reasons for the differences from the perspective of institutional and relational economic geography. As such, the thesis is not intended to conduct in-depth quantitative analysis of urban water infrastructure investment and service delivery in the two cities. Instead, the thesis is focused on in-depth understanding in geographical perspective of economic agents and invisible relationships responsible for capital flow and service delivery of urban water infrastructure. The thesis introduces urbanism, political economy, institutional governance, pricing regulation, transaction

cost and contract theories into the geographical discourse. The overarching aim of this thesis is to compare and analyse how the different political, institutional and governance frameworks influence urban water infrastructure investment and service delivery in Beijing and London. As such, the thesis has four aims with each aim focusing on a particular aspect of urban water infrastructure investment and governance.

Aim 1: *To examine how investment models in Beijing and London vary for urban water infrastructure investment and what the underlying institutions are for the different landscapes of urban water infrastructure investment in Beijing and London.*

The first aim of the thesis is to compare and analyse how Beijing and London finance urban water infrastructure, why the two cities choose different investment models, and what the underlying urbanisms are for the spatial difference of urban infrastructure landscape shaped by various infrastructure investment models in different geographical contexts. By using Beijing and London as empirical cases to investigate the spatial heterogeneity of infrastructure investment models and the underlying urbanisms in the era of globalization, Chapter Three aims to illustrate that “finance is inherently geographical in nature” and to make a contribution to ‘Geography of Finance’ (Clark and Wójcik, 2007). Furthermore, Chapter Three also contributes to the understanding of various trajectories in Global North and South for urban infrastructure investment.

Aim 2: *To explore the effects of different institutional governance in Beijing and London on urban water infrastructure investment and service delivery.*

Chapter Four aims to explore how different political, institutional and governance frameworks influence urban water infrastructure investment and service delivery in Beijing and London. The comparison of urban water governance models in Beijing and London seeks to illustrate how the interactions between institutional environment and institutional arrangement vary across space, and how the different interactions shape local water service performances. Since the public sector takes the lead in urban water provision in Beijing while the private sector does so in London, the significance of research in the chapter is to contribute to hotly contested debates on state capitalism versus liberal capitalism. Moreover, Chapter Four aims to contribute to ‘Geography of Capitalism’ (Dixon, 2014) and to fill in the need for better understanding ‘capitalism with Chinese characteristics’ (Peck and Zhang, 2013).

Aim 3: *To analyse the performances of different water pricing systems in Beijing and London in coordinating intrinsic value, market value and investment value of urban water infrastructure services.*

Chapter Five aims to compare and analyse how different water pricing systems in Beijing and London coordinate intrinsic value, market value and investment value of urban water infrastructure services. Through empirical investigation and comparative study, the chapter seeks to investigate the water pricing system from a systems perspective. By analysing the underlying

governance frameworks behind water pricing systems in the two cities, Chapter Five makes contribution to ‘Geography of Governance’ (Liverman, 2004; Seldadyo et al., 2010) which concerns whether and how to put a price on environmental services and who should make environmental decisions. In particular, since current mainstream economic methods fail to identify “the hard-to-quantify benefits that infrastructure projects can bring” (Rosewell, 2013), pricing nature and governing the environment are important elements of the geographical discussions of how to respond to processes of globalization, financialisation and global environmental change as well as their impacts on people around the world (Liverman, 2004).

Aim 4: *To understand different contract designs in Beijing and London for financing large-scale urban water infrastructure projects.*

The aim of Chapter Six is to compare and explore the government-led contract in Beijing and the regulatory-led contract in London for financing large-scale urban water infrastructure projects. Two cases are chosen for the comparative study: South-to-North Water Diversion Project in Beijing and Thames Tideway Tunnel Project in London. Both projects have similar scale of investment amount, but the two cities choose different contracts and investment models for financing the two projects. Through close dialogue and document review, the chapter aims to explore why Beijing and London choose different types of contracts for financing the large-scale urban water infrastructure projects; how the respective contract functions in Beijing and London; and what the advantages and disadvantages are for the two types of contracts, and how to improve them respectively. Since “all contracts occur in the context of a social matrix” (Macneil, 1978), the

comparative study of infrastructure contracts in Beijing and London in this chapter aims to contribute to the emerging field ‘geography of contract’ (Clark and Monk, 2014) which emphasises the understanding of relational contract by taking different institutional and geographical contexts into account.

1.4 Scope and Structure of Thesis

The thesis consists of four substantive chapters addressing the four research aims outlined above. Each of the four chapters has its own theoretical framework and literature, empirical study, findings and implications. Although the four chapters have different focuses on investment models, institutional governance, pricing systems and infrastructure contracts, all the four chapters have a coherent and overarching objective for better understanding the heterogeneous landscape of urban water infrastructure investment and governance in different institutional and relational contexts.

Figure 1.3 illustrates a schematic overview of the thesis.

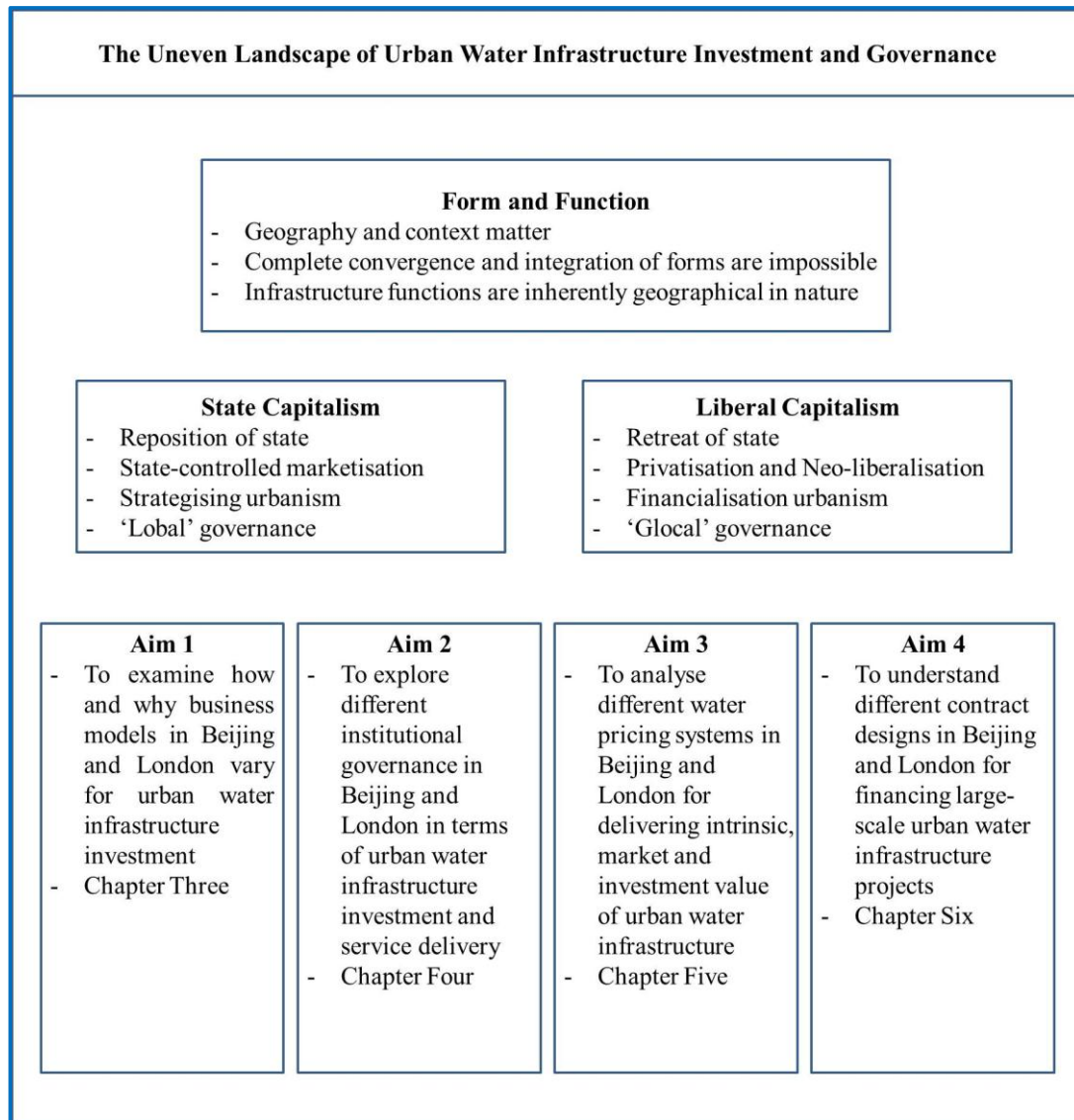


Figure 1.3 Schematic Overview of Thesis

By contrast with the statement “form follows function” proposed by Robert C. Merton and Zvi Bodie (2005), the thesis aims to show that “infrastructure functions are inherently geographical in nature” through the comparative study of urban water infrastructure investment and governance in Beijing and London. As Adam Dixon (2011, 2012) argues “complete convergence and integration of forms are impossible”, the thesis seeks to prove that geography and context matter for urban water infrastructure investment and governance. The structure of

thesis is as follows. Chapter Two reviews relevant literature in this field and sets up the overarching theoretical framework for the thesis. In particular, the chapter discusses the implications of state capitalism and liberal capitalism for infrastructure investment and governance. State capitalism does not mean the state adopts the control and demand model for infrastructure investment and governance. Instead, it means the reposition of state and state-controlled marketization. In the context of state capitalism, the underlying institution for urban infrastructure investment and governance can be labelled as ‘strategising urbanism’ (Lin et al., 2014). This kind of urbanism is forging a new style of ‘lobal governance’ through which local actors playing a vital role in monitoring and guiding local economic development to attract the inflow of global business and capital. On the contrary, liberal capitalism does not mean the state ceases control on every element of economic activities. Instead, it means the state retreats from explicit decision-making positions to exert implicit influence and control through arm’s length regulators and renegotiations in the context of privatisation and neo-liberalisation. The underlying institution for urban infrastructure investment and governance in the context of liberal capitalism is labelled as ‘financialisation urbanism’. This urbanism has forged a new style of ‘glocal governance’ (Torrance, 2008) through which local infrastructure assets are owned by global investors and regulated by local actors. The following four substantive chapters compare and analyse the two capitalisms through empirical cases of urban water infrastructure investment and governance in Beijing and London. The final chapter summaries the main findings and implications as well as proposes the possible directions for future research.

1.5 Methodology

In line with the four research aims outlined above, a multi-method qualitative approach which mainly consists of case studies and close dialogue (semi-structured interviews) is employed for in-depth understanding and investigation of the uneven landscape of urban water infrastructure investment and governance in Beijing and London. These methods are commonly employed for observing and analysing the diversity of economic life that are common in the institutional and relational turns in new economic geography research (Amin, 1999; Bathelt and Glückler, 2003, 2013; Boggs and Rantisi, 2003; Martin and Sunley, 2010; Yeung, 2005). This section introduces the main methods used in this thesis: case study and close dialogue.

1.5.1 Case study

Case study is a widely used research method in social science (Ragin and Becker, 1992; Stake, 1995; Yin, 2009). Nonetheless, conventional wisdom generally considers case study as a subjective method which gives too much scope for researchers' own interpretations and may be well suited for pilot studies rather than full-fledged research schemes. According to the Dictionary of Sociology, case study refers to "the detailed examination of a single example of a class of phenomena" (Abercrombie et al., 1984). The dictionary also claims that "a case study cannot provide reliable information about the broader class, but it may be useful in the preliminary stages of an investigation since it provides hypotheses, which may be tested systematically with a larger number of cases" (Abercrombie et al., 1984), which is indicative of the conventional wisdom about case study method. These common misunderstandings about case study method have been corrected by Professor Bent Flyvbjerg (2006) who argues that case study is "a method that holds

up well when compared to other methods in the gamut of social science research methodology”.

The main concern for case study method is that it is often seen as less rigorous than is quantitative, hypothetic-deductive method as it does not apply “scientific methods” (Diamond, 1996). The concern is mainly due to the common misunderstanding that theoretical (context-independent) knowledge such as formula or universal theory is generally considered more valuable than concrete, practical (context-dependent) knowledge. Nonetheless, in social science, concrete and context-dependent knowledge is more valuable than the vain search for predictive theories and universals (Flyvbjerg, 2006). The most advanced form of understanding of context-dependent knowledge is achieved when researchers place themselves within the context being studied. Only in this way can researchers understand the viewpoints and the behaviours which characterize the economic actors (Giddens, 1982). The advantage of the case study method is that it can “close in” on real-life situations and test views directly in relation to phenomena as they unfold in practice (Yin, 2009). As such, this thesis employs the case study method to investigate the context-dependent knowledge of urban water infrastructure investment and governance in Beijing and London, so that the viewpoints and behaviours behind the investment models and governance frameworks in different institutional and relational contexts can be thoroughly observed and analysed. Moreover, the question of subjectivism and bias toward verification of hypothesis applies to all methods, not just to the case study and other qualitative methods (Flyvbjerg, 2006). In fact, case study method has its own rigor, different to be sure, but no less strict than the rigor of quantitative methods (Stake, 1995).

More importantly, the case study method is ideal for generalising the findings using the type of test that Karl Popper called “falsification”: if just one observation does not fit with the

proposition, it is considered not valid generally and must therefore be either revised or rejected (Popper, 1959). Case selection is thus important as generalizability of case studies can be increased by the strategic selection of cases (Ragin, 1992; Rosch, 1978). Atypical or extreme cases can reveal more information when the objective is to achieve the greatest possible amount of information on a given problem or phenomenon, and the case study method is well suited to clarify the deeper causes behind a given problem and its consequences (Flyvbjerg, 2006). In this context, in order to challenge the statement “form follows function” proposed by Merton and Bodie (2005), this thesis selects urban water infrastructure of Beijing and London as cases and comparative studies to argue that “infrastructure functions are inherently geographical in nature” thus “complete convergence and integration of forms are impossible” (Dixon, 2014). The government-led model in Beijing and the market-led model in London represent the two extreme ends of the spectrum of capitalism: state capitalism versus liberal capitalism. So if this thesis finds that the current investment models and governance frameworks in the two cities can function respectively (can finance large-scale water infrastructure projects and deliver reliable water services affordably), then it means that form does not necessarily follow function. Moreover, if the thesis clarifies the underlying causes behind the different infrastructure landscape and associated consequences, then it shows that “infrastructure functions are inherently geographical in nature” and geography matters for infrastructure investment and governance. As such, four empirical cases and comparative studies on investment models, governance frameworks, pricing systems and infrastructure contracts for urban water infrastructure in Beijing and London are conducted in the four substantive chapters of the thesis.

1.5.2 Close dialogue

The other main method employed in this thesis is close dialogue (Clark, 1998). This method is used for exploring the uneven landscape of urban water infrastructure and governance in Beijing and London because one of the distinctive features of economic geography is its commitment to understanding the world as lived – an empirical project – rather than the world as theorized (Clark, 2007). Close dialogue method, a mode of case-study research, “uses structured and unstructured interviews in the context of relationships between nominal equals to reveal the actual logic of decision making” (Clark, 1998). Much work in the geography of finance and other areas in economic geography has been conducted based on close dialogues with industry respondents (Clark, 1997; Dixon, 2014; Leyshon et al., 1998; McDowell, 1997; O'Neill, 2010). As Schoenberger (1991, 1996) shows that close dialogue can involve complex relationships between interviewers and interviewees, close dialogue is often guided by a set of preconceived questions rather than being allowed to wander question-by-question following the respondent.

In order to understand the “actual logic of decision making” behind the different investment models and governance frameworks for urban water infrastructure in Beijing and London, 45 semi-structured interviews with experts in local governments, water authorities, regulators, water companies, investment institutions, academia were conducted. The list of interviewees is attached in the Annex 2. The letter of introduction from the supervisor also helped me to meet appointed interviewees and to conduct extra interviews through their keen recommendation of their colleagues and friends (See Annex 3). Before conducting interviews and fieldwork, research ethics was approved by the University of Oxford (Annex 4) and plans were proposed for the fieldwork (Annex 5). In addition, although close dialogue is normally done on the basis of one-to-one

interviews, another way of approaching the dialogue process is to collect respondents together in a conference setting or to invite them to join a research colloquium (Clark, 2007). Therefore, I organised a special session “Geography of Urban Infrastructure” at the Annual Meeting of Association of American Geographers (AAG) in Tampa, US in April 2014 and the workshop on “Infrastructure Investment in Emerging Markets and Developing Economies: Systems-Thinking for New Institutions and Global Challenges” in Oxford, UK in July 2015. Both conferences were good chances to communicate with the experts from all over the world for better understanding of the uneven landscape of infrastructure investment and governance.

1.6 Limitations of Research

This thesis aims to explore the uneven geographical phenomenon of urban water infrastructure investment and governance in Beijing and London. It investigates how political, legal and governance frameworks influence the decision-making process of urban water infrastructure investment and the performance of water service delivery in the two cities with different institutional and relational contexts. It should be acknowledged that there are limitations of the thesis. These limitations are outlined in this section and will be discussed again for possible directions of future research in the final chapter.

Firstly, this research only compares and analyses urban water infrastructure in Beijing and London in order to conduct in-depth analysis of water infrastructure sector in the two cities. The thesis does not analyse other infrastructure sectors in the two cities such as energy and transport which have totally different regulatory frameworks and investment models to the water sector. By focusing only on the water sector, the thesis may mislead readers to assume that the investment

models and institutional governance described in this thesis are suitable for other infrastructure sectors as well. In fact, although these infrastructure sectors including water, energy and transport have common characteristics, investment models and governance frameworks vary from sector to sector due to different regulation standards and investment models. Nonetheless, since the overall aim of the thesis is to understand how and why “infrastructure functions are inherently geographical in nature”, the comparative study of state capitalism and liberal capitalism in financing and governing urban water infrastructure provision in this thesis is sufficient to explain the interrelationships between form and function for infrastructure.

In addition, although the qualitative methodology utilised in this thesis contributes to the analysis of institutions underlying investment models, governance frameworks, pricing systems and infrastructure contracts for urban water infrastructure in the two cities, quantitative analysis of relevant infrastructure data can provide more breadth to this burgeoning research area. Since good social science is opposed to an either/or and stands for a both/and on the question of qualitative versus quantitative methods (Flyvbjerg, 2006), a combination of qualitative and quantitative methods is best for exploring the landscape of urban infrastructure investment and governance worldwide. Due to unavailability of reliable infrastructure data at the infant stage of this burgeoning research field, this thesis primarily focuses on how and why the two cities use different models for urban water infrastructure investment and governance through qualitative methods. As such, the thesis mainly relies on case studies and close dialogues methods to observe and analyse the underlying reasons for different landscapes of urban water infrastructure investment and governance.

Finally, since the boundaries for water and wastewater services in England and Wales are

divided by watershed rather than jurisdictions, it is challenging to obtain data and information specific to London in terms of water and wastewater services. There are four water companies providing water supply services in London; while the wastewater service in London is provided by Thames Water which provides wastewater services to 15 million customers across London and the whole Thames Valley area. This means that data and information specific to London are difficult to come by as these water companies' annual reports contain data and information for their respective watersheds rather than for London only. In this context, this thesis chooses Thames Water – the largest water and wastewater service provider for London as the representative of market-led model in London to compare with government-led model in Beijing. As such, the data used in this thesis cannot accurately reflect the true situation of London regarding water and wastewater services. However, since the aim of the thesis is focused on analysing why and how different political, institutional and governance frameworks influence investment models and service delivery, the shortage of data specific to London does not affect the qualitative analysis of the political economy underlying urban water infrastructure investment and governance in different institutional and relational contexts.

Although this thesis has these limitations outlined above, it does not affect its theoretical and practical contributions. In theory, the qualitative analysis and comparative study of urban water infrastructure investment and governance in Beijing and London in this thesis fills in the gap in comparing various trajectories of development models in Global North and South, and makes contribution to geography of finance and geography of capitalism. In practice, this thesis provides reference to governments, regulators and infrastructure companies to learn from each other, and offers lens to investors to get to know how and why geography matters when investing in

infrastructure in different institutional and relational contexts. The next chapter sets the overarching theoretical framework of this thesis, followed by four substantive chapters analysing investment models, institutional governance, pricing systems and infrastructure contracts respectively. The final chapter concludes with the main findings and implications as well as possible directions for future research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In various fields of social science, there is widespread recognition that infrastructure is special (Frischmann 2012). Infrastructure services, commonly considered as public or semi-public good, have traditionally been provided and funded by the public sector. However, the efficiency of public management of infrastructure has been questioned and governments' ability to leverage funds for new facilities and for maintenance and rehabilitation of existing ones has decreased (Karlsson et al. 2007). These factors have led to increasing participation of private sectors in the provision of infrastructure services. Some countries since the end of the 1970s even adopted privatisation policies as a major instrument in search of expenditure and tax cuts and higher efficiency. Nonetheless, studies have not found clear evidence of cost savings and efficiency gains under privatisation reforms (Bel, Fageda, and Warner 2010; Boyne 1998; Domberger and Jensen 1997; Jensen and Stonecash 2005; Marsh 2007). Instead, some studies have challenged privatisation, especially outsourcing public services such as infrastructure provision to private sectors which are generally considered as service-efficiency-and-profitability oriented rather than service-quality-and-security oriented (Box 1999; Christensen and Laegreid 2002; Denhardt and Denhardt 2002; Nalbandian 2005). Despite these controversies, the debate over public services has eventually shifted from ideology to pragmatism – not a quest for better institutional 'form', but for better 'function' of service delivery (Warner and Hebdon 2001; Warner and Hefetz 2004, 2009). The shift of the debate over 'form and function' in delivery of public services, in particular the provision of infrastructure services, has aroused the author's interest to investigate infrastructure investment and governance in different geographical and institutional contexts: how various forms

of infrastructure governance deliver similar functions of infrastructure investment and provision across the space.

Among all infrastructure services, water infrastructure provision is perhaps the most sensitive service due to its unique value for human beings. The privatisation of water infrastructure provision in many countries since the late 1980s has generated fierce controversy. Proponents of privatisation assert that private companies perform better than their government counterparts. The hotly disputed litany of government woes such as low rates of cost recovery, underinvestment, overstaffing, inefficient management has dominated the discourse used by advocates of water privatisation over the past decades, and is often summed up by the label “government failure” (World Bank 1993). From this perspective, it is unethical not to involve private sectors if they can perform better than government counterparts at delivering water services. In contrast, opponents of privatisation argue that public sector led water infrastructure systems have comparative advantage in providing more effective, equitable, and responsive services to water users, particularly in transition and developing countries (Lobina and Hall 2008). In their view, it is unethical to profit from water, a substance essential for life and human dignity. David Harvey, for example, characterizes water privatisation as one example of “accumulation by dispossession” – the enclosure of public assets by private interests for profit which invariably deepens social and environmental inequities (Harvey 2003). Despite the fierce controversy, water privatisation is just one example of a series of neoliberal-type reforms that have shifted the provision of public services from the public sector to the private sector (Harvey 2005). More importantly, the debate over water privatisation is “a microcosm of contemporary struggles over the roles of states and markets, and over the acceptability and efficacy of markets and private ownership as mechanisms

for public services delivery” (Bakker 2010).

It has been noted that from an economic and an organizational perspective, the theory of Coase (1937) and Williamson (1999) suggests that whether making or buying a service primarily depends on the level of technical expertise in specific physical infrastructure as well as difficulty in contract specification and monitoring. Transactions costs have been used to explain government choice in the decision to contract out public services (Nelson 1997; Sclar 2000; Zerbe and McCurdy 1999). However, recognition of the importance of transaction costs on contracting out public services has led to scholars in different research fields looking at the nature of the service and of the contracting process (Bel and Fageda 2007; Brown, et al. 2008; Hefetz and Warner 2004, 2007; Levin and Tadelis 2010), as well as the different natures of transaction environments by geography (Bel and Costas 2006; Bel and Mur 2009; Dijkgraaf and Gradus 2008; Fitch 2007; Warner 2006). In particular, instead of treating economic agents as ‘undifferentiated black boxes’, the commitment of economic geographers is to understand the geographical and institutional organization of economic activity given the cultural, institutional and regulatory differences that exist between regions and nations (Clark et al. 2000). Since “failure to include attention to market and place characteristics denies the importance of local differences in public service delivery” (Hefetz and Warner 2011), this thesis argues that infrastructure investment and governance is highly contextual in nature, and various forms of infrastructure governance can fulfil the similar function of infrastructure investment and service delivery in the different geographical and institutional contexts.

The purpose of this chapter is to outline the overarching theoretical context in this thesis and review the previous studies in this area. It starts from challenging Merton and Bodie (2005)’s

statement ‘form follows function’ and argues that understanding the complex and heterogeneous infrastructure investment and governance requires a close-dialogue and case-study based economic geography framework. Then the chapter introduces the subject of economic geography, particularly the emerging ‘institutional turn’ and ‘relational turn’ in economic geography which are the overarching theoretical context of this thesis, followed by elaborating the contract theory for infrastructure. The chapter subsequently demonstrates the uneven landscape of infrastructure investment and governance around the world, with analysis of variegated capitalism in economic geography as well as the case study of urban water infrastructure of Beijing and London employed in this thesis. The chapter finally shows the outline of the thesis demonstrating the focus of each chapter.

2.2 Form and Function

The comprehensive definition of ‘infrastructure’ given by the US NRC has actually comprised of “two fundamentally different frames of reference for analysis” of infrastructure – the institutional perspective versus the functional perspective. Robert C. Merton, the Nobel laureate in Economics best known for his pioneering contributions to continuous-time option pricing model – the Black-Scholes-Merton formula, has co-authored with his colleague Zvi Bodie a series of papers about the institutional and functional perspective of financial systems (Merton 1995a, 1995b; Merton and Bodie 2005). They propose a Functional and Structural Finance (FSF) approach which is a synthesis of the neoclassical, neo-institutional, and behavioural perspectives to offset the resulting inefficiencies of the predictions of the ideal frictionless neoclassical equilibrium for a given institutional structure. In their view, functions are the “anchors” of a

system which rests on two basic premises: “1) functions are more stable than institutions – that is, functions change less over time and vary less across geopolitical boundaries; and 2) competition will cause the changes in institutional structure to evolve toward greater efficiency in the performance of the system”. They insist that ‘form follows function’, and “in the longer run, after institutional structures have had time to fully develop, the predictions of the neoclassical model will be approximately valid for asset prices and resource allocations” (Merton and Bodie 2005). This means that they believe there is ideal institutional form for efficient function of economic activities regardless of geographical differences.

Nonetheless, what Merton and Bodie ignored is ‘function’ can only come into play when it is consistent with its embedded ‘form’ environment. In this respect, geography is still integral to understanding the contemporary financial systems and other economic activities even in the scope of convergence and integration. Adam Dixon (2011) provides a basic introduction to the geography of finance from both form and function perspectives, and he argues that “financial functions are inherently geographical in nature” and the forces that alter the institutional form and makeup of financial systems are conditioned and/or constrained by geographically-specific political, social and cultural circumstances. To illustrate this, he compares the financial system in Germany with that in the USA given that the former is considered to be the quintessential coordinated market economy (CME) and the latter the quintessential liberal market economy (LME). Although the analysis in his article demonstrates that the German financial system has converged closer in form and function to that of the USA, Dixon (2012) argues that “it does not make the claim that the two countries are converging to some unique political-economic form, nor does it deny the critical importance of national-level public policy and institutions in shaping the

location of economic activity and the behaviour of economic agents”. In contrast with Merton and Bodie’s view, Dixon (2014) argues that complete convergence and integration of forms are “neither inevitable nor can the outcomes of change be expected to be uniform”.

Although great attention has been paid in economic geography that different institutional forms can and do perform similar functions (Rodríguez-Pose and Storper 2006), there are challenges in showing how various forms such as national level political-economic differentiation are relevant to functions in specific geographical contexts, given the “patently asymmetric models of capitalism” problematically “obfuscate significant formal and functional convergence” (Dixon 2012). To overcome the barrier of idealistic view seeing economy and society as a whole, it is required to seeing economic and social processes at “a variety of scales rather than privileging one scale as the unit of analysis” (Dixon 2014), which is rooted in approaches in economic geography.

Furthermore, the functional perspective proposed by Merton and Bodie is not limited to financial systems. It derives from the “functional approach in sociology” pioneered by Robert K. Merton (1957). In fact, the community in economic geography, particularly in the geography of finance, has also employed the institutional versus functional perspective in understanding the multi-scalar complex economic landscape (Clark and Wójcik 2007; Dixon 2014). Atif Ansar (2010) distils Merton’s functional perspective of financial systems and applies it to infrastructure. He argues that “an institutional perspective on infrastructure is not oblivious to the functions of infrastructure” and “the functional and institutional perspectives differ in terms of where they place emphasis”. In addition, while proposing four institutional solutions for improving the adoption of alternative investment products (AIPs) in the pension fund investment management industry, Clark (1997) argues that governments “can play an important role in promoting

institutional innovation in the pension fund investment management industry". He also acknowledges that "this idea would seem to be at odds with the common presumption that the market will provide such institutions if there is sufficient demand". For example, Allen and Gale (1994)'s study on product innovation in the finance industry presumes that a world of institutional supply consistent with market demand. Their view is associated with the work of economic theorists like Coase (1974) whose analysis of the private provision of public goods seems to suggest that institutional innovation is a market process. Although market inefficiency and market incompleteness in the real world has been acknowledged by economic theorists, there may be a real danger that "ideological squabbles over the proper role of government in general will swamp the issue of financial innovation" (Clark 1997).

It should be noted that the functional versus institutional perspective is not a rigid dichotomy since the two perspectives are interrelated. In the book "The Geography of Finance: Corporate Governance in the Global Marketplace", Clark and Wójcik (2007) write, "Our approach is informed by Merton and Bodie (2005) who argued for greater sensitivity to the interaction between economic imperatives, institutional formations, and behavioural responses. By this account, institutions have a history and a geography as well as a functional logic – the form is not sufficient if the latter is systematically albeit relatively inefficient". However, they argue that "Unlike Merton and Bodie, we are not convinced that there is an optimal institutional form. Capitalism is in perpetual motion, creating the future and destroying the past without an overriding blueprint for long-term economic efficiency." (Clark and Wójcik, 2007). Likewise, there is no optimal institutional form for infrastructure investment and governance in the economy given the various spatial, temporal and relational contexts. This implies that better understanding

of infrastructure investment and governance requires a new multi-disciplinary framework which takes geographical factors into account. That is where economic geography should come into play, especially the emerging ‘institutional’ and ‘relational’ turns.

2.3 Understanding Infrastructure in the Context of Institutional and Relational ‘turns’ in Economic Geography

Economic geography is a sub-discipline of geography and a growing field of study in economics. Generally, economic geography is concerned with “the spatial configuration of firms, industries, and nations within the emerging global economy in all its manifestations” (Clark et al. 2000). One of the main differences between economists and economic geographers is the emphasis attached by the former on stylized facts and the very different one attached by the latter on the heterogeneity of economic landscape across space (Clark 1998). The use of stylized facts, which claims, attributed to Michael Jensen (1998), that the efficient-market hypothesis is the best established fact in the social sciences, is dominated in mainstream economics and the “new” economic geography proposed by Paul Krugman (1991). In this way, there can be an optimal form of infrastructure governance for the best function of infrastructure investment and service delivery, given “form follows function” (Merton and Bodie 2005). In order to achieve the “best” function, different forms will evolve towards the proposed “best” form based on efficient-market hypothesis. Nonetheless, the hegemony of stylized facts has aroused geographers’ unease about the implications of equilibrium-focused spatial-economic convergence models for public policy which may deny the value for the spatial differences of local economic development programs (Clark 1998).

The plausibility of assumptions like homogeneous information, limited transaction and adjustment costs, and the presumption of spatial-economic convergence have been disputed by geographers and even some economists who have wondered if the preference for analytical elegance and tractability by concentrating upon mathematical methods and general equilibrium analysis models in economic research is justifiable (Baumol 1991; Hahn 1991). For example, Shleifer (2000) and his colleagues have questioned the robustness of arbitrage processes in financial markets and pointed out the existence of systemic inefficiencies or irrationalities, although financial markets are assumed to be the most efficient markets of western economies. To some extent, Shleifer's work questions the plausibility of stylized facts about financial markets and seeks to overturn comfortable assumptions made about the coherence and order of economic systems. Likewise, the complicated interrelationships among all stakeholders involved in the infrastructure systems make it impossible to achieve coherence and convergence in infrastructure investment and governance given different geographical, cultural and institutional contexts.

In order to escape the shadow cast by the efficient-market hypothesis in explaining heterogeneous economic landscape across space, a case-study and close-dialogue based methodology is needed for theoretical innovation in observing the full range and diversity of research practices in economics and geography. As such, economic geography can play an important role in better understanding the spatial differences in market economies, since it has three basic building blocks or intellectual pillars which are widely shared by geographers and economists though often contested and disputed (Clark et al. 2000). Firstly, economic geography recognizes the diversity of economic life which requires a close and detailed analysis of the particular attributes of certain firms, industries and regions. Understanding the water infrastructure

investment and governance in the capital of China is different from understanding that in the capital of the United Kingdom. Secondly, economic geography understands the process of change in and across the economic landscape. The emerging force of global institutional investors changing the ownerships and shaping the landscape of local infrastructure assets (O'Neill 2013) has aroused debate about the extent of penetration of nations' economic systems by economic forces operating at a number of scales. Thirdly, economic geography understands the geographical and institutional organization of economic activity given the spatial differences of cultures, regulations and institutions in various regions. Instead of treating economic agents as undifferentiated 'black boxes', economic geography aims to connect the existing theories of infrastructure (like the theories of public good or public welfare) with its embedded environments such as cultural, social and institutional backgrounds. In particular, the emerging "institutional turn" and "relational turn" in economic geography provide good insights for better understanding infrastructure investment and governance in different geographical and institutional contexts.

2.3.1 Institutional turn in Economic Geography

One of the key expansions in theoretical foundations, methodologies and empirical research in the process of the renaissance of economic geography (Bodman et al. 2013) over the past few decades is called "institutional turn" which recognizes that various social institutions on which economic activity depends and through which it is shaped should be given due attention for fully understanding of the form and evolution of the economic landscape (Martin 2000). In contrast with the historic tendency for economic geography to follow mainstream economics in abstracting 'the economic from its wider social, political and cultural contexts' (Amin 1999), there has been a

shift in economic geography which has placed increasing emphasis upon the social and cultural dimensions of economic life (Lee and Wills 1997; Thrift and Olds 1996). As a consequence, economic geographers have increasingly drawn upon concepts from institutional economics and economic sociology to understand processes of regional development in the context of globalisation (Amin and Thrift 1994; Cooke and Morgan 1998; Storper 1997).

The “institutional turn” in economic geography derives from various sources. Firstly, the widespread adoption by economic geographers of French regulation theory (Boyer 1990) which emphasises on the “mode of social regulation” can be seen as a wider shift in economic geography towards an institutionalist approach (Martin 2000). Although the regulation theory itself fails to analyse the nature and evolution of the social frameworks such as rules, customs, norms and conventions, the attention of economic geographers has been focused on the nature of the socio-institutional structure as an “essential underpinning of efficient capitalist production” (Storper and Walker 1989). Secondly, there has been a growing recognition of the “socio-cultural” within economic geography, since the economic process is a socio-cultural process, and institutions are central to the socio-cultural construction of the economic (Thrift and Olds 1996; Crang 1997). Thirdly, there has been a growth in “institutionalism” in the social sciences such as economics, sociology and political science over the past three decades (North 1990; Williamson 1985). Given the increasingly “blurring of the boundaries” between the social sciences, it is not surprising that economic geography has also begun to embrace institutionalism. Fourthly, the rise of the institutional turn in economic geography is partly because economic geographers’ interest in the nature and implications of the upheavals in the institutions of capitalism (Martin 2000).

Given the above catalysts, “institutional turn” is emerging on the research agenda in

economic geography, although the field is still very much in its infancy (Martin 2000). Economic geographers have drawn two main insights from institutional economics: that economic action is both shaped by social context and path-dependent (Cumbers et al. 2003). In other words, institutional economic geography emphasises that economic activity is socially and institutionally situated, which means that it cannot be explained by reference to atomistic individual motives alone, but has to be understood as enmeshed in wider structures of social, economic, and political rules, procedures and conventions (Mitchell 2000). As such, the institutionalist approach to economic geography is needed for better understanding of the characteristics of infrastructure investment and governance in different geographical and institutional contexts.

Before proceeding, it is important to comment briefly on the definition of the term “institution”. Within economic geography and related disciplines, the term “institution” is often vaguely defined, refer to different meanings, or almost become a ‘black box’ to relate to otherwise unexplained influences in economic development (Martin 2000). A typical definition is that given by Rutherford (1994): “An institution is a regularity of behaviour or a rule that is generally accepted by members of a social group, that specifies behaviour in specific situations, and that is either self-policed or policed by external authority”. Yet there are numerous variants and inflections of this definition. While some studies view institutions as ‘the things, that pattern behaviour, e.g. routines, norms, shared expectations, morals, etc.’ (Edquist and Johnson 1997), others focus on the role of laws, rules, regulations, etc (Gertler 2010; North 1990). Although institutions have been discussed numerous times within the discipline in recent years (Amin 1999; Rodríguez-Pose and Storper 2006), calls for an institutional perspective have not led to more clarity in research practice.

So how should economic geographers treat ‘institutions’? In response to literature that implicitly or explicitly treats institutions as if they were a ‘black box’, Bathelt and Glückler (2013) try to present an explicit understanding of institutions as “correlated and relatively stable social interactions between economic agents that develops upon rules and regulations in rather contingent ways”. They even call for insisting on applying an explicit and consistent understanding of institutions in economic geography because it will provide “the opportunity to ‘translate’ the findings of other studies that apply different understandings into comprehensive concepts and theories of the relations between technological and market change, relational action, and institutional change” (Bathelt and Glückler 2013). But is it possible to have a consistent understanding of ‘institutions’ in different studies? Before converging the understandings of ‘institutions’, we need to think about why there exist such diverse treatments of ‘institutions’ in the disciplinary of social sciences, even in the field of economic geography.

In fact, it should be noted that there exists broad versus narrow understanding of ‘institutions’ when dealing with different research objectives. Bathelt and Glückler (2013)’s view that “institutions are considered neither as organizations nor as rules or simple regularities, but rather as stabilizations of mutual expectations and correlated interaction” is a broad understanding of ‘institutions’ in the economy and society. Nonetheless, when investigating on a particular subject (such as a legal case), the term ‘institutions’ generally has narrow understanding and specific implication (such as law or regulation). Therefore, it is difficult to apply the consistent understanding of ‘institutions’ in any study area. Furthermore, Clark and Wójcik (2007) argue that “institutions are created in response to market imperatives, those imperatives continue to evolve (or dissipate) so as to (in part) reinforce those institutions but also, inevitably, undercut their

longevity”. In other words, the functions of ‘institutions’ in different geographical contexts may be similar, but the forms of ‘institutions’ must necessarily adapt to meet changing market imperatives in the specific geographical context if they are to remain viable and effective. This means that there can be no consistency in understanding of ‘institutions’ given the spatial heterogeneity of forms of ‘institutions’.

In this thesis, the author takes both broad and narrow understandings of ‘institutions’, considering ‘institutions’ as the governance of infrastructure provision. When it comes to comparison of urban water infrastructure governance in Beijing and London, the ‘institutions’ refer to specific institutional arrangements for governing water services in the two cities. When the investment models in the two cities are discussed, the ‘institutions’ is considered as the underlying mutual expectations for the decision-making process of infrastructure investment. As such, on the one hand, it focuses on ‘organizations or rules’ for infrastructure service delivery; on the other hand, it distils from Bathelt and Glückler (2013)’s view that “institutions are considered as stabilizations of mutual expectations and correlated interaction” and apply it into the study of infrastructure investment and governance. Whatever the interpretation of ‘institutions’ is, the governance of urban infrastructure investment and provision needs to be understood not only from institutional perspective but also from relational perspective.

2.3.2 Relational turn in Economic Geography

The rise of a relational approach to economic geography has coincided with extensive restructuring in mass markets and mass market production in global economies (Boggs and Rantisi 2003). The economic restructuring has the characteristics of the specialization of core

tasks and capacity within lead firms and the externalization of peripheral tasks and capacity to contractors (Piore and Sabel 1984; Florida and Kenney 1990). Instead of treating the interrelationships (both formal and informal) between these economic agents as mere contractual exchanges for the purpose of minimizing cost (Maskell 2001), the inter-firm linkages also have implied collaboration (such as the sharing of knowledge, expertise and resources) in creating added value for competitive advantage (Storper 1997). Although some previous studies have illustrated that different forms of socio-economic coordination often lead to divergent levels of performance (Cooke and Morgan 1998; Saxenian 1994; Braczyk et al. 1998), past theoretical models in economic geography have not been able to account for the micro-level dynamics among economic agents in the emergent forms (Boggs and Rantisi 2003). Accordingly, the “relational turn” in economic geography can be viewed as a response to these limits of past approaches which view economic geography in line with “universal laws, linear developments and closed systems” (Bathelt and Glückler 2003).

The objective of relational economic geography is to analyse the economic relations by using a “geographical lens” (Bathelt and Glückler 2003). Rather than simply describe the spatial categories, processes and regularities, the “relational turn” in economic geography focuses on the importance of economic agents and how they act and interact in space (Boggs and Rantisi 2003; Sunley 2008; Yeung 2005). According to Bathelt and Glückler (2003), there are three propositions for the relational economic geography: contextuality, path-dependence, and contingency. Firstly, since economic agents are situated and embedded in specific contexts of social and institutional relations (Granovetter 1985, 1992), the interactions among them cannot be explained by universal laws. Secondly, recognizing contextuality means recognizing path-dependence because the

economic decisions, actions and interactions occurred in the past enable and/or constrain the context of current decision makings, and even partly influence future directions (Nelson and Winter 1982; Nelson 1995). Thirdly, despite of the characteristics of contextuality and path-dependence, it is difficult or even impossible to predict economic actions accurately through universal spatial laws because economic processes are contingent and economic actions are fundamentally open-ended (Sayer 1992, 2000). Therefore, a contextual, path-dependent and contingent perspective is the core of the relational economic geography which enables a complex understanding of economic action and its localized consequences (Bathelt and Glückler 2003).

In this regard, since infrastructure investment and governance is highly contextual in nature, the relational perspective in economic geography can help for a better understanding of the actual logic of decision makings for the complicated processes of infrastructure investment and service delivery in different social and institutional contexts. It should be noted that it is economic agents and their interactions in a specific space are the core of the analysis within the framework of relational economic geography rather than space and spatial categories (Sunley 2008). Space should be used as the “geographical lens” for asking particular questions about economic phenomena but space should not be the primary object of knowledge (Bathelt and Glückler 2011). In other words, what we need to seek for is not identifications of spatial laws, but explanations of localized economic processes and their consequences (Bathelt and Glückler 2003). It is particularly through the application of a distinctive spatial perspective or geographical lens that leads economic geographers to view and analyse an economic phenomenon different from economists or sociologists.

2.3.3 Long-term Relational Contract for Infrastructure

Given the uncertainty and complexity of infrastructure investment projects as well as the long gestation periods for the potential returns (and risks) with such projects, long-term contracts with an agreed allocation of risks and returns are needed for binding parties together which underpin the provision of urban infrastructure (Clark and Evans 1998). But how to design the long-term contract for infrastructure investment is a real challenge. Although Coleman (1992) holds that “contracts allocate risks; they specify who bears what costs in the event such-and-such occurs”, a number of social scientists and analysts (Baier 1995; Casson 1991; Luhmann 1979; Gambetta 1988) contend that contract is only a formal device to be resorted to when all else fails, and social relationships such as trust relations among economic agents are more important than formal contracts for coping with complexity and uncertainty in general, and in the investment industry in particular.

Nonetheless, Hardin (1996) argues that trust is the result of a variety of social processes depending upon the existence of past commitments or relationships that encourage trust between each other. This means that trust derives from relationships rather than creates relationships spontaneously. It is also suggested from Clark (1998a, b) that the core of the framing process for investment decision-making is risk-aversion and fiduciary responsibility. This is consistent with a more empirical observation that distrust is endemic to the finance industry. Given the complexity and uncertainty of infrastructure projects, distrust is significant because “it is very likely that any relationships important in promoting an investment project would give way over time as individuals move on to other projects”. In this context, contracts which function as “a formal mechanism bounded by a set of sanctions and a process of recovery if trust is misplaced” (Clark

and Evans 1998), are generally required for infrastructure projects.

Despite of the perceived advantages of formalism for contracts including the systematic evaluation and deliberate allocation of risks between partners, many investors seem to imagine that there exists a desirable and ideal contract whose priori defined terms and conditions can cover all possible contingencies from the start of infrastructure projects. Rakoff (1994) refers to this idealism embedded in the contract as the “perfect tender” model of contract. Although such ‘complete’ contracts like more than 15000 pages of legal script for privately financed infrastructure projects in the UK are designed and executed in practice, they are far from ‘ideal’ since mistakes can be made, a party’s interests can be hidden in obscure terms, and there are financial and cognitive limits to scrutinising such complex contractual documents (Clark and Evans 1998). The function of contracts should not be exaggerated since it is impossible to foresee all possible contingencies and it is not always possible to incorporate unlikely but recognised possibilities into contracts. Given the inefficiency of complete contracts, Rakoff (1994) proposes ‘substantial performance contract’ as an alternative option. In this way, whether the contract has been executed successfully or not should be evaluated based on the substantive performance of the contract rather than the literal terms and conditions in the contract. However, this gives the court discretion in evaluating the overall efficiency of contractual institutions (Coleman 1992). The virtue of the contract can only be fulfilled through independent evaluation of the substantive performance contract.

Bolton and Dewatripont (2005) and Posner (1995) consider contracts as bilateral contracts with two self-interested parties who have more to gain from forging a transaction and carrying it through than from acting separately. The efficiency of bilateral contacts depends on the clarity of

terms and conditions, particularly as regards what counts as the appropriate measures of performance of the contract. As such, bilateral contracts are assumed ‘complete’ in that upon termination there are no residual claims to be adjudicated or interests to be reconciled. Whereas much of contract theory presupposes that the object of analysis is the bilateral contract, attention has shifted towards relational contracts. It is suggested by Clark and Monk (2014) that relational contracts are incomplete in three ways. Firstly, relational contracts do not have a specified or required date of termination. Secondly, revision and renegotiation on the terms and conditions of contracts may happen over time as circumstances change. Thirdly, these types of contracts may economise on the search costs associated with finding other parties who may or may not provide complementary services. In this respect, relational contracts are a means of governing economic and financial relationships among economic agents in the investment activities, in contrast to bilateral contracts or complete contracts which open and close at specific times based upon a priori defined costs and benefits.

In this thesis, the author suggests that both formal contracts and informal relationships are important for long-term infrastructure investment. Relational contracts rather than bilateral contracts are more suitable for dealing with complexity and uncertainty of infrastructure investment since revision and renegotiation on terms and conditions of contracts are needed as circumstances may change over the long gestation period of infrastructure projects. In particular, since the substantive performance of contracts should be evaluated by independent bodies embedded within given institutions, the governance of infrastructure investment is important for judging the success of relational contracts. To some extent, the governance system for infrastructure investment and service delivery can be considered as a broader and implicit

‘contract’ binding all stakeholders underpinning the provision of infrastructure. In effect, the governance of infrastructure investment projects over the long term will turn out to be more important than the initial agreement which binds the contracting parties. Nevertheless, few in government or in the finance industry have recognised the long-term significance of the governance process for delivering promised rates of return (Clark and Evans 1998). Given the uneven landscape of infrastructure governance around the world, it is meaningful to understand the governance systems in different geographical contexts for enabling parties in relational contracts to adapt to changing circumstances of infrastructure investment and service delivery.

2.4 Geography of Infrastructure

2.4.1 The Landscape of Infrastructure Investment and Governance

Infrastructure investment and governance continue to undergo major transformation across the globe. In the developed nations, utility structures have been eroded and with deteriorating fiscal capacity, public-led infrastructure development is severely constrained (The Economist 2014). In many cities of the developing countries, the expansion of fiscal capacity has not kept pace with increased demand for new infrastructure development due to rapid and continued urbanization (Wang et al. 2011). The changing face of infrastructure governance worldwide is characterised by a high demand for investments in infrastructure development or renewal, by governments’ budget constraints and by emerging environmental requirements such as climate change (Karlsson et al. 2007). These factors have led to the increasing participation of private sectors in the provision of public infrastructure such as Public-Private Partnership (PPP). However, the government has played and continues to play a significant and widely accepted role in

ensuring the provision of infrastructure services. Although private parties and markets play an increasingly important role in providing many types of traditional infrastructure, the government's role as provider, subsidizer, coordinator, and/or regulator of infrastructure provision remains intact in most cities throughout the world (Frischmann 2012).

Around the world, the role of government in the provision of infrastructure varies according to the context. The core characteristics of infrastructure such as ownership, financing, regulation and use rights have varied considerably through time and across space (Eichengreen 1995; Doig 1990, 2001). In most developed countries, particularly in the United Kingdom (strictly speaking, it mainly occurs in England), infrastructure assets are becoming financial products as a result of current political economic frameworks (Babcock-Lumish and Clark 2005), with cities and regions valued merely on a quarter-to-quarter basis (Torrance 2008). The rising of a global infrastructure market and the emergence of institutional investors for changing ownerships of infrastructure assets have been forging a 'glocal' form of governance (Torrance 2008) and 'financialisation of infrastructure' (O'Neill 2013). In this context, the phenomena on the 'retreat of state' (Clark 1999) in infrastructure are considered as 'hollow out' which means that the national state or the government has come to be seen merely as one amongst many actors seeking to influence political process and economic development (Jessop 1990, 2001). Nonetheless, the state "can never fully exit the field of infrastructure" (O'Neill 2013), as it maintains the success of financialisation act of infrastructure. In this way, there is always a politics of infrastructure in play, from an individual infrastructure project in local scale to the whole set of infrastructure systems in global scale (O'Neill 2009).

In China, urban infrastructure financing is closely related to the country's transition to a

market-oriented economy that fosters the pro-growth role of city governments labelled as “city entrepreneurship” (Tao et al. 2010). The redistribution of fiscal power between the central government and local governments in China that produces significant difference of financial capacities among different administrative ranks of cities contributes to the changing roles played by the government and the market in financing urban infrastructure (Wang et al. 2011). Compared with the powerful force of financial market and implicit force of arm-length semi-governmental regulators for infrastructure investment and governance in the United Kingdom, domestic and local political relations has played and continue to play a role pivotal to urban infrastructure development in the process of urban transformation in China (Lin and Ho 2005). Although China has achieved the phenomenal urbanization with “a scale and speed unprecedented in human history and a striking trajectory unparalleled elsewhere in the world” (Lin et al. 2014), the understanding of the politics of Chinese urban infrastructure investment and governance remains rudimentary.

The uneven landscape of infrastructure investment and governance across the world drives the need to rethink the criteria of the decision-making for infrastructure in different social and institutional contexts, such as what infrastructure is to be provided, in what form it should be provided, who should provide it, who should pay, and who should operate it (O'Neill 2010). As such, understanding the spatial phenomena of infrastructure investment and governance requires the recognition of “infrastructure” as a language category which has different forms of ideogram. Nonetheless, little has been done in exploring the role of the important “infrastructure” language and its embedded context in the creation of our cities and economies across the world (O'Neill 2013). Since economic geography is a field of academic enquiry preoccupied with the

geographical scope and scale of economies in the context of economic change, the driving forces behind those changes, and the role of localities in global economic transformation (Clark et al. 2000), the better understanding of infrastructure in different social and institutional contexts requires the case-study and close-dialogue based economic geography framework. As a group of economic geographers have argued that there is “an urgent need and a unique chance to push the agenda of a geographic take on finance” (Benner et al. 2011; Sokol 2013; Wójcik 2009), this thesis argues that the unique language of “infrastructure” needs to be injected into the conceptualization of economic geography to provide a solid analytical handle on better understanding of “geography of infrastructure”. The author suggests that the ‘geography of infrastructure’ can be built on the theoretical and empirical foundations laid down by ‘geography of finance’ (Clark 2005; Hall 2010, 2011, 2012; Martin 2010), ‘geography of governance’ (Clark and Wójcik 2007), ‘geography of capitalism’ (Dixon 2014) and ‘geography of contract’ (Clark and Monk 2014) as well as the ‘institutional turn’ (Amin 1999; Cumbers et al. 2003; Martin 2000) and ‘relational turn’ (Bathelt and Glückler 2003, 2013; Boggs and Rantisi 2003) in economic geography.

2.4.2 Geography of Capitalism

There is another meaningful exploration for understanding the landscape of infrastructure in the context of economic geography. Since “there is always a politics of infrastructure in play” (O'Neill 2013), investigating the institutional and social contexts underlying infrastructure investment in different geographical and spatial frameworks is important for investors and policy makers. In particular, analysing the spatial heterogeneity of decision-making process and flow of

capital for infrastructure provision provides a unique opportunity for analysing economic relations by using ‘geographical lens’ (Bathelt and Glückler 2013), contributing to a vibrant debate topic currently – varieties of capitalism (VoC).

It is interesting to note that though there is a continuing debate over whether the Chinese economy can be considered to be functionally capitalist (Arrighi 2007; Meyer 2011), China’s development model has been described by some critical observers as state capitalism or state capitalism with Chinese characteristics which is ‘the most formidable foe that liberal capitalism has faced to date’ (Economist 2012a, b). State capitalism is “a system in which the state functions as the leading economic actor and uses markets primarily for political gain” (Bremmer 2009). Nonetheless, despite there are still socialist legacy evident in the contemporary China such as unambiguous property rights and massive state presence in the national economy (Szelényi 2010), there are analyses confirming that the private-sector contribution to overall economic growth in China has risen markedly over time, accounting for 50-70% of GDP (McNally 2008; OECD 2003; Wang 2004; Kornai 2009). In fact, it has been enigmatically stated that ‘China is both far away from socialism and far away from capitalism, with a unique blend of central orchestration and local devolution’ (McNally 2006; Zhang and Peck 2014). Given the transitional and hybrid nature of the Chinese economy, the problematic of Chinese capitalism seems to represent not only a provocative but also a productive case for the study of VoC (Peck and Zhang 2013).

Although adjudicating between ‘local’ forms of capitalism has long been one of staple concerns for economic geographers (Bathelt and Gertler 2005; Christopherson 2002; Clark and Wójcik 2007; Dixon 2011; Peck and Theodore 2007), the debate around VoC has mainly been occupied by heterodox economic scholarship for two decades. The two poles of a single

continuum – running from US-style ‘liberal market economies’ (LMEs) to German-style ‘coordinated market economies’ (CMEs) have been employed for explaining divergent trajectories of growth and restructuring in different parts of the global system (Amable 2003; Blaut 1993; Coates 2000). Nonetheless, the monochrome world of VoC scholarship has eventually found its endogenous analytical limits in the explanatory reach and capacity of the VoC framework itself. The limits are reflected from an apparent proclivity for selective forms of firm-centric research, coupled with the continued privileging of a restricted number of institutional domains (Peck and Zhang 2013). Although China has achieved what Stiglitz (2006) called ‘probably the most remarkable economic transformation in history’, the studies on Chinese model have reflected the limits of the VoC framework. Particularly, recent explorations of the Chinese model by using VoC framework even have resulted in divergent conclusions. Witt (2010) contends that ‘Chinese capitalism looks more like a LME than a CME’ by using the principles of the VoC approach; while Fligstein and Zhang (2011), who employed the same analytical approach, argue that Chinese model is most closely related to the CME-style French model. Given that the VoC framework was developed exclusively for the understanding of capitalist diversity among ‘advanced capitalist nations’ such as USA, Germany and Japan (Hall and Soskice 2001), it is no wonder that there are far-reaching challenges in attempting to visualize China through the analytical lens of the VoC approach.

Despite the problematic Chinese capitalism has placed stress on the methodologically nationalist, firm-oriented VoC approach and the singular LME-CME yardstick, it might provide a means to further articulate emergent approaches to ‘variegated capitalism’ in economic geography (Dixon 2011; MacKinnon et al. 2009; Peck and Theodore 2007). Particularly, variegated

capitalism approaches have the following divergences with the orthodox VoC approach: first, they employ multi-scalar rather than mono-scalar for analysis; second, they emphasise more on contradiction and disjuncture than on nationally scaled institutional coherence; third, they utilize relational perspectives, emphasizing the mutual interdependencies between ‘local’ economies over endogenous logics and separatist treatments; fourth, they investigate cross-cutting and connective processes, not only as carriers of convergence tendencies but in the context of combined and uneven development and fifth, they attempt to reach into more-than-capitalist worlds while confronting the ecological dominance of neoliberal globalism at the same time (Peck and Theodore 2007; Sheppard 2011; Jessop 2012). As such, the comparative study of Chinese model and British model for urban water infrastructure investment and governance in this thesis can provide not only a provocative but also a productive case for variegated capitalism in economic geography.

2.4.3 Urban Water Infrastructure Investment and Governance of Beijing and London

In term of urban water infrastructure, understanding the diverse types of urban water infrastructure investment and governance should start with recognizing public and private provision of water services coexist in many cities of the world (Bakker 2010). Although the effective institutional governance and regulation of water services is essential for sustainable water infrastructure system (Rouse 2013), it should be noted that there is no “one-fit-all” model for urban water infrastructure investment and governance given the spatial differences of economics, history, law and philosophy.

Generally, there are three ideal governance approaches often discussed in reference to urban

water management: hierarchical, market and network approaches (van de Meene et al. 2011). Hierarchical governance consists of formal arrangements and representative democratic accountability mechanisms (Kjaer 2004), which was often observed in large, centralised public authorities for water services (Vlachos and Braga 2001), with vertical accountability and little stakeholder participation (Pahl-Wostl 2007). Market governance, essentially applying private sector management principles to the public sector (Hood 1991), aims to allocate resources efficiently and empower citizens (Pierre and Peters 2000). This approach became popular during the 1990s and was observed in urban water management through full cost pricing, introduction of competition and privatisation (Bakker 2002). Network governance is founded on reciprocity and consensus, and acknowledges public, private and civil actor participation is required for effective public policy development and implementation (Klijn and Koppenjan 2000). Although each above governance approach has been promoted as a solution to public policy challenges, it is argued that the three ideal governance approaches will rarely be observed in reality, but rather mixed or hybrid forms will be detected in practice due to the complexity of real world situations (Hill and Hupe 2002; Meuleman 2008; Pierre and Peters 2000). As water governance is essentially a local issue and involves a plethora of stakeholders at basin, municipal, regional, national and international levels (Rouse 2013), a major challenge lays in the implementation of solutions for sustainable urban water infrastructure governance is to tailor them to local contexts.

It is impossible for China to achieve remarkable development for its rapid and continued urbanization without a range of urban infrastructure in place. Nonetheless, the study on urban infrastructure investment and governance in China remains rudimentary, with a handful of exceptions (Chan 1997; Deng 2003; Kumar et al. 1997; Wu 1999). Contrasted with the pervasive

power of financial industry in the Anglo-American world, political powers from national to local scale play important roles in infrastructure financing and provision (Lin et al. 2014). The Local Government Financing Platform (LGFP) model emerged as the special product of China's economic transition and contributed to urban infrastructure development in the process of China's urbanization (Yin and Wang 2013). In regard to water infrastructure in China, most literature has focused on rural water infrastructure provision since agriculture is still the largest water user in China (Cai 2008). However, with urbanization and population growth in China, more attention should be paid to how to set up robust urban water infrastructure governance system for sustainable water infrastructure investment and service delivery. Beijing, which is the capital city of China and one of its fastest-growing municipalities, is facing severe water scarcity problems (Probe International Beijing Group 2008). In fact, a large number of initiatives have been launched, ranging from separating grey and brown water to financing sophisticated ecological projects in the framework of the Olympic Games in 2008, to make Beijing a more ecological city (Dijk 2009). Nevertheless, although impressive environmental laws and regulations have been adopted and agencies dedicated to environmental protection have been formed in the past three decades, "much of the environmental energy generated at the national level dissipates as it diffuses through the multi-layered state structure, producing outcomes that have little concrete effect" (Lieberthal 1997). To some extent, water crisis is a governance crisis in China.

On the other side of the world, it is also impossible to ignore the rise of the power from financial industry, especially from institutional investors, for shaping the landscape of cities alongside with the regulations of governments. Long-term institutional investors such as pension funds, insurance companies, and sovereign wealth funds may lead us to a new era of infrastructure

investing (Clark et al. 2011). The Regulatory Asset Based (RAB) model which emerged contingently in regulating network utilities such as water companies and energy companies has made urban infrastructure assets in the UK becoming global financial products and led to a trend 'financialisation of infrastructure' (O'Neill 2013). At one level, the RAB model facilitates the rising of a global infrastructure market and changing governance of infrastructure in cities (Torrance 2009); at another level, however, the RAB model and changing governance of urban infrastructure demand new styles of infrastructure policy and regulation. London, the capital city of Britain and a dynamic, growing city, is also facing the effects of a changing climate along with growing demands on water resources (Greater London Authority 2011). With half the water mains now over 100 years old and the combined sewerage network built in the 1860s which cannot cope with an increase in water demand plus an increase in sewage and rainwater in the system, a large quantity of investment is needed for renewing and upgrading the infrastructure and the provision of water service in London for meeting the requirements of European Union Water Framework Directive. The on-going Thames Tideway Tunnel project is a case in point, and it still remains controversial (Bloomberg New Energy Finance 2013).

Although Beijing and London have different institutional and social contexts for urban water infrastructure investment and governance, the increasing demand on water services (including water supply and sewerage treatment) and growing pressure on fiscal capacity make the two cities have the same objectives and willingness to overcome these challenges for sustainable water infrastructure investment and service delivery. Robust but different governance systems are required for the two cities in dealing with complexity and uncertainty of urban water infrastructure investment and service delivery in different geographical contexts. The differences and similarities

of urban water infrastructure investment and governance in the two cities can produce a meaningful comparative study of economic relations in various institutional contexts, which is apposite for contributing to the emerging variegated capitalism in economic geography.

2.5 Conclusion

This chapter has outlined the overarching theoretical context for investigating infrastructure investment and governance in different geographical and institutional contexts. By challenging the Functional and Structural Finance framework proposed by Merton and Bodie (2005) which emphasises “form follows function”, the chapter elaborates the endeavour made by economic geographers who argue that “functions are inherently geographical in nature” (Ansar 2010; Clark and Wójcik 2007; Dixon 2012; Rodríguez-Pose and Storper 2006) and complete convergence and integration of forms are “neither inevitable nor can the outcomes of change be expected to be uniform” (Dixon 2014). As such, the better understanding of the spatial heterogeneity of infrastructure investment and governance requires the case-study and close-dialogue (Clark 1998) based economic geography framework.

The academic enquiry on infrastructure from the perspective of economic geography is an important and growing field. Given the emerging “institutional turn” and “relational turn” in economic geography, the two theoretical approaches (institutional approach and relational approach) provide useful “geographical lens” to use space as a basis for asking particular questions about economic phenomena on urban infrastructure investment and governance due to the twofold reasons: urban infrastructure investment and governance are inherently contextual in nature; urban infrastructure investment and governance consist of significant information

asymmetries, long-term contract, repeated transactions, and complicated interrelationships among all involved stakeholders. As such, it should be noted that infrastructure has its own unique language category which shapes our cities and economies but remains underexplored.

In this context, this thesis argues that the unique language of “infrastructure” needs to be injected into the conceptualization of economic geography to provide a solid analytical handle on better understanding of “geography of infrastructure”. The work on this growing field can be built based on previous theoretical contributions by economic geographers on “geography of finance”, “geography of capitalism”, “geography of governance” and “geography of contract”. By choosing Beijing and London as “geographical lens” to investigate the spatial economic phenomena on urban water infrastructure investment and governance, Chapter Three of the thesis firstly analyses the economic aspect by comparing the investment models employed by Beijing and London for urban water infrastructure investment, which contributes to “geography of finance”. Contributing to “geography of capitalism”, Chapter Four of the thesis investigates the environmental aspect of urban water infrastructure of the two cities through comparing state capitalism versus liberal capitalism in terms of urban water infrastructure provision. Then Chapter Five of the thesis explores the social aspect of urban water infrastructure provision in the two cities by comparing the governance frameworks of water pricing systems, which is built upon the “geography of governance”. With the burgeoning field “geography of contract”, Chapter Six of the thesis studies the contact aspect for financing large-scale urban water infrastructure projects of the two cities.

The overall framework for the theoretical context of the thesis is shown below.

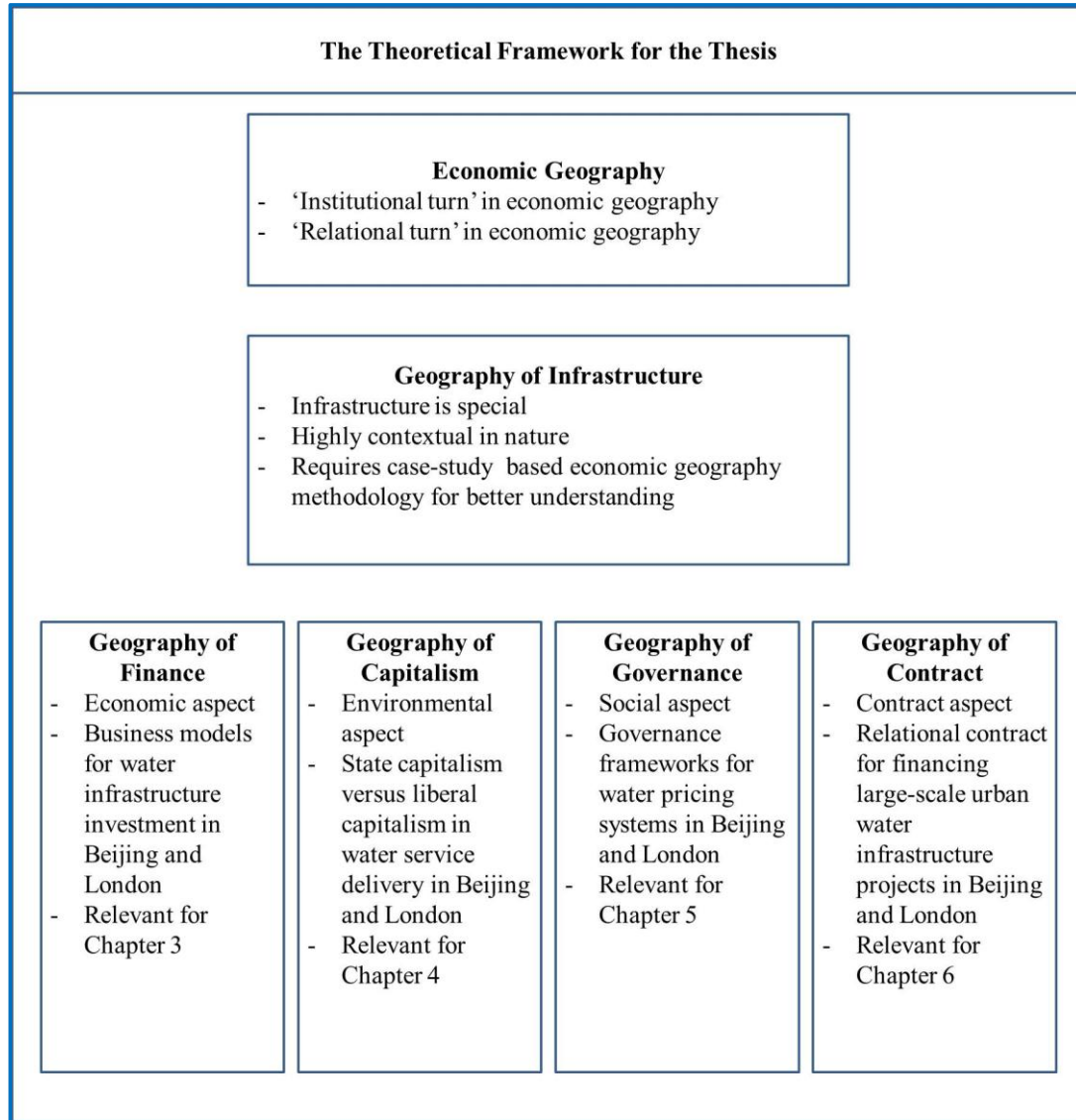


Figure 2.1 The Theoretical Framework for the Thesis

Based on this overarching theoretical framework for the thesis, the specific theories such as governance theory, institution theory, pricing and regulation, corporate governance, sunk cost and time-inconsistency are drawn upon to explore particular issues within each of these core chapters. As mentioned, this multi-disciplinary research is where the case-study and close-dialogue based economic geography should come into play for understanding the complex economic phenomena in the given contexts. The qualitative methodological approach which comprises of

semi-structured interviews, database and document reviews is used for better understanding the different forms of ideogram for the unique language of infrastructure.

Having outlined the theoretical context of the thesis and provided an overview of previous studies on infrastructure, the thesis now moves into the substantive part of the thesis. This part consists of four case-study chapters on economic, governance, pricing and contract aspect of urban water infrastructure investment and governance in Beijing and London respectively. The conclusions and future research directions are explored in the final chapter.

CHAPTER THREE: A TALE OF TWO URBANISMS IN THE ERA OF GLOBALISATION: COMPARISON OF THE LOCAL GOVERNMENT FINANCING PLATFORM MODEL IN BEIJING AND THE REGULATORY ASSET BASED MODEL IN LONDON

3.1 Introduction

In the era of globalization, economic cooperation has enhanced global shifts of capital and businesses. This has reconstituted city governments as entrepreneurial agents in terms of institutional structures and strategies proactively promoting economic growth, because urban development is increasingly dependent on local efforts to compete for attention, investment and opportunities (Brenner, 2004). The entrepreneurial tendency of cities creates enormous demand for infrastructure investment to make cities more attractive for global business opportunities, which forces cities to explore new sources of infrastructure financing due to fiscal constraints (Wang et al., 2011). As a result, cities in the era of globalization have been (re)developing their institutions of infrastructure investment in response to competitive advantages (Sassen, 1991; Scott, 2001). Nonetheless, little effort has been made on comparing the various trajectories of urban infrastructure investment models in different political economies, especially the dialogue between Global North and South. Contrasted with Global North where the state is described either as being ‘hollowed out’ or subsumed to the powerful and irresistible operation of global market forces, domestic and local political relations continue to play a role pivotal to urban infrastructure investment in China, although market reforms and opening up has been practiced for over three

decades (Lin et al., 2014). In this perspective, the spatial difference of urban infrastructure investment models and the underlying urbanisms between Global North and South would provide an interesting comparison with significant potential to fill existing knowledge gaps and advance urban theoretical enquiry.

It was perhaps a historical coincidence that, when Ronald Reagan and Margaret Thatcher promoted neoliberalism across the Anglo-American world in the 1980s, China's Deng Xiaoping initiated the fundamental restructure of economic development model in the name of 'reform and opening up' (改革开放), which essentially shares common neoliberal elements of marketization, privatisation, deregulation and globalization (Harvey, 2005; Peck et al., 2009; Wu, 2008). Yet it is interesting to note that China has adopted a unique path towards economic development and urbanization. The Local Government Financing Platform (LGFP) model emerged as the special product of China's economic transition and contributed to urban infrastructure development in the process of China's urbanization. On the one hand, the LGFP model has helped China in addressing urban infrastructure backlogs by opening up new venues for financing; on the other hand, the LGFP model which heavily relies on unconventional sources such as land resources has accumulated potential debt risks in China's local governments (Wang et al., 2011). In the United Kingdom (UK), privatisation and the retreat of state (Clark, 1999) have increasingly shifted urban infrastructure provision from public good to private property. There are three relatively distinct parts to the infrastructure finance market in the UK: Private Finance Initiative (PFI) and Public-Private Partnership (PPP) projects; contracted but not regulated projects; and regulated companies with corporate level financing (Wardlaw, 2009). In particular, the Regulatory Asset Based (RAB) model which emerged contingently in regulating network utilities such as water

companies and energy companies has made urban infrastructure assets in the UK becoming global financial products and led to a trend ‘financialisation of infrastructure’ (O'Neill, 2013). At one level, the RAB model facilitates the rising of a global infrastructure market and changing governance of infrastructure in cities (Torrance, 2009); at another level, however, the RAB model and changing governance of urban infrastructure demand new styles of infrastructure policy and regulation. Since economic action is not unconditional but guided or constrained by explicit rules and regulations as well as implicit conventions of social and economic life (Bathelt and Glückler, 2013), the LGFP model and the RAB model to some extent mirror the spatial heterogeneity of the underlying institutions and urbanisms. Although the growth and spatiality of urbanism in different temporary and spatial contexts has never ceased to intrigue urban specialists (Brenner and Theodore, 2002; Goldman, 2011; Leitner et al., 2007; Nijman, 2007; Smith, 2002), few studies have investigated the various trajectories of investment models for infrastructure development and the underlying urbanisms in different geographical contexts.

In this context, the aim of this chapter is to investigate the spatial difference of the underlying institutions and urbanisms behind the LGFP model and the RAB model for financing infrastructure to pursue competitive advantages of a city in the era of globalization. As Beijing, the capital of China, aims to become ‘world city’ by 2050 (Xinhua, 2010), competitive infrastructure is a crucial factor for fulfilling this goal. Particularly, how to deal with water challenges constraining the development of Beijing is not an easy task due to its geographical location in rather dry northern China and its growing water demand. While London, the capital of Britain, aims to maintain its top position as global financial centre (Pickford, 2013), its aging infrastructure is needed to be upgraded to make the city more attractive for global investors and businesses. In

particular, how to tackle the aging water networks in London is challenging since water security is important for the prosperity of London in the face of a growing population and increasing demand for water resources (Greater London Authority, 2011). Since the Beijing government finances its water infrastructure through the LGFP model while the London government does so through the RAB model, this chapter employs urban water infrastructure of Beijing and London as empirical cases to explore the various trajectories of urban water infrastructure investment models and the underlying urbanisms in different geographical contexts. The chapter mainly examines the following questions: What are the LGFP model and the RAB model? How do they emerge and evolve over time, respectively? How do the LGFP model and the RAB model actually function in financing urban water infrastructure of Beijing and London, respectively? Why do the two cities choose different models? What are the underlying urbanisms behind the spatial difference of urban infrastructure landscape shaped by various infrastructure investment models in different geographical contexts? To illustrate these issues, this chapter firstly explores the emergence and evolution of the LGFP model and the RAB model. The chapter then employs urban water infrastructure of Beijing and London as empirical cases to investigate the spatial heterogeneity of infrastructure investment models and the underlying urbanisms in the era of globalization.

The remainder of this chapter is organised as follows. It starts with the conceptual exploration of institutions in economic geography and a critical review of previous studies on the LGFP model and the RAB model. The issues concerning research design and methodology are then clarified. The empirical section firstly explores the emergence and evolution of the LGFP model and the RAB model, and then investigates the two models through empirical studies of urban water infrastructure of Beijing and London. The discussion section compares the underlying

institutions and urbanisms behind the LGFP model and the RAB model. Findings and limitations of the research and their implications for further study are discussed in the final section.

3.2 Geographies of governance: urban infrastructure investment and institutions

3.2.1 Institutions in economic geography

Institutions are important because economic action as social action is not unconditional. Economic action such as infrastructure investment can be guided or constrained by institutions which are related to some sort of rules and regulations or to conventions of social and economic life. However, although work on local and regional economies over the past decade has been marked by an increased concern with institutions and the relationship between institutional dynamics and economic development (Amin, 1999, 2001; Cumbers et al., 2003; Martin, 2000; Wood and Valler, 2001), ‘institutions’ in the literature of economic geography and related disciplines are often vaguely defined, or almost become a ‘black box’ to relate to otherwise unexplained influences in economic development (Bathelt and Glückler, 2013). While the one account emphasizes organizations as institutions, the other focuses on the role of laws, rules, regulations, etc. (Gertler, 2010; North, 1990). Both perspectives, although quite different in character, tend to view institutions as structures that shape and direct action. Another perspective links institutions to the development of trust, to the way authority is expressed, and to ‘how things are done’ and ‘how learning takes place’ in different national contexts (Lundvall and Maskell, 2000). In this understanding, institutions are linked explicitly to practices of repeated interaction, instead of viewing them independently from economic action. In contrast with the ‘black box’ explanation, Bathelt and Glückler (2013) present an explicit understanding of institutions that

deviate from defining them as simple regularities, rules, or organizations (governments). They view institutions as correlated and relatively stable social interactions between economic agents that develop upon rules and regulations in rather contingent ways. Based on Bathelt and Glückler (2013) conceptual exploration of ‘institutions’ in economic geography, this chapter conceives institutions as stabilizations of mutual expectations and correlated interaction built on rules and regulations to explore the emergence and evolution of the LGFP model and the RAB model in different geographical contexts empirically.

3.2.2 The LGFP model and local ‘land finance’ phenomena in urbanizing China

One of the most important milestones in contemporary global development has been the phenomenal urbanization in China. Rapid and continued urbanization would not be possible without a range of new urban infrastructure in place. Despite a growing number of studies characterising the economic and spatial restructuring of Chinese cities in the context of a transforming political economy (Chan, 2007; Fan, 2008; Ma and Wu, 2005; McGee et al., 2007; Wu, 2008; Wu et al., 2007), the understanding of urban infrastructure investment in urbanizing China has been underexplored. Although several studies have explored various issues related to urban infrastructure financing (Chan, 1997; Deng, 2003; Kumar et al., 1997; Wu, 1999), literature to date has paid less attention to how Chinese cities fund their urban infrastructure and the underlying institutions. Cao et al. (2008) analyse the issue of local ‘land finance’ in the context of China’s fast urban expansion and argue that low-cost land acquisition is the fundamental cause of land-related distortions that have occurred during China’s urbanization. Wang et al. (2011) scrutinise the changing roles played by the state and the market in financing urban infrastructure

in China. They argue that urban infrastructure financing in China has much to do with the country's transition to a market-oriented economy that fosters the pro-growth role of city governments as well as the redistribution of fiscal power between the levels of the urban hierarchy that produces significant variation of financial capacities among different administrative ranks of cities. Lin et al. (2014) who have examined the recent growth and proliferation of urbanism in post-reformed China argue that the commodification of urban land and the upgrading as well as expansion of the urban built-environment have been actively pursued by municipal governments as a strategy to contest the reshuffling of state power in the era of neoliberalization. Although these studies have identified that the financing of urban infrastructure development in China has much to do with land finance and municipal governments play important roles in China's urbanization, few have analysed the interrelationships between the LGFP model and the underlying institutions, nor compared the LGFP model in Chinese cities with the infrastructure investment models in the cities of the Anglo-American zone.

3.2.3 The RAB model and financialization of urban infrastructure landscape in Britain

Much research efforts have been made on privatisation and the retreat of state (Clark, 1999) in infrastructure in the UK, increasingly shifting urban infrastructure provisions from public good to private property as well as changing the institutional governance of infrastructure. Some consider the phenomena as hollowing out and/or the shift from government to governance (Jessop, 2002; Rhodes, 1994), which means that the national state has come to be seen merely as one amongst many actors seeking to influence political process and economic development (Jessop, 1990, 2001). However, Goodwin et al. (2005) argue that it is no longer enough to simply refer to a

‘hollowing out’ of the nation state in an era of economic and political restructuring, because hollowing out, through its focus on the processes affecting the national state, fails to grasp the potential for similar processes to take place within territories that exist within national states. Conversely, regions within national states may choose to preserve pre-existing organisations and strategies of governance. It is only through grappling with the notion of ‘filling in’ – in empirical and conceptual terms – that the spatially contingent evolution of governance within particular territories or regions can be appreciated (Jones et al., 2005). Despite of these controversies, little attention has been paid to the recent trend ‘financialisation of infrastructure’ (O'Neill, 2013) in the Global North which gives rise to a global infrastructure market and changing governance of infrastructure in cities (Torrance, 2009). In particular, the RAB model in regulating network utilities such as water companies and energy companies has made such infrastructure assets in the UK becoming financial products in recent years and demonstrated a strong track record of attracting private capital especially institutional investors from all over the world. This local unbundling and global interlinking is changing the governing structures of infrastructure, as arm's length regulators are created and the relationships between governments, investors, operators and contractors are defined by contractual mechanisms (Babcock-Lumish and Clark, 2005). Contrasted with local ‘land finance’ model for infrastructure investment in China, urban infrastructure landscape in Britain, owned by global owners and regulated by local actors, are forging new styles of ‘glocal’ governance (Torrance, 2008). Therefore, more comparative studies between Global North and South, either conceptual or empirical, are needed for better understanding of the spatial heterogeneity of urban infrastructure landscapes as well as the underlying institutions and urbanisms.

3.3 Research design and methodology

The theoretical and empirical enquiry in this chapter essentially concerns the spatial difference of the underlying urbanisms behind the LGFP model and the RAB model for financing infrastructure to pursue competitive advantage of a city in the era of globalization. The urban water infrastructure of Beijing and London is chosen as empirical cases because the Beijing government finances its water infrastructure through the LGFP model while the London government does so through the RAB model. As Beijing, the capital of China, aims to become ‘world city’ by 2050 (Xinhua, 2010), competitive infrastructure is a crucial factor for fulfilling this goal. Particularly, how to deal with water challenges constraining the development of Beijing is not an easy task due to its geographical location in rather dry northern China and its growing water demand. While London, the capital of the UK, aims to maintain its top position as global financial centre (Pickford, 2013), its aging infrastructure is needed to be upgraded to make the city more attractive for global investors and businesses. In particular, how to tackle with the aging water networks in London is challenging since water security is important for the prosperity of London in the face of a growing population and increasing demand for water resources (Greater London Authority, 2011). With the same goal of pursuing water security for the competitive advantage of the city in the era of globalization, the various trajectories of urban water infrastructure investment models in different geographical contexts provoke enquiry about the underlying institutions and urbanisms. Specifically, this chapter explores the following research questions:

- (1) How do the LGFP model and the RAB model emerge and evolve over time in different geographical contexts?

(2) How do the LGFP model and the RAB model function in financing water infrastructure of Beijing and London?

(3) Why do the two cities choose different investment models for water infrastructure development?

To answer these questions, three working hypotheses are made for testing. First, institutions have influence on the function and the evolution of the LGFP model and the RAB model as ‘institutions have a history and a geography as well as a functional logic’ (Clark and Wójcik, 2007). Second, urban water infrastructure investment of Beijing and London are influenced not only by industry regulations explicitly but also by social interactions implicitly, since ‘institutions are viewed as correlated and relatively stable social interactions between economic agents that develop upon rules and regulations in rather contingent ways’ (Bathelt and Glückler, 2013). Finally, the spatial difference of the LGFP model and the RAB model represents the various underlying urbanisms in the different geographical contexts. More specifically, the urbanism behind the LGFP model can be described as “strategizing urbanism” to the extent that it has been actively pursued and practiced by municipal governments to fulfil their political and economic goals (Lin et al., 2014); while the urbanism behind the RAB model can be viewed as “financialization urbanism” that it has been shaped by both local governments which exploit the force of global financial industry to fulfil their political goals and global financial industry which grasps global investment opportunities in various geographic jurisdictions to get their expected risk-adjusted rates of return (Torrance, 2009).

One major methodology challenge is related to studying the emergence, production, and change of institutions empirically (Bathelt and Glückler, 2013), because institutions cannot be

measured by obvious or easily identifiable indicators, but need to be analytically extracted from social practice. Accordingly, the empirical study of institutions can only be conducted through in-depth interviews or observation techniques, as well as other methods that are able to record process information (Barley and Tolbert, 1997). Therefore, the empirical studies of the LGFP model in Beijing and the RAB model in London in this chapter are mainly conducted based on close dialogue (Clark, 1998b) with key individuals and critical review of relevant documents¹. In this study, urbanism is used to denote the practices of upgrading and developing urban infrastructure as a means to pursue competitive advantage of the city in the era of globalization and secure as well as enhance the political interests of local state officials. The emphasis is placed on how Beijing and London choose investment models for necessary water infrastructure provision and what are the underlying urbanisms for these two cities to adopt different models for infrastructure investment. Obviously, the practice of urbanisms in the two cities under two particular geopolitical situations does not provide a base strong and broad enough to make widely applicable generalisations. Nevertheless, the empirical comparison study of urban infrastructure investment and governance in Beijing and London making original contribution to the ‘geographies of infrastructure’ can serve as a starting point for the dialogue between cities in the Global North and South for a better understanding of the divergent trajectories of urbanisms in the era of globalization.

3.4 The Local Government Financing Platform model for financing urban water infrastructure of Beijing and the strategizing urbanism

3.4.1 The evolution of the Local Government Financing Platform model in the process of China's urbanization

One of the most important milestones in contemporary global development has been the phenomenal urbanization with an unprecedented scale and speed in China (Lin et al., 2014). Rapid and continued urbanization not only presents tremendous potential for economic growth, but also creates enormous demand for urban infrastructure development. Traditionally the financing of infrastructure development has been the responsibility of the central government; however, a tax-sharing reform introduced in 1994 meant that local governments started to take the majority share of infrastructure financing, with limited support from the central government. With less financial support from the central government, local governments had to seek additional funding sources. Nonetheless, restricted by the budgetary law, local governments are not allowed to get loan from banks or issue bond *directly* for infrastructure projects. In this context, many local governments initiated the Local Government Financing Platform (LGFP) model utilizing market capital to fund infrastructure development. Figure 1 shows the operation mode of the LGFP model. Generally, the LGFP model constitutes one or several corporations set up by local governments through allocation of state-owned assets and/or land resources to get loan from banks or issue bond *indirectly* for infrastructure projects. The evolution of the LGFP model is closely related with China's institutional change in the investment and financing system as well as the underlying strategizing urbanism for China's urbanization.

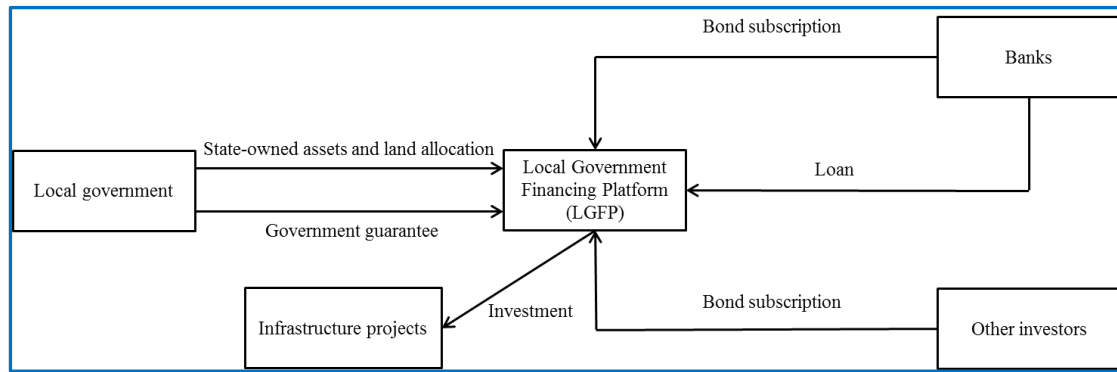


Figure 3.1 The operation mode of the Local Government Financing Platform model

Source: adapted from (Yin and Wang, 2013)

Market-oriented economic reform and increased integration into the global economy from the late 1970s have placed China on a new path of accelerated urbanization with an unparalleled scale and speed (Zhang, 2008). Before the reform, the central government was the sole planner and financier of urban infrastructure projects and local governments only functioned as executors of the central plans under the state's monopoly of fiscal revenues (State Administrative Council, 1950a, b). In 1980s the province of Guangdong was the first to try out the model of 'building road through loans, collecting tolls for repayment' (贷款修路, 收费还贷) which was then popularised to the whole country and can be considered as the forerunner of the LGFP model. In 1994 China began implementing an extensive reform of its tax system, also known as separate tax system reform or tax-sharing system reform (分税制改革). The introduction of the tax-sharing system, legislated as the budgetary law (预算法), has significant influence on China's economic transition (Herschler, 1995; Ma, 1995; Toh and Lin, 2005; Tsui, 2005) including profound transformation in urban infrastructure financing. After the reform of the tax-sharing system, local governments were given more autonomy and local expenditures in principle were paid by local revenues. From 1994 to 1997 local governments gradually established local agencies such as building and development

leadership group offices (建设开发领导小组办公室) which functioned as the LGFP model for planning and guiding infrastructure development.

The Southeast Asia financial crisis in 1997 boosted the promotion of the LGFP model across China. In order to mitigate the shock impacts of financial crisis, local governments took measures to expand investment to stimulate economic growth, in which infrastructure investment accounted for large proportion of total investment. Nonetheless, the central government only provided part financial support to the approved infrastructure projects while local governments had to raise funds for the remaining part. In this context, the LGFP model began to play an important role in infrastructure investment and financing where various forms of project financing such as BT (Build-Transfer), BOT (Build-Operate-Transfer), ABS (Asset-Backed Security), etc. were exploited. In particular, the Wuhu model in which China Development Bank cooperated with local governments to finance urban infrastructure development through debt financing successfully addressed the shortage of capital and was then popularized across the country. In 2004 the State Council of China released a key policy document for reforming the investment system (State Council of China, 2004). Considering the exposed flaws in the previous stage such as bad credit quality of some LGFPs, local governments were required to set up new type LGFPs through attracting external capital for participation and restructuring the corporate governance of previous LGFPs. From 2004 to 2008, the new type LGFPs began to cooperate with commercial banks in China, and its service scope extended from funding traditional infrastructure projects to funding economic entities such as small and medium enterprises (SMEs), high-tech enterprises and industrial parks which are important for local economic development but difficult in raising fund themselves.

The latest global financial crisis undoubtedly had a remarkable impact in the development of the LGFP model. Within the network of global economic integration, China also felt great economic shock especially in export sectors. In November 2008, the Chinese government announced an economic stimulus plan of ¥4 trillion (US\$586 billion) as an attempt to minimize the impact of the global financial crisis (Barboza, 2008). Nonetheless, the central government finally only transferred ¥1.18 trillion as fiscal support to local governments, and the remaining capital demand of ¥2.82 trillion was left for local governments to solve themselves (Yin and Wang, 2013). Correspondingly the number of LGFPs soared during this period. The accumulated debts and the potential risks of the current LGFP model aroused the attention of Chinese central government. In June 2010 the State Council of China released a policy document which aimed at regulating the governance structure of the LGFP and monitoring the scale of debts of LGFPs (State Council of China, 2010). Then in November, China Banking Regulatory Commission (CBRC) made relevant provisions on controlling debt risk of LGFPs. The commercial banks in China correspondingly adjusted the credit policy and strengthened the risk management of loans to LGFPs. Since then the LGFPs have begun to turn to off-balance sheet activities such as bond issue, Government-Trust cooperation, and insurance fund debt investment. Nonetheless, these under-regulated and poorly managed shadow banking² businesses hide potential risks in China's local governments and may cause potential financial crisis.

Table 3.1 summarises the evolution of the LGFP model in China's urbanization over the past three decades¹. It can be seen from the table that the LGFP model emerged contingently and

¹ Documentary and statistical materials in this paper, particularly those presented in figures and tables, were collected from fieldwork during the summers in 2012 and 2013. The fieldwork covered relevant government departments, infrastructure companies, financial institutions, research institutes and universities. The majority of time was spent interviewing relevant city authorities and experts. The interviews were carried out in a semi-structured, open-ended fashion, with the focus on exploring the characteristics and challenges of urban

evolved over time based on various local situations in China. Instead of developing from explicit regularities, rules or organizations, the LGFP model can be viewed as ‘correlated and relatively stable social interactions between economic agents that develop upon rules and regulations in rather contingent ways’ (Bathelt and Glückler, 2013). On the one hand, it should be admitted that the LGFP model has contributed to urban infrastructure development in the process of China’s urbanization. On the other hand, however, the boom of the LGFP model has hidden the potential risks in Chinese local governments and mirrored the underlying strategizing urbanism embraced by Chinese cities for contesting the rescaling of state power (Lin et al., 2014) and pursuing the competitive advantage of a city in the era of globalization.

Table 3.1 The evolution of the LGFP model in the process of China's urbanization

Budding stage 1978-1994	Initial stage 1994-1997	Promotion stage 1997-2004	Development stage 2004-2008	Booming stage 2008-2010	Regulated development stage 2010-
<i>Critical events that boost the development of the LGFP model</i>					
The model of 'building road through loans, collecting tolls for repayment' first tried in Guangdong province in 1980s	The introduction of tax-sharing system in 1994, legislated as Budgetary Law	The Southeast Asian financial crisis in 1997; the Wuhu model	The policy document on reforming of investment system released by the State Council of China in 2004	The global financial crisis in 2008; the economic stimulus plan of ¥4 trillion (US\$586 billion) released by the Chinese government	The policy documents and regulation rules released by the State Council of China and the China Banking Regulatory Commission in 2010
<i>Major implications for the development of the LGFP model</i>					
The model of Guangdong province was then popularized across China; the forerunner of the LGFP model	Marked a profound transformation in urban infrastructure financing system; the LGFP model began to come into play	Boosted the promotion of the LGFP model across China.	The LGFPs were restructured; the LGFPs began to cooperate with commercial banks and their service scopes expanded	The boom of the LGFPs	The commercial banks in China correspondingly tightened the credit line and strengthened the risk management of loans to the LGFPs; the LGFPs turned to off-balance sheet activities for urban infrastructure development

Source: Compiled by the author from literature study and field interviews

3.4.2 The Local Government Financing Platform model for financing water infrastructure of Beijing

Beijing is an inland region located at North China where water shortage is one of the main constraints for urban development due to the climate and geographic reasons. The average annual water resource per capita of Beijing is only 248 m³, which is less than one-eighth of the national average and one-thirtieth of the world average (Pan, 2006). With population growth and urban development, the Beijing government has to develop its urban water infrastructure for increasing its water supply in addition to rigorous water demand management. One of the critical projects for increasing water supply is the South-to-North Water Diversion Project². Furthermore, wastewater treatment and drainage system is also needed to be strengthened further in response to growing population and more frequent storm events due to climate change. Therefore, in the next few years the main challenge in the water sector for the Beijing government is to finance the upgrade and development of its water infrastructure sustainably for breaking the water constraint on urban development.

In order to raise capital for developing the supporting facilities for allocating water from the South-to-North Water Diversion Project, the Beijing government set up a special purpose vehicle named Beijing South-to-North Water Diversion Project Investment Centre in November 2011. The centre was renamed as Beijing Water Investment Centre (BWIC) in July 2013, whose

² The South-to-North Water Diversion Project (南水北调工程) is a multi-decade infrastructure project and the largest of its kind ever undertaken. The project aims to divert water from the Yangtze River at South China to the Yellow River, Huai River and Hai River at North China so as to ease the growing water shortage of the provinces and cities at North China. The project includes Western, Central and Eastern three routes. The Eastern Route project was completed in November 2013. The Central Route project will be completed by the end of 2014. The South-to-North Water Diversion Project aims to divert water of 44.8 billion m³ each year from South China to North China. The complete project is expected to cost ¥500 billion (approximate \$82.64 billion, calculated on the exchange rate of \$1.00 = ¥6.05), and ¥243.4 billion (about \$40.23 billion) has been spent by the end of 2013. (Source: Office of the South-to-North Water Diversion Project Commission of the State Council <http://www.nsbd.gov.cn/zx/english/>)

responsibility is to finance all water infrastructure assets of Beijing. Figure 3.2 shows how BWIC functions as the LGFP model to finance the water infrastructure of Beijing. With the authorization of the Beijing government, BWIC consolidates all water infrastructure assets of Beijing so as to improve the credit level for raising capital from consortium of banks, finance leasing companies and other institutional investors. The main financing source is debt financing and BWIC relies on loans from consortium of banks (most are state-owned banks). Although BWIC uses the water infrastructure assets as collateral for loans or finance leasing, these state-owned assets are owned by Beijing State-owned assets Supervision and Administration Commission on behalf of the Beijing government. This means that those investors lend money to BWIC because of the underlying government guarantee rather than the profitability of the water infrastructure projects. In fact, due to the underdevelopment of pricing mechanism, revenues collected from consumers cannot cover the costs of the projects³. In consequence, the Beijing government allocates land resources near river to BWIC to use earnings from land development for repayment. Nonetheless, given the fact that land resource is limited and local land use right assignment fee is a windfall of revenue or a once-only capital gain for local government (Lin and Ho, 2005), the current LGFP model relying on land finance as collateral for borrowing and repayment can hardly be stable or sustainable in the long run. Furthermore, since land prices are extremely volatile, the current LGFP model that relies on land and property values as the collateral for borrowing may result in a threat to overall fiscal stability should there be a decline or bubble burst in the real estate market (Peterson, 2006).

³ The domestic water tariff in Beijing was ¥4 yuan/m³ (around \$0.67 dollars/m³). From May 1st 2014 onwards, Beijing adopt the block water tariff system which has three blocks. The water tariff for the first block system is ¥5 yuan/m³ (around \$0.83 dollars/m³) if the annual domestic water use of the household is within 0-180 m³; the water tariff for the second block system is ¥7 yuan/m³ (around \$1.17 dollars/m³) if the annual domestic water use of the household is within 181-260 m³; the water tariff for the third block system is ¥9 yuan/m³ (around \$1.5 dollars/m³) if the annual domestic water use of the household is more than 260 m³.

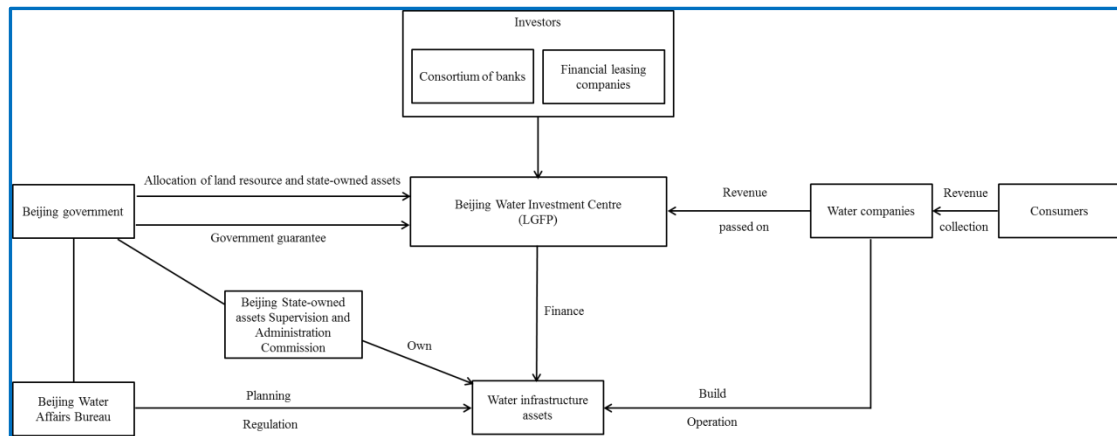


Figure 3.2 The LGFP model in financing water infrastructure of Beijing

Source: the author

As Table 3.2 shows, the water industry of Beijing is divided into three parts: Beijing Water Affairs Bureau (BWAB) is in charge of policy making, planning and industry regulation; BWIC is responsible for water infrastructure investment and financing; while Beijing Waterworks Group (BWG) and Beijing Drainage Group (BDG) are responsible for operation of water supply and wastewater treatment respectively. It seems that this separation of the water industry of Beijing can be seen as attempts at assigning different risks to those best able to manage them, which is called ‘government-led, corporate operation, social participation’ (政府主导, 企业运作, 社会参与). However, BWIC is not authorised to set up business plans for water infrastructure development or to assess the profitability of the projects. In fact, BWIC is not an independent investment institution but only functions as the LGFP model for raising fund for the water infrastructure projects approved by the Beijing government. This means that BWIC does not take the risk of investment, and all the risks of infrastructure investment are undertaken by the Beijing government. But the equity risk of infrastructure investment never goes away. Ultimately, the

taxpayers of Beijing absorb the risk if investment decision goes wrong or on-going project suffers cost overrun. Obviously, domestic and political relations such as the Beijing government play a leading role in shaping the landscape of urban water infrastructure of Beijing. In this perspective, the underlying urbanism behind the LGFP model can be described as “strategizing urbanism” to the extent that it has been actively pursued and practiced by municipal government to fulfil the political and economic goals (Lin et al., 2014). Nonetheless, with so much information and so many actors involved in urbanization, it remains doubtful whether the government-led model can address the real demand of citizens and enhance the competitive advantage of the city in the era of globalization. The government-led urbanism or strategizing urbanism, which employs the subjective judgement of local state officials to pursue competitive advantage of the city in the era of globalization, likely gives rise to over-investment or mis-investment if other non-government actors cannot effectively participate in the decision-making process of infrastructure investment.

Table 3.2 Regulator and water companies for water infrastructure of Beijing

Agency	Responsibility	Attribute	Shareholder
Beijing Water Affairs Bureau (BWAB)	Policy making, planning, regulation	Government agency	-
Beijing Waterworks Group (BWG)	Construction and operation of water supply services	State-owned company	Beijing State-owned assets Supervision and Administration Commission
Beijing Drainage Group (BDG)	Construction and operation of drainage and sewerage services	State-owned company	Beijing State-owned assets Supervision and Administration Commission
Beijing Water Investment Center (BWIC)	Water infrastructure financing and investment	State-owned company	Beijing State-owned assets Supervision and Administration Commission

Source: the author

3.5 The Regulatory Asset Based model for financing urban water infrastructure of London and the financialization urbanism

3.5.1 The evolution of the Regulatory Asset Based model in the process of Britain's privatisation

In order to build, finance and operate its infrastructure, Britain has tried most models of infrastructure governance over the last century: unregulated private-sector activities, municipal ownership, state ownership, monopolies, competition, privatisation, utility regulation, PFIs and variants such as PPP, direct subsidies, and state guarantees. In general, the infrastructure governance in Britain has been concerned with two core issues: ownership and competition (Helm, 2013). After the Second World War, the answer was nationalization and monopoly. From 1980s on, the answer was privatisation and competition. The Private Finance Initiative (PFI) was launched by the Major government in 1992. Although it is an obvious and important solution to infrastructure shortfall (Clark and Root, 1999) and a means of mobilising the burgeoning assets of pension fund capitalism for public investment (Clark, 1998a), the PFI has not been as successful as hoped by the British government since it did not solve the pricing, finance and investment problems – as the nationalized model had also eventually failed to do. All these required a new framework of regulation and customer billing as solutions to the contracting and time-inconsistency problems. With the evolution of privatisation of infrastructure, the Regulatory Asset Based (RAB) model emerged as a regulatory device to provide investors in privatized network utilities with comfort that their investments would not be treated unfairly and hence keep down the cost of capital (Stern, 2013).

Figure 3.3 shows the operation mode of the RAB model. The RAB is a number which

represents past investments, comprising what investors paid when the assets were originally privatised plus subsequent capital expenditure adjusted for depreciation. At the price-setting periodic reviews, the regulator determines whether the capital expenditure in the previous period has been efficiently conducted. It then transfers the (efficient) number into an asset base – the RAB. This asset base is the aggregate of the efficient capital expenditure plus an initial value for the purchase of the existing assets. The accounting number RAB is protected by the duty which is placed upon regulators to finance the business including the RAB. This financing duty gives rise to an effective guarantee that the regulated company’s investment will be recovered over time from consumers. Thus, the equity risk in the RAB for the regulated company is zero as the risk has been transferred to consumers who are obliged to pay for the RAB. The result is that the RAB is overwhelmingly debt financed at rates close to the government’s cost of debt. Even these RAB assets are less risky than government bonds since they are asset backed (Helm, 2013).

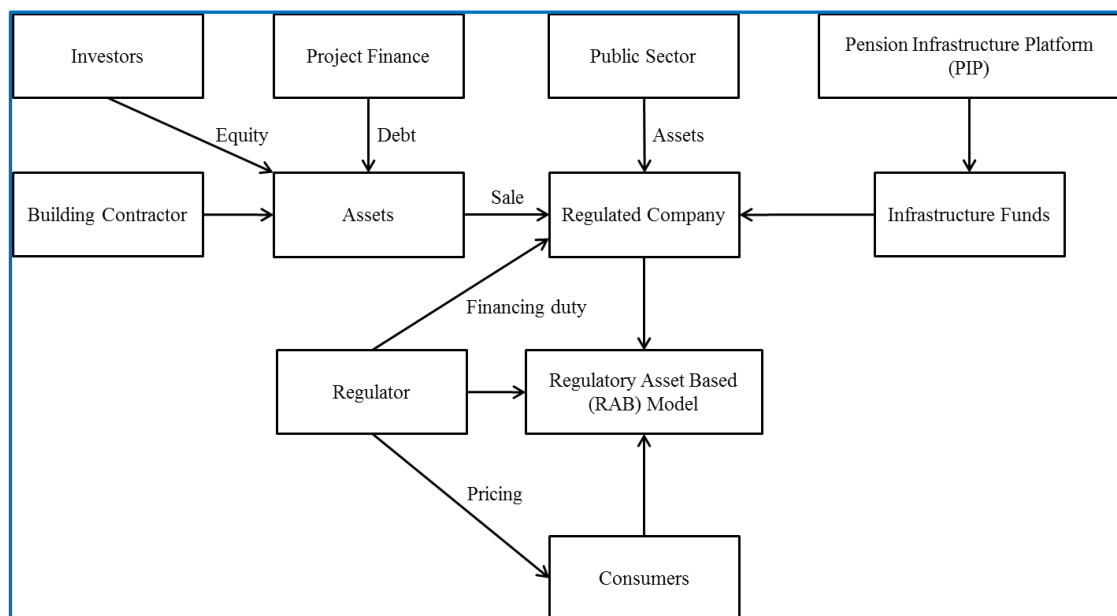


Figure 3.3 The operation mode of Regulated Asset Based (RAB) model

Source: adapted from (Pinsent Masons, 2012)

The RAB model emerged almost by accident in most of the British regulated utilities. It was initially developed for the UK water infrastructure industry by the Water Services Regulation Authority (Ofwat) in the early 1990s. Ofwat created it for the purpose of setting its first set of 5-year price limits which were published in 1994. Since then the RAB model was widely used in other UK infrastructure industries such as energy, railways and telecoms, and also spread across Europe. The initial value of the RAB of water companies in England and Wales is the average market value of the privatized water companies over the first 200 days for which the shares were listed in 1989. This starting value was applied in 1990 and has since been updated annually by the 12-month rate of retail price inflation. Each year the accounting number RAB is changed because of adding the capital expenditure to enhance and maintain the network at current prices and deducting current cost depreciation. Hence, the RAB for the privatized water industry of England and Wales is made up of: (i) a heavily discounted value of the assets at privatisation in 1989, annually revalued by inflation; *plus* (ii) capital stock increments since 1989 valued at their incurred cost; *minus* (iii) current cost depreciation on post-privatisation assets (Stern, 2013). The current legislation for water industry defines the primary duties of Ofwat as: (i) furthering the consumer objective; and (ii) ensuring that regulated water companies “... are able (in particular by securing reasonable returns on their capital) to finance the proper carrying out [of their regulated water functions]” (Ofwat, 2011). This financing duty of the regulator for the RAB model is the reason why overseas institutional investors have been so interested in British water utilities in recent years and why the cost of private capital can be kept down for infrastructure investment.

It is worth noting that there is no mention of RABs in UK primary legislation (Stern, 2013). The current British RABs evolved following the privatisation of the UK network infrastructure

industries, yet it is nowhere mentioned in legislation nor has there been any explicit mention of the term in water or other UK network infrastructure industry licences. However, precisely because they have no explicit legislative support, their reliability as a commitment device depends crucially on regulators keeping to the spirit as well as the letter of RAB commitments. This implicit binding force underlying the RAB model is in accordance with Bathelt and Glückler's (2013) conceptual exploration of 'viewing institutions as stabilizations of mutual expectations and correlated interaction rather than explicit regularities, rules, and organizations'. If UK regulators were seen by investors as violating that spirit, then the credibility of the RAB model as a commitment device could disappear very quickly – and would probably be virtually impossible to retrieve (Stern, 2013). The importance of RAB as a commitment device is not, however, just in their existence. It arises primarily out of the regulatory context in which they are set, updated and revised. Well defined RAB model in insecure regulatory environments offer little as a commitment device; whereas, at least in principle, the same degree of commitment could be offered by a secure regulator using a different mechanism. The role of the RAB as a commitment device is a consequence of the quality of its implementation rather than from the definition of the RAB per se. It is just that the RAB model has been accepted as a useful commitment device for the UK infrastructure industry and its relative success in implementation has provided a reputational support.

3.5.2 The Regulatory Asset Based model for financing water infrastructure of London

London is a dynamic, growing city and is also facing the effects of a changing climate along with growing demands on resources. Together these pressures will aggravate the stress on existing

systems by creating greater demands for water from the mains and the natural environment, increased flows to and discharges from the sewage treatment works, greater risks of surface flooding as rainwater runs off new houses, driveways and roads, and increased risks of storms and tidal surges (Greater London Authority, 2011). With half the water mains now over 100 years old and the combined sewerage network built in the 1860s which cannot cope with an increase in water demand plus an increase in sewage and rainwater in the system, a large quantity of investment is needed for renewing and upgrading the infrastructure and the provision of water service in London for meeting the requirements of European Union Water Framework Directive.

Contrasted with the jurisdiction-based water governance in Beijing, the water governance in London is basin-based and there is no specific department agency in London responsible for water services regulation. Figure 3.4 demonstrates the key actors in the water policy-making process in England and Wales. The Department for Environment, Food and Rural Affairs (Defra) has overall policy responsibility for the water industry. It is also the sponsoring department for the regulators Environment Agency (EA), Water Services Regulation Authority (Ofwat) and Drinking Water Inspectorate (DWI). Currently there are four private companies (Essex & Suffolk Water, Sutton & East Surrey Water, Thames Water, Veolia Water Central⁴) providing water supply service and one private company (Thames Water) delivering sewerage service, shown in Figure 3.5.

⁴ Veolia Water Central was sold along with its sister companies Veolia Water Southeast and Veolia Water East to Morgan Stanley and M&G Investments in 2012. The three companies were merged to form Affinity Water on 1 October 2012.

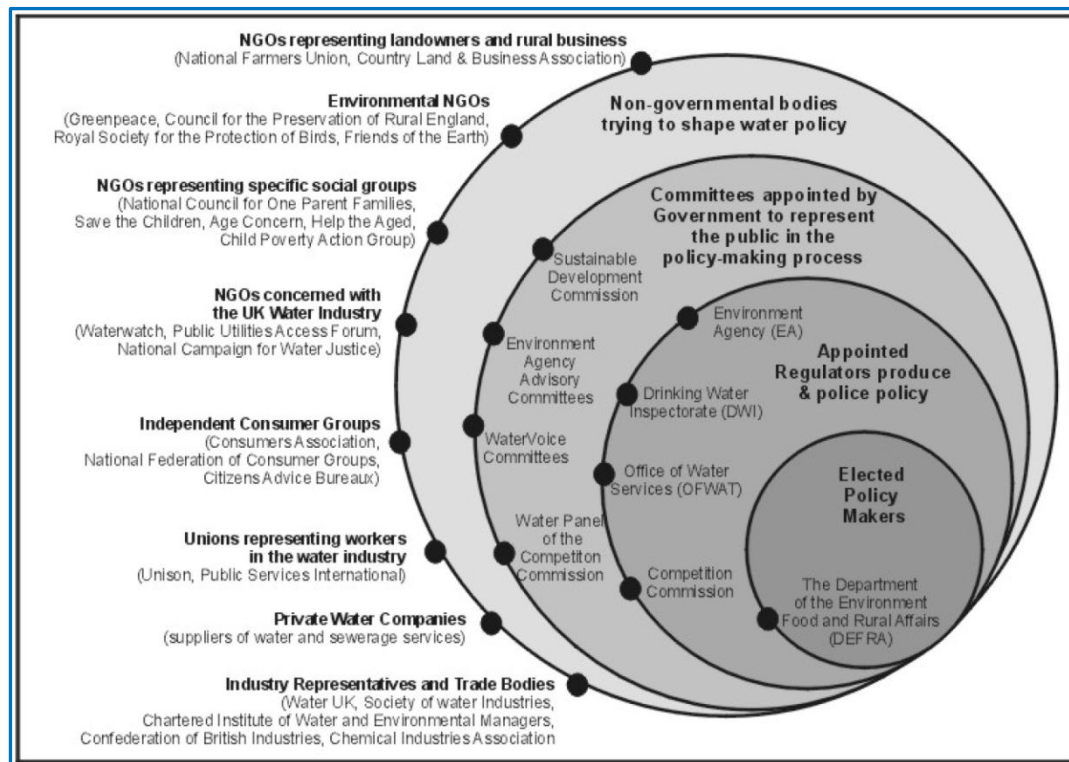


Figure 3.4 Water infrastructure governance system in England and Wales

Source: (Page and Bakker, 2005)

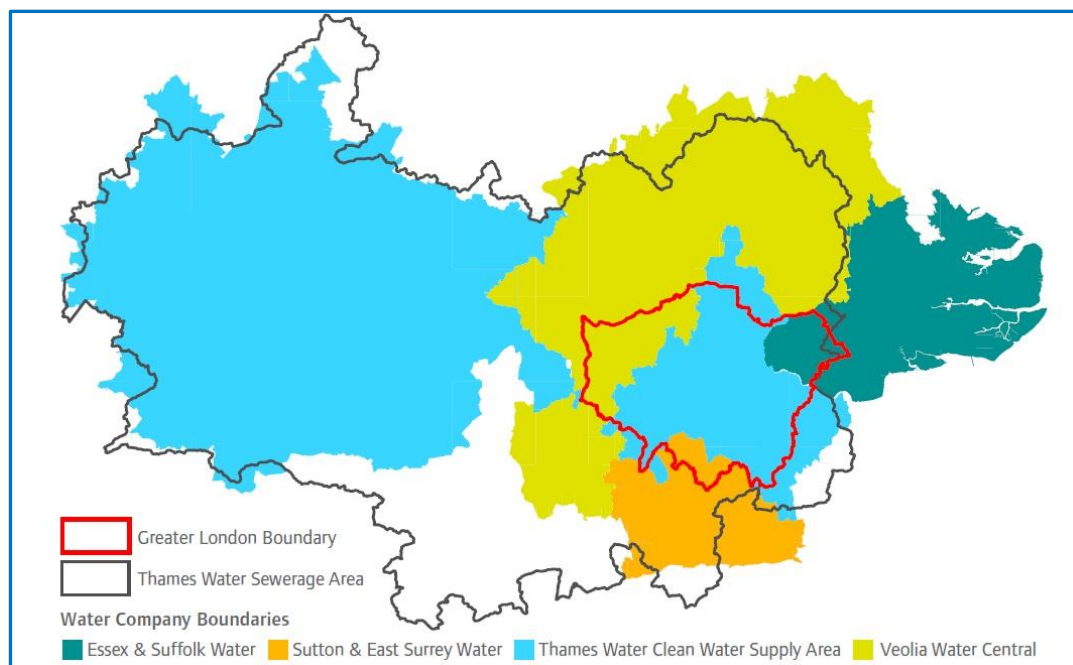


Figure 3.5 Water company service areas in London

Source: (Greater London Authority, 2011)

Figure 3.6 shows how the RAB model functions in financing water infrastructure of London. At the end of the five-year periodic review, the regulator Ofwat determines whether the capital expenditure in the previous period has been efficiently conducted, and then transfers the efficient number into the asset base RAB. Then at the beginning of the new round of the five-year periodic review, the water companies submit business plans giving the improvement schemes based on the requirement of Ofwat and their costs according to each company's real situation. Ofwat considers these plans by taking into account both the costs and the required efficiency improvements, and calculates the required water prices to pay for the work whilst giving the companies a reasonable profit. There are then discussions between Ofwat and each company before Ofwat announces its decision on the price limits for each company. The water companies can use the RAB as collateral for debt finance and they have statutory protection via the regulator's financing duty for the RAB model. The result is that the RABs are overwhelmingly debt financed at rates close to the government's cost of debt. This is why overseas investors such as pension funds, sovereign wealth funds and other institutional investors find the existing RABs so attractive rather than greenfield new infrastructure investment (Helm, 2013). It can be seen from Figure 3.6 that the decision-making process of water infrastructure investment of London are interacted between local regulator, water companies and global investors. In this perspective, the urbanism behind the RAB model can be viewed as "financialization urbanism" that it has been shaped by local government which exploits the force of global financial industry to fulfil the political goals as well as global financial industry which grasps global investment opportunities in various geographic jurisdictions to get their expected risk-adjusted rates of return.

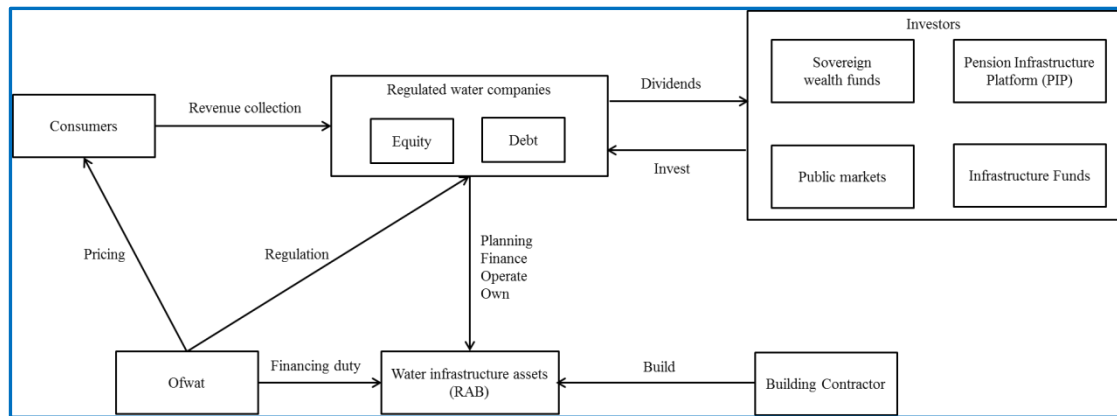


Figure 3.6 The RAB model in financing water infrastructure of London

Source: the author

As shown in Table 3.3, the RAB model in financing water infrastructure of London gives rise to the emergence of the supranational ‘glocal’ governance of the water industry in London. The regulator Ofwat is local non-ministerial government agency responsible for economic regulation of the privatised water and sewerage industry in England and Wales, while the shareholders of the four companies providing water supply and sewerage services for London are consortiums of institutional investors from all over the world. These institutional investors have a global map of investment opportunities, differentiated by their expected risk-adjusted rates of return in the various geographic jurisdictions. ‘Glocal’ infrastructure products, owned by global private owners and regulated by local actors and contracts, are developing and forging new styles of ‘glocal’ governance of urban infrastructure (Torrance, 2009). While the local regulatory agency Ofwat plays an explicit role in the governance of water infrastructure assets of London, these assets are actually directed by both the performance regulation and the private management of the financial returns through the financing duty of the RAB model. Infrastructure spending, then, becomes an autonomous external variable capable of generating major positive or negative economic effects

according to its timing and level; and decisions about these are increasingly taken outside the realm of government, and often by admitting new players and organisations into the governance arrangement of a city (O'Neill, 2010). Therefore, the landscape of water infrastructure of London is increasingly shaped by the interaction between global investors and local regulators.

Table 3.3 Regulator and water companies for water infrastructure of London

Agency	Responsibility	Attribute	Shareholder
Water Services Regulation Authority (Ofwat)	Economic regulation of the privatised water and sewerage industry in England and Wales	Non-ministerial government agency	-
Thames Water	Planning, financing and operation of water supply and sewerage services	Private-owned company	A consortium led by Macquarie European Infrastructure Fund 2 (MEIF2)*
Affinity Water	Planning, financing and operation of water supply services	Private-owned company	A consortium led by Infracapital Partners and Morgan Stanley Infrastructure Partners**
Essex & Suffolk Water (part of Northumbrian Water)	Planning, financing and operation of water supply services	Private-owned company	A consortium comprising Cheung Kong Infrastructure Holdings Limited, Cheung Kong (Holdings) Limited and Li Ka Shing Foundation Limited***
Sutton & East Surrey Water	Planning, financing and operation of water supply services	Private-owned company	A consortium comprising Japanese trading company Sumitomo Corporation and Osaka Gas Corporation****

* Thames Water was acquired by Kemble Water Limited on 1 December 2006. Kemble Water Limited is 100 per cent owned by Kemble Water Holdings Limited. The investors in Kemble Water Holdings Limited are pension funds and other long-term institutional investors. They include Macquarie European Infrastructure Fund 2 (MEIF2), pension funds and institutions from the UK and Europe, Canada, Australia, the Middle East and China.

** On 28 June 2012, Veolia Water Central was purchased by a consortium led by Infracapital Partners and Morgan

Stanley Infrastructure Partners. Infracapital is the infrastructure investment fund managed by M&G (Prudential). On 1st October, we changed our name to Affinity Water.

*** Essex and Suffolk Water is part of the Northumbrian Water Group. Northumbrian Water Group was delisted from the London Stock Exchange on Friday 14th October 2011 following a cash acquisition by UK Water (2011) Limited (a company indirectly wholly owned by a consortium comprising Cheung Kong Infrastructure Holdings Limited, Cheung Kong (Holdings) Limited and Li Ka Shing Foundation Limited).

**** On 4 February 2013, Japanese trading company Sumitomo Corp. acquired Summit Water UK Ltd, the holding company of Sutton & East Surrey Water Plc for £164.5 Million. On 30 September 2013, Sumitomo Corp sold half of the holding in Summit Water UK Ltd to Osaka Gas Co.

Source: Compiled by the author from literature study and field interviews

3.6 Discussions

Table 3.4 summaries the main findings from the comparison study of the LGFP model in Beijing and the RAB model in London. As can be seen from Table 3.4, the urban infrastructure investment models employed in the two cities reflect the distinct underlying urbanisms. An investigation of the LGFP model in financing water infrastructure of Beijing has identified the strategizing urbanism embraced by Chinese cities for the phenomenal urbanization. A downward transfer of responsibilities and liabilities from the central government to local governments, coupled with an upward transfer of power to control tax revenue, has necessitated Chinese municipal governments to become entrepreneurial enough to develop urban land as a fixed yet resourceful asset for revenue generation to finance social and economic development. With the governance of hierarchical bureaucracy, the ultimate investment decision is made by the local government favouring “strategizing urbanism”. The action of “strategizing urbanism” is to mobilise local land resources to consolidate local power in the reshuffling of central-local relationship in China and pursue competitive advantage of the city in the era of globalization. Therefore, the LGFP model is employed by municipal governments to fulfil their strategic development planning for shaping urban landscape. Nonetheless, with so much information and so

many actors involved in urbanization, it is doubtful whether the government-led model or the strategizing urbanism can address the real demand of citizens and enhance the competitive advantage of the city in the era of globalization.

The empirical study of the RAB model in urban water infrastructure of London has reflected the “financialization urbanism” practiced by the London government. Due to the rigorous protection of private property right of land use and the restrictions on public budget, the London government has to exploit private capital for necessary infrastructure investment. Non-local owners, through abiding to contractual obligations, play an increasing role in the governance of infrastructure projects at the urban scale (Torrance, 2009). This forges new styles of supranational ‘glocal’ governance, and the decision making of infrastructure investment is the balance of local government and global financial industry. Hence, the political goal of the London government is to invest in infrastructure without apparent increase of public borrowing; and the economic goal of global financial industry is to obtain risk-adjusted rates of return from infrastructure investment. The ‘glocal’ governance that follows from this global-local interaction to provide infrastructure builds on the increased use of international norms of commercial law to govern an infrastructure project from afar; project assessment and management is increasingly ruled by law (Clark, 1999). Nonetheless, with infrastructure use now requiring user payments as infrastructure development and operation become privatised, and with the selection of infrastructure projects based increasingly on economic productivity criteria, the principles of universality, equitable access and free use of positive externalities are diminished (O'Neill, 2010). The ‘glocal’ governance model or “financialization urbanism” offers both opportunity and danger. Opportunity lies in the ability to unlock some of the world’s largest sources of capital in a period when governments can no longer

shoulder the investment required to build wealth and prosperity for the future. But danger lies in substituting private gain for public good as the major driver in investment decision-making in shaping urban landscape. Balancing these competing needs will be the key (Hebb and Sharma, 2014).

Table 3.4 Comparison of the LGFP model in Beijing and the RAB model in London

	Beijing	London
Urban Water Infrastructure Investment	Local Government Financing Platform (LGFP) model	Regulatory Asset Based (RAB) model
Urbanism	Strategizing urbanism	Financialization urbanism
Governance	Hierarchical bureaucracy	Supranational glocal governance
Ultimate investment decision maker	Local government	Balance between local government and global financial industry
Goals	Consolidation of power in the reshuffling of central-local relationship	Infrastructure investment without apparent increase of public borrowing (local government); Profitability of financial products (global financial industry)
Means	Infrastructure investment and governance within the strategic development planning of local government	Infrastructure investment and governance within the global portfolio through adherence to local contract

Source: the author

3.7 Conclusion

This chapter investigated the spatial difference of the underlying institutions and urbanisms behind the LGFP model and the RAB model through empirical cases of urban water infrastructure

of Beijing and London. Although the growth and spatiality of urbanism in various political economies have been explored by many scholars (Brenner and Theodore, 2002; Goldman, 2011; Leitner et al., 2007; Lin et al., 2014; Nijman, 2007; Wu, 2008), the various trajectories of urban infrastructure landscapes shaped by various institutions and urbanisms in different temporal and spatial contexts have remained poorly understood. Contrasted with Global North where the state is described either as being ‘hollowed out’ or subsumed to the powerful and irresistible operation of global market forces, domestic and local political relations continue to play a role pivotal to urban infrastructure investment in China, although market reforms and opening up has been practiced for over three decades (Lin et al., 2014). In this perspective, the spatial difference of urban infrastructure investment models and the underlying urbanisms between Global North and South would provide an interesting comparison with significant potential to fill existing knowledge gaps and advance urban theoretical enquiry.

The chapter finds that institutions have influence on the function and the evolution of urban water infrastructure investment models in Beijing and London, although both the models emerged in rather contingent ways. In addition, institutions influence urban water infrastructure investment in an implicit way ultimately, which can be seen from no rules for the evolution of the LGFP model in Beijing and no explicit legislative support for the RAB model in London. This does not mean that the explicit laws and rules are not important; rather it emphasises the importance of viewing institutions as ‘correlated and relatively stable social interactions between economic agents that develops upon rules and regulations in rather contingent ways’ (Bathelt and Glückler, 2013). More importantly, the difference of the institutions for urban infrastructure investment in Beijing and London lies in the difference of social and political origins of institutions for urban

infrastructure investment in the two countries. More specifically, the urbanism behind the LGFP model is described as “strategizing urbanism” to the extent that it has been actively pursued and practiced by municipal governments to fulfil their political and economic goals (Lin et al., 2014); while the urbanism behind the RAB model can be viewed as “financialization urbanism” that it has been pursued by governments to exploit the force of global financial industry to fulfil their political goals and involved with global financial industry to grasp global investment opportunities in various geographic jurisdictions to get their expected risk-adjusted rates of return (Torrance, 2009).

Theoretically, this chapter studying the spatial difference of urban water infrastructure investment models and the underlying urbanisms in Beijing and London, makes an original contribution in the ‘geography of infrastructure’. Since economic geography is a field of academic enquiry preoccupied with the geographical scope and scale of economies in the context of economic change, the driving forces behind those changes, and the role of localities in global economic transformation (Clark et al., 2000), the field of infrastructure study is where economic geography should come into play. As a group of economic geographers have argued that there is “an urgent need and a unique chance to push the agenda of a geographic take on finance” (Benner et al., 2011; Sokol, 2013; Wójcik, 2009), this chapter argues that infrastructure investment and governance need to be injected into the conceptualization of economic geography to provide a solid analytical handle on infrastructure studies. The chapter suggests that the ‘geography of infrastructure’ can be built on the foundations laid down by ‘geographies of money and finance’ (Clark, 2005; Hall, 2010, 2011, 2012; Martin, 2010) and the ‘institutional turn’ in economic geography (Martin, 2000; Martin and Sunley, 2010). Obviously, the practice of urbanisms in the

two cities under two particular geopolitical situations does not provide a base strong and broad enough to make widely applicable generalisations. Future research is needed to explore how the spatial heterogeneity of infrastructure governance (via institutional arrangement and institutional environment) influences delivery of infrastructure service and efficiency of infrastructure investment. Nevertheless, the empirical comparison study of urban infrastructure investment and governance in Beijing and London making original contribution to the ‘geographies of infrastructure’ can serve as a starting point for the dialogue between cities in the Global North and South for a better understanding of the divergent trajectories of urbanisms in the era of globalization.

CHAPTER FOUR: THE INSTITUTIONAL ECONOMIC GEOGRAPHY OF URBAN WATER INFRASTRUCTURE GOVERNANCE: A COMPARISON OF BEIJING AND LONDON

4.1 Introduction

Water is essential for life, and globally the provision of water services is the most important of all functions. However, water crisis still exists in many places of the world nowadays. Since “nearly 80% of the world’s population is exposed to high levels of threat to water security” (Vorosmarty et al., 2010), water security – defined as an acceptable level of water-related risks to humans and ecosystems, coupled with the availability of water of sufficient quantity and quality to support livelihoods, national security, human health, and ecosystem services (Grey and Sadoff, 2007), is receiving considerable attention. In addition, almost all increase in the global population is expected to be in urban areas - an additional 1.8 and 3.2 billion people are expected to live in urban areas by 2030 and 2050 respectively (UN, 2010), which would give rise to more pressure on urban water infrastructure. Furthermore, climate change is expected to exacerbate current stresses on water resources from population growth and economic and land-use change, including urbanization (IPCC, 2012).

To some extent, the “water crisis” is largely a governance crisis. Managing and securing access to water for all is not only a question of financing and technology, but is also a matter of good governance (OECD, 2012). Generally, there are three ideal governance approaches often discussed in reference to urban water management: hierarchical, market and network approaches

(van de Meene et al., 2011). Hierarchical governance consists of formal arrangements and representative democratic accountability mechanisms (Kjaer, 2004), which was often observed in large, centralised public authorities for water services (Vlachos and Braga, 2001), with vertical accountability and little stakeholder participation (Pahl-Wostl, 2007). Market governance, essentially applying private sector management principles to the public sector (Hood, 1991), aims to allocate resources efficiently and empower citizens (Pierre and Peters, 2000). This approach became popular during the 1990s and was observed in urban water management through full cost pricing, introduction of competition and privatisation (Bakker, 2002). Network governance is founded on reciprocity and consensus, and acknowledges public, private and civil actor participation is required for effective public policy development and implementation (Klijn and Koppenjan, 2000).

Although each above governance approach has been promoted as a solution to public policy challenges, it is argued that (Hill and Hupe, 2002; Meuleman, 2008; Pierre and Peters, 2000) the three ideal governance approaches will rarely be observed in reality, but rather mixed or hybrid forms will be detected in practice due to the complexity of real world situations. As water governance is essentially a local issue and involves a plethora of stakeholders at basin, municipal, regional, national and international levels, a major challenge lays in the implementation of solutions for sustainable urban water governance is to tailor them to local contexts. Due to the various water governance producing different outcomes of water services, it is important to understand how the interaction between institutional environment and institutional arrangement varies across space, and how it shapes local water service performances, which are central issues of concern in institutional economic geography (Martin, 2000).

Recently, institutions and regulatory reform have gained prominence in terms of resolving urban water supply challenges (Bakker et al., 2008) and many economic geographers tried to understand urban water crisis and explore solutions for sustainable water services considering local actual situation. Gandy (2008) found that the city of Mumbai's dysfunctional water infrastructure has its roots within the colonial era and the city's water crisis needs to be understood in relation to the particularities of capitalist urbanization and state formation in an Indian context. Furlong (2012) used a case study of water sector reform in Ontario, Canada to indicate that regulation at higher scales may be limited in its ability to enforce expected change in the water sector where municipal governance issues are not also addressed. Kallis et al. (2010) surveyed managers of public and private urban water utilities in California to see if they differ in their approaches to conservation and to their customers. They found that California's public utilities appear more proactive and target-oriented in asking their customers to conserve than their private counterparts and the state continues to be important in legitimating and guiding conservation behaviour, whether the utility is in public hands or private. Bakker (2005) explored how water's geography underpinned the failure of commodification initiatives in England and Wales and she summarized that market environmentalism in water supply in England can be characterized as a case of successful privatisation, broad-based commercialization, and failed commodification.

Although many economic geographers have investigated water infrastructure governance from the perspective of institutional economic geography (Bakker, 2002; Castree, 2008; Furlong and Bakker, 2010; Moss, 2009), few studies have compared the performance of urban water service delivery in different institutional contexts through analysing the underlying capitalisms, especially the current debate on state capitalism versus liberal capitalism. Therefore, this chapter

intends to provide a new insight into the institutional governance of urban water infrastructure provision from the perspective of capitalism. Since the public sector takes the lead in water services in Beijing while the private sector does so in London, the chapter compares the nature and characteristic of state capitalism and liberal capitalism with the specific exploration of water infrastructure provision in the two global cities with similar water supply challenges but different institutional and cultural contexts. It is generally believed that the water governance model in Beijing possesses the characteristic of state capitalism while that in London possesses the characteristic of liberal capitalism. However, this chapter finds that neither state capitalism nor liberal capitalism can describe the whole characteristics of urban water infrastructure governance in Beijing and London. The reality is that although the intent and the extent vary, state intervention exists in most countries, especially for the fundamental water infrastructure provision. Through document review and close dialogue (Clark, 1998) with key individuals in water companies and regulators, the chapter focuses on the spatial difference of the interaction between institutional environment and institutional arrangement and how the interaction shape and/or be shaped by the performance of urban water infrastructure provision.

4.2 Conceptual and theoretical framework

All humanly used resources are embedded in complex, social-ecological systems (SESs) which are composed of multiple subsystems and internal variables within these subsystems at multiple levels (Ostrom, 2009). As such, governance of urban water infrastructure provision, in combination with other aspects of the local or regional political economy, nicely exemplifies the challenges of governance of SESs as complex adaptive systems. In a complex SES, subsystems

are relatively separable but interact to produce outcomes at the SES level, which in turn feed back to affect the subsystems and their components. Thus, understanding a complex whole requires knowledge about specific variables and how their component parts are related (Norberg and Cumming, 2008). Furthermore, due to the interconnected nature of the hydrologic cycle, one person's use of water generates externalities for others. The externalities would become problematic without institutional arrangements to clarify rights and responsibilities (Meinzen-Dick, 2007). Therefore, effective institutional governance and regulation of water services are essential for the establishment of sustainable water infrastructure provision systems (Rouse, 2007).

There is wide diversity within and across disciplines in what kinds of rules and relations are construed as “institutions” (Goodin, 1996). Commons defines institution as “collective action in control, liberation and expansion of individual action [governed by] working rules [that] ... indicate what individuals can, must, or may, do or not do, enforced by collective sanctions”(Commons, 1931). Ostrom considers institutions as “the prescriptions that humans use to organize all forms of repetitive and structured interactions ... [which] affect information, incentives and outcomes for natural resources”(Ostrom, 2005). North compares institutions to rules of the game and he held that institutions (rules of the game) distinct from organisations (teams) and individuals (players) (North, 1990). Throughout this chapter, institutions are defined as “constitutive rules and practices prescribing appropriate behaviour for specific actors in specific situations” (March and Olsen, 2006). The framework developed by E. Ostrom (Ostrom, 2009) to analyse factors and processes determining sustainability in complex SESs proposes various governance system variables, including rules as well as monitoring and sanctioning processes. This chapter, however, tries to investigate how these governance system variables influence urban

water service delivery in Beijing and London from a big picture perspective – the underlying capitalisms.

Capitalism is a complex, dynamic, and extraordinarily robust way of organizing economic activity (Mann, 2013). There are multiple variants of capitalism, including liberal capitalism, welfare capitalism, corporate capitalism and state capitalism. This chapter only focuses on state capitalism and liberal capitalism. State capitalism is a form of capitalism in which the state acts as the dominant economic player and uses markets primarily for political gain (Bremmer, 2010). It is a capitalist system that is already global in reach but one that differs from Anglo-American capitalism in important respects. China is generating a form of state capitalism in which the state controls the commanding heights of the economy in the form of state-owned, state-sponsored, or private yet state-loyal corporations and sovereign wealth funds. Liberal capitalism, on the other hand, is a form of capitalism based on liberal market economies with minimal state involvement in the allocation of goods and services (Hall and Soskice, 2001). It is a capitalist system that emphasizes free enterprise and private ownership of land and capital over government planning and nationalized industry. The liberal capitalism prevailing in Britain is characterized by a strong distrust of the government and an equally strong faith in the market, and its ambitious liberalization program extends beyond real markets to financial markets.

It is argued that while the great economic conflict of the twentieth century pitted capitalism against Marxism, the battle of the twenty-first century will be characterized by state versus liberal capitalism (Choate, 2009). Since water is public good and is fundamental to human health, the state versus liberal capitalism debate for urban water infrastructure provision has remained for decades. In Beijing, the government has played and continues to play a significant role in ensuring

the provision of water services. However, the efficiency of public management of infrastructure has been questioned and governments' ability to leverage funds for new facilities and for maintenance and rehabilitation of existing ones has decreased. On the other hand, although the privatisation of urban water infrastructure provision in London has been relatively successful, the performance of water service delivery after privatisation still remains controversial. In this chapter, we offer an innovative insight – rooted in international political economy, economic geography and geopolitics – into the institutional governance of urban water infrastructure provision in the two cities through considering the different capitalism backgrounds.

4.3 Comparison of urban water infrastructure governance and water security strategy in Beijing and London

4.3.1. Water governance structure in China and Beijing

The water governance structure in China is a multi-layered hierarchy and the various agencies⁵ within this structure are divided by territory, function, and rank. In order to understand the water infrastructure governance system in China, we provide a brief overview of the political and institutional dynamics in China's governance system, and their implications for urban water infrastructure governance, using the case study of Beijing as an illustration. China has five basic levels of administration: national, provincial, municipal, district/county and country (see Figure 1). National governments oversee provinces, and provincial governments oversee municipalities. The municipal government and its agencies have two functions: (1) they directly govern the municipal-level city and provide public services; and (2) they oversee county-level governments

⁵ The term “agency” is used in the general sense to mean a government organization, whether it is a national ministry, state-level agency, provincial department, or municipal bureau in the Chinese context.

within their jurisdiction. As shown in Figure 4.1, each agency has two lines of reporting: (1) line accountability to the responsible government entity (prime minister, governor, or mayor); and (2) functional supervision and reporting to the agency above it.

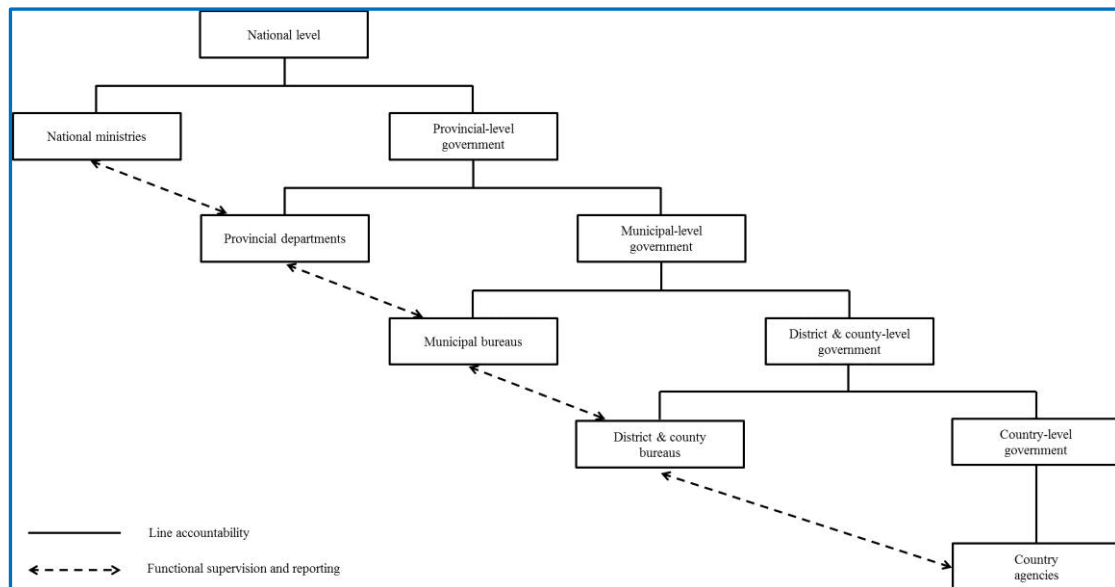


Figure 4.1 Overview of institutional structure in China's governance system

Source: adapted from (World Bank, 2007)

Figure 4.2 shows the water infrastructure governance system in Beijing. As shown in the figure, the hierarchy includes a “leading group” under the leadership of the mayor and several specific agencies that are related with water infrastructure provision in Beijing. Among them Beijing Water Affairs Bureau (BWAB) is the agency directly responsible for the water services and management in Beijing. There are two main functional organizations supervised by BWAB: Beijing Waterworks Group (BWG) and Beijing Drainage Group (BDG). BWG is responsible for the water supply services in the central districts of the capital city as well as the newly developed suburban areas and BDG is responsible for the sewage treatment and rainwater reuse services in Beijing. Both water utilities are the large state-owned enterprises wholly funded by the Beijing

municipal government.

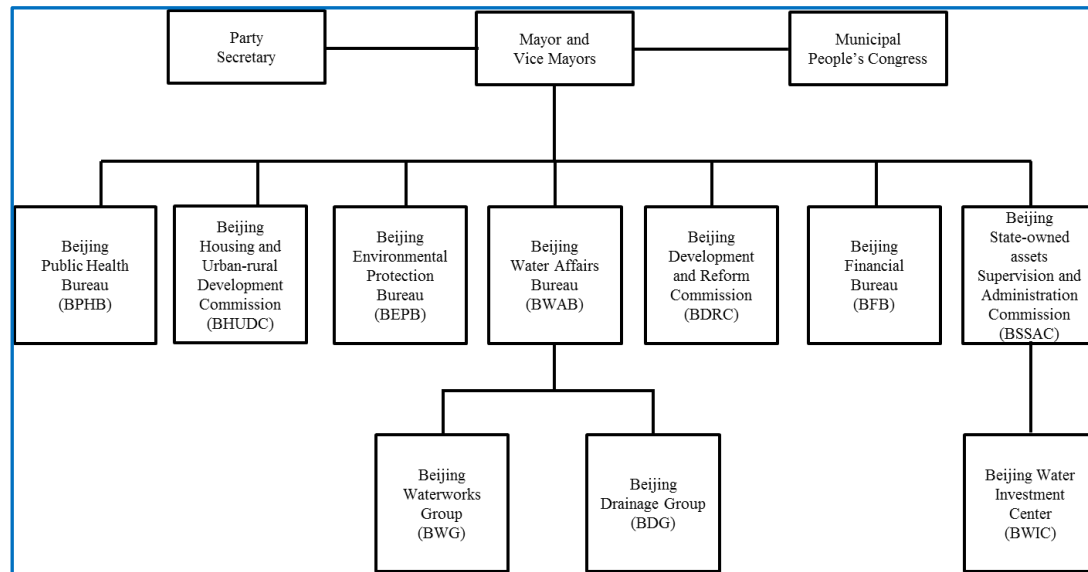


Figure 4.2 Water infrastructure governance system in Beijing

Source: adapted from (World Bank, 2007)

All significant government decisions ultimately fall under the jurisdiction of the mayor and the set of vice mayors, collectively referred to as the “leading group”. The water utilities in Beijing (BWG and BDG) have a “parent bureau” (BWAB) that is responsible for overseeing the utilities. All issues requiring a decision from the leading group or other municipal government agencies are typically done through the parent bureau, including (a) budget allocations from the BFB, and (b) investment approval and tariff adjustments by the BDRC. Decisions by these government agencies are usually discussed and approved by the vice mayor and if necessary the leading group.

There are two points deserve to be mentioned about this organization hierarchy. One point is that agencies within the same rank cannot issue binding orders to each other. Only higher-ranking agencies can issue authoritative orders to lower-ranking organs. Since Beijing is the special

municipality directly under the Chinese central government, Beijing Municipal Government reports directly to the central government and has the same bureaucratic rank as the ministries and commissions in the ministerial level. In this context, the ministries and commissions lack the power to address dilemmas of conflict between local economic growth and environmental and resources protection and their attempts to override the interests of jurisdictions such as provinces and municipalities are not successful (Song et al., 2010). The other point is that the water-related agencies in the city level are mainly responsible for water infrastructure investment and governance in that city. Contrary to frequent assumptions about centralization of power in China, there is a centralized planning system but a highly decentralized economy, in which there is de facto fiscal federalism, with about 70 percent of all government spending in 2002 being undertaken by subnational governments (Zheng, 2006).

4.3.2 Water governance structure in England and London

The water governance in England and Wales after privatisation adopted market governance approach which became popular during the 1990s and was observed in urban water management through full cost pricing, introduction of competition and privatisation (Bakker, 2002). The current water governance structure and regulation in England and Wales is shown in Table 4.1.

Table 4.1 Water governance structure and regulation in England and Wales

Scale	European Union		National					Regional		
Regulator	European Union (EU)	Union	Environment Agency (EA)	Office of Water Services (Ofwat)	Department for Environment, Food and Rural Affairs (Defra)	Drinking Water Inspectorate (DWI)	Competition Commission	Consumer Council for Water	Environment Agency for Regional Offices	Consumer Council for Water Regional Offices
Role	European legislation, standard setting		Environmental regulator	Economic regulator	Government department which sets the overall policy framework in England and Wales	Water quality regulator	Mergers; appeals	Customer representation	Tribunal on regulatory decisions	Customer representation
Issues	Sets European water, wastewater and environmental standards		Principal adviser to the government on the environment, leading public body protecting and improving the environment of England and Wales; competent authority for implementation of the Water Framework Directive	Protect customers; sets price limits; secures that companies can finance and fulfil their functions; monitors compliance with licence conditions; standards of service	Standard setting, drafting of legislation, appoints regulator, special permits (e.g. drought orders)	Drinking water quality monitoring and enforcement	Company mergers; body of appeal	Handles water company customer complaints; represents consumers in policy-making process	Water resources (water abstraction licences); environmental water quality (discharge consents; monitoring)	Handles water company customer complaints; represents consumers in policy-making process

Source: adapted based on (Bakker, 2003; Defra and Ofwat, 2006)

As can be seen from Table 4.1, the European Union (EU) plays a key role in legislation and standard setting, formally through issue-based Directives and now through the comprehensive Water Framework Directive. Since the United Kingdom is the member state of the EU, the legislation and standard set by the EU must be introduced for the water governance and regulation in the UK (Defra and Ofwat, 2006). In the national scale, there are mainly five water regulators in the UK: the Environment Agency (EA), the Drinking Water Inspectorate (DWI), the Office of Water Services (Ofwat), the Department of the Environment, Food and Rural Affairs (Defra) and the Competition Commission. Among these regulators Ofwat is the most powerful one, and is the key actor in the commercialization of the water supply industry, particularly through the duty to increase competition in the industry, where feasible (Bakker, 2003). In addition, the Consumer Council for Water which is independent of both the water industry and the regulator was set up in 2005 to protect the interests of customers.

Contrasted with the jurisdiction-based water governance in China and Beijing, the water governance in the England is basin-based and there is no specific department agency in London responsible for water services regulation. Currently there are 34 private companies which deliver water and sewerage services in England and Wales, including 10 regional companies providing both water and sewerage services and 10 regional companies providing water services only. These regional companies have a regional monopoly for their services based on boundaries that were fixed at privatisation in 1989⁶, though they can apply to vary their appointment to cover a new area. Four water companies providing water services in London, which is shown in Figure 4.3 and Table 4.2. Since Thames Water is the UK's largest water and sewerage company serving 14 million customers across London and the Thames Valley, this chapter will only focus on this private owned water company, which can fully represent the private infrastructure provider under the liberal capitalism. The shareholder of Thames Water is Kemble owned by a consortium of investors which consists largely of pension funds and other long-term institutional investors from Europe, Canada and Australia. In addition, the consortium included Canadian, Australian and Dutch pension funds that invested in the water asset directly, and now hold their share of Thames Water on their balance sheet (Ofwat, 2007a).

⁶ The Water Act of 1973 made provision for the formation of 10 Regional Water Authorities (RWAs), structured on river basins with their boundaries being the watershed lines separating river systems. The Water Act 1989 provided for the flotation of the 10 RWAs on the stock market, with much of the stock purchased by small investors.

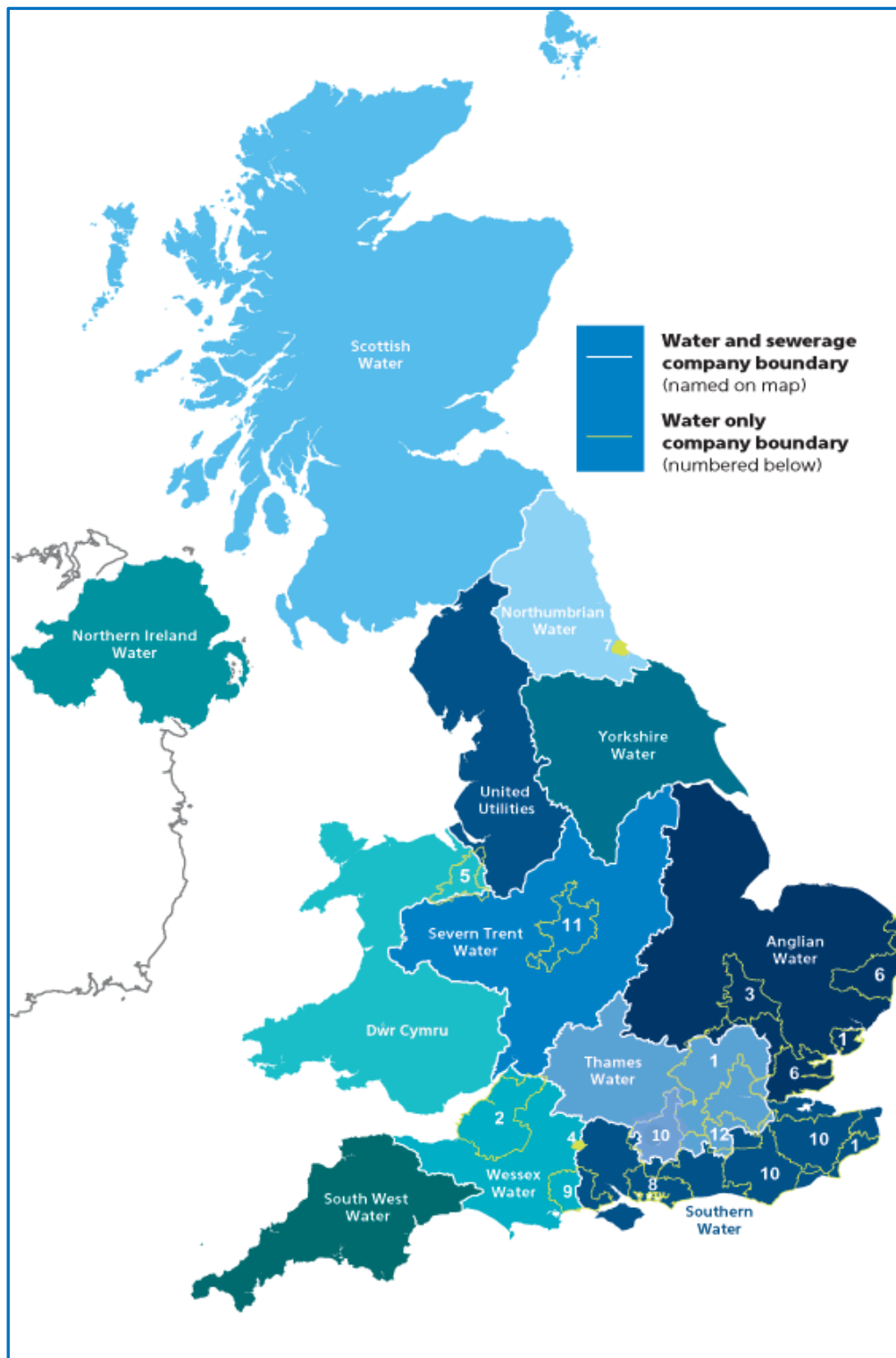


Figure 4.3 Map for water and wastewater suppliers in the UK.

Source: (Water UK, 2014)

Table 4.2 Water companies operating in London

Company	Service
Thames Water	Water supply and sewerage
Veolia Water Central	Water supply only*
Essex & Suffolk Water (part of Northumbrian Water)	Water supply only*
Sutton & East Surrey Water	Water supply only*

* Thames Water provides sewerage services in these areas

Source: (GLA, 2011)

4.3.3 Water crisis and water security strategy in Beijing and London

Beijing, the capital of China, is becoming an important global city in the world. Due to the dramatic economic development over the last 30 years, Beijing is experiencing rapid urbanization, with the population increase from 8.7 million in 1978 to 19.6 million in 2010 (Beijing Statistical Yearbook 2011), which gives rise to much pressure on Beijing's water supply. In addition, Beijing is an inland region located at the Northern China with around 585 mm annual average precipitation, which is an area of physical water scarcity (Seckler et al., 1998). Furthermore, the unprecedented impacts of climate change would test the adaptation ability of Beijing's water infrastructure system.

Currently the majority of Beijing's water supplies depend on surface water sources and groundwater sources from rural areas. For surface water, Miyun reservoir and Guanting reservoir are the main surface water sources. In recent years, due to the impact of the continuously draught years, the surface water cannot meet the water demand for the urban area, thus three emergent groundwater sources were built, which are Pinggu Groundwater Source Emergent Project, Juma River Groundwater Source Emergent Project and Huairou Groundwater Source Emergent Project, to complement the deficit of surface water. (Information from Beijing Water Affairs Bureau)

Beijing witnessed a rapid development in the public water supply. By 2011, there were 181 waterworks providing water service in Beijing with a daily water supply capacity up to 4.73 million m³ (BWAB, 2012). However, with population growth and social-economic development in the urban area, the water consumption will continue to increase in the coming years. In order to meet these challenges, three main measures are taken into practice: 1) water-saving equipment and technology are encouraged and more restricted water demand management will be strengthened; 2) water transfer project is under construction and the "South-to-North Water Transfer" project will meet one third of water demand of Beijing when the project is completed; 3) nine reclaimed water plants with the production capacity of 0.65

million m³ per day will be upgraded and extended and 0.6 billion m³ treated wastewater will be reused mainly for agriculture and industry (Pan, 2006).

London, the capital city of the United Kingdom, is a leading global city and the world's financial centre located on the River Thames. Its population of 7.75 million is 12.5 per cent of the UK population living on just 0.6 per cent of the land area (GLA, 2010). As it continues to attract people and businesses, London is a growing city facing the effects of a changing climate along with growing demands on resources. Moreover, most part of London's water infrastructure is more than 100 years old, and water loss because of leakage is a severe problem threatening to water supply. Together these pressures will aggravate the stress on existing water infrastructure systems.

The majority of London's water supplies come from the rivers Thames and Lee, with about 70 per cent of all the water taken from the freshwater River Thames upstream of Teddington Weir. It is then stored in reservoirs around the capital. The remainder is mostly abstracted from the 'confined chalk', which is concealed below the clay of the London basin (GLA, 2011).

The water company Water Resource Management Plans (WRMPs) identify seven main options to increasing water supply: 1) increasing abstraction; 2) desalination; 3) increasing reservoir capacity; 4) wastewater effluent reuse; 5) raw water transfers; 6) groundwater recharge; 7) international water imports. In addition to all the supply side options, there is the opportunity to reduce water demand. Reducing leakage can contribute to improving security of supply in the same way as developing a new source of water. For example, reducing leakage from the distribution mains by one percentage point would provide enough water for about 47,120 people⁷. Thames Water has been working steadily to reduce leakage from their network and have met their leakage reduction targets for the last five years. Their Victorian Mains Replacement Programme, identifies the worst leaking pipes and priorities their replacement. In the last round of funding (2005-2010), Thames Water replaced in excess of 2,000 kilometres of water mains and aim to reduce leakage to 114 litres per household in 2030-2035 (GLA, 2011).

4.4 Discussions

It is generally believed that the urban water governance model in Beijing possesses the characteristic of state capitalism while that in London possesses the characteristic of liberal capitalism. Although the

⁷ One per cent leakage = 5,890,000 litres per day divided by average consumption of 125 l/p/d = 47,120 people. Source: GLA, 2011, "Securing London's Water Future: The Mayor's Water Strategy", (Greater London Authority, London)

water infrastructure governance models of the two cities are different, both of them contribute to ensuring water service delivery in each city currently. Each governance model has its own strength. For Beijing, it can concentrate resources to accomplish large undertakings. For instance, the “South-to-North Water Transfer” project is a giant project which needs the power of the state for negotiation of benefit conflicts among different agents. For London, it has incentive to improve economic efficiency. For example, Ofwat has estimated that the efficiency improvements made by the water companies over the period 1990-2007 absorbed 70% of the investment cost, without which water charges would have been considerably higher (Ofwat, 2007b). In addition, the water governance model in London is more attractive to global capital investment. This can be exemplified by an acquisition happened in 2006: The Australian investment bank Macquarie bought Thames Water through an array of its infrastructure funds on behalf of its predominantly institutional clients – large and small pension funds from around the world (Torrance, 2009).

However, both water governance models have shortcomings. In the context of state capitalism, as the direct control over economic matters via state-owned enterprises continues to enable central and local authorities to allocate financial resources and guide economic activities, the water utilities in Beijing are more closely tied to the state bureaucracy than are normal limited liability corporations. The loser is efficiency of utility operations. As a manager in a Beijing water company said “The main incentive mechanism in the company is awarding you a certificate or promotion in recognition of your hard work or innovation... My salary has not increased or decreased for many years no matter I do a good or bad job, as long as I don’t commit severe errors.” (from fieldwork in Beijing) Obviously, lack of appropriate incentive mechanism makes water companies in Beijing unwilling to try all means to cut cost.

In liberal capitalism, on the other hand, maximum profit which is the major incentive for the water company in London to achieve efficiency savings would sometimes conflict with the public benefit of fundamental water infrastructure provision. Under a regulatory regime where prices are capped, most major efficiency savings in labour have been made, and little if any expansion of the consumer base is possible, the main sources for increased profit arise from cost cutting, such as reducing the provision for the renewals of the underground network. For instance, between 2010 and 2015 Thames Water had planned to replace a further 2,097 kilometres of mains, but have only been funded to replace 1,097 kilometres of mains. Thames Water claims that this level of funding is only sufficient to maintain leakage at current levels, and not enough to continue leakage reduction (GLA, 2011).

Table 4.3 displays the difference between the urban water governance models in Beijing and London.

Table 4.3 Comparison of urban water governance models in Beijing and London

	Beijing (China)	London (Britain)
Primary goals	Safeguard public interest Conformity with legislation/policy	Maximize profit Efficient performance
Property rights	Public (state) property	Private property
Organizational structure	State owned utility	Private company (corporation)
Regulatory framework	Command and control	Market mechanisms
Accountability mechanism	Hierarchy	Contract
Key incentives	Political goals (promotion)	Price signals (share movements or bond ratings)
Key sanctions	Administrative penalty Litigation	Financial loss Takeover Litigation
Consumer role	User & citizen	User & customer
Governance (decision-making process)	Expert-led, top-down	Individualistic, distributed
Primary decision makers	Administrators, experts, public officials	Company managers, experts
Worldview of nature	Public good	Commodity

Source: adapted based on (Bakker, 2010)

As can be seen from Table 4.3, the water governance model in Beijing demonstrates the characteristic of bureaucracy in the state capitalism. With the command and control regulatory framework, the primary goal of the water utility in Beijing is to safeguard public interest and the key incentives are political goals. As such, the decision-making process is the top-down process (expert-led) and the primary decision makers are administrators, experts and public officials. The water governance structure in China is a multi-layered hierarchy and “much of the environmental energy generated at the national level dissipates as it diffuses through the multi-layered state structure, producing outcomes that have little concrete effect” (Lieberthal, 1997). With such a complex system of water institutional structure, the policy-making process is unclear. Finding out how policies are made in China is much like tracing the movement of a single blood cell through the entire human body; the journey is time consuming and long, involves a network of organs, and the specific route depends on the situation (Hou, 2000).

In contrast, the water governance model in London shows the characteristic of democracy in the liberal capitalism. Relies on market mechanism regulatory framework, the primary goal of the water utility in London is maximum profit and efficient performance, and the key incentives are price signals (share movements or bond ratings). As such, the decision-making process is distributed and the primary decision makers are company managers and experts. Besides, the shareholders of Thames Water may use their

ownership position to reduce the risk of adverse unexpected share-price movements because pension-fund investors are driven by share-price concerns (Clark and Hebb, 2005). Market efficiency has been achieved after privatisation of water infrastructure provision due to the nature and characteristic of liberal capitalism. However, when water charge increases, criticism is often directed at the government for allowing price increase and at the water companies for making profits. Since balancing efficiency and equity is no easy task, especially for public good provision such as water, the controversy about the performance of water infrastructure provision in England and Wales still remains.

However, it is worth noting that the state capitalism in China clearly does not resemble a purely state capitalist system. There are certain twists, since institutionally state capitalism in China encompasses production clusters based on highly entrepreneurial and flexibly networked systems of small and medium-size firms. As for water infrastructure projects in Beijing, private sectors have participated into the construction works of many waterworks plants or wastewater treatment plants. Therefore, the Chinese political economy contains a distinct duality or dialectic: the state controls finance and the commanding heights of industry, while most competitive sectors in retail and manufacturing are populated by private (both foreign and domestic) or hybrid ownership firms. This hybridization has allowed some of the dominant Anglo-American institutions and values to enter China, creating a “market-liberal form of state capitalism” (ten Brink, 2010). On the other hand, state intervention still exists in liberal capitalism, though the intent and the extent in the economy vary from that of state capitalism. As a matter of fact, although the UK government has divested control over the financial management of the water industry, it still maintained control over regulatory functions concerning health, environment, and resource management, functionally separating the regulation of ‘market’ and ‘consumer’ interests (Bakker, 2003).

Another noticeable point is bureaucracy does not only exist in public agencies and does not necessarily have negative meaning. The term “bureaucracy” has deep roots. Its origin lies in the French word, *bureau*, at least as far back as the 1300s. In time, they came to call the room the “bureau”, and “bureaucracy” was born. Since then, bureaucracy has acquired a wide variety of meanings, some highly negative. More generally, however, “bureaucracy” refers to the complex organizations assigned to perform specific tasks (Kettl, 2006). Two things are important. First, throughout thousands of years, governments have yet to discover any better instrument that empowers them to do what they need to do. Government without powerful bureaucracies is no government at all (Goodsell, 2004). Second, the pathologies of

bureaucracy, of which there are many, are not solely the province of public bureaucracies. They apply to private bureaucracies as well, from large corporations to small-scale operations. They are inherent in the effort to organize groups of people to do hard, complex things. Therefore, bureaucracy not only exists in the water utilities in Beijing but also in the private water companies in London. As such, the challenge for both water governance models in the two cities is how to empower bureaucracies enough to attack the tough water crisis problems while avoiding the trap of making them so powerful as to challenge democratic rule.

The flow of power in a bureaucracy involves two related notions. First, because top decision-makers cannot possibly oversee everything, they must delegate power to lower-level officials. It is a paradox of bureaucratic power that top officials can acquire it only by giving it up, but attacking any complex problem demands that top-level officials trust those at lower-levels with the details. Second, in deciding how to deal with those details, individual bureaucrats have power because they have discretion in how they do their jobs. This can be observed in both water governance models in Beijing and London. In Beijing, the Ministry of Water Resources in national level only issue water-related policies and laws, and the Beijing Water Affairs Bureau and water utilities in Beijing are responsible for monitoring and implementing the policies according to the local context. In London, the water companies submit business plans giving the improvement schemes and their costs according to each company's real situation. Ofwat considers these plans by taking into account both the costs and the required efficiency improvements, and calculates the required water prices to pay for the work whilst giving the companies a reasonable profit. There are then discussions between Ofwat and each company before Ofwat announces its decision on the price limits for each company. No doubt the water utilities in the two cities are the "individual bureaucrats" with the details about specific water problems in their areas and knowing how to deal with them. Therefore, a major issue for managing bureaucracies is ensuring compliance with bureaucrats exercising their discretion in ways that are consistent with the organization's mission (Etzioni, 1961; Gouldner, 1967).

4.5 Conclusion

Ultimately, it is an unhelpful oversimplification to divide the world into "state capitalism" and "liberal capitalism" camps. The reality is that most countries are arranged along a spectrum where both the intent and the extent of state intervention in the economy vary. In Norway, for instance, the ministry has a

detailed set of ‘provisions’ regulating the management and operation of its sovereign wealth fund, which is enmeshed in the machinery of government (Clark and Monk, 2010). In addition, the chancellor of Britain, George Osborne, has identified the Thames Tideway Tunnel scheme as part of the national infrastructure plan. This will allow Britain’s biggest water company Thames Water to borrow money hugely, as a government body in effect, at the keenest rates of interest. On the other hand, it is unreasonable to ascribe China’s success to the state rather than the market. Although China’s economy continues to be managed on the basis of a five-year plan, an authoritarian tradition that goes all the way back to Josef Stalin, the Chinese authorities are grappling with a problem that owns more to market forces than to the plan: the reform of the previous state-owned enterprises towards modern corporations is a good example. Furthermore, foreign capital has also entered into the water market in Beijing through BOT (Build-Operate-Transfer) or other ways of cooperation. For instance, the Lugouqiao Wastewater Treatment Plant in Beijing was invested and operated by the Beijing Drainage Group and Veolia Water Group (France).

This chapter suggests that neither state capitalism nor liberal capitalism can cover the whole characteristics of the urban water governance models in Beijing and London. Through comparison studies of water governance in Beijing and London, we can see that both water governance models in Beijing and London can be successful for ensuring effective and sustainable water infrastructure provision, providing that there are sound government policies, some form of independent regulation or scrutiny, and incentives to performance better. It is important to stress that “one size doesn’t fit all”, and the appropriate form of institutional governance depends upon a country’s situation or the local circumstances (Rouse, 2007). Instead of arguing which capitalism is more successful, what should be done is improving each urban water infrastructure governance model based on specific institutional context to make it more adaptive and resilient to rising water challenges of the city in future.

Therefore, the restructuring of the institutional governance and regulation of water services in Beijing and London is needed to overcome the current shortcomings. As for the water infrastructure system in Beijing, the separation of policy, regulation and delivery needs to be more complete and transparent with government officials unable to interfere in operational matters. The separation should be accompanied by transparency of budget and accounts, and effective monitoring of the required deliverables. Furthermore, appropriate incentive mechanism should be set up in the water industry in Beijing and comparative

competition mechanism can also be introduced to Beijing's water infrastructure provision. In regard of the water infrastructure system in London, the formalized link between company performance and company revenues should be taken into account within the economic regulatory framework, and the actual performance information of the water company should also be reflected in share performance. In addition, the government should play a key role in adjudicating competing regulatory priorities by setting down performance criteria for the water industry.

In the next two decades, the growth of population and the increase of economic activities combined with uncertain impact from climate change will undoubtedly pose great pressure to effective and sustainable water infrastructure provision in Beijing and London. The major challenge of water infrastructure system in Beijing is developing new water infrastructure under the pressure of financial limitation while that of London is replacing aging water infrastructure under the pressure of efficiency gain. It is hard to say which water governance model is better given the different backgrounds, the histories and the conditions pertaining today. However, such comparisons allow governments and utility managers to ask questions about why another utility is apparently performing better in a specific area, to find out more, and to pursue sustainable water service by learning from each other.

CHAPTER FIVE: GEOGRAPHY OF GOVERNANCE:

SYSTEM-THINKING IN WATER PRICING SYSTEM OF BEIJING AND LONDON

5.1 Introduction

Pricing system is at the core of sustainable urban water infrastructure provision. It has to meet diverging financial, economic, environmental and social objectives for water services, some of which may be conflicting (OECD, 2009). A major challenge therefore is designing water pricing system in a way that strikes an appropriate balance among these competing objectives. This requires a down-to-earth trade-off between the various policy objectives, assessing the costs and benefits of different tariff levels, examining the distributional impacts of tariff structures, and developing appropriate compensatory or mitigation measures to avoid affordability problems. Thus, pricing system that is properly designed and tailored to local conditions can be an effective instrument to balance the environmental, social, economic, and financial aspects of water infrastructure provision (Hukka and Katko, 2015).

Nonetheless, underpricing of water services seems to be a worldwide phenomenon. John F. Murdoch Jr. once criticized the tradition of low water prices resulting from the historical development of the water services and argued that the water industry should be ashamed of too-low water prices (Hukka and Katko, 2015). Murdoch's criticism shows challenge and complexity in designing effective water pricing system. In fact, since infrastructure is "a complex social and technological process that enables or disables particular kinds of action in the city" (Graham and McFarlane, 2014), designing water pricing system is not only an economic issue but also a governance issue. It requires a robust governance framework to balance different interests of stakeholders including governments, regulators, utilities, investors and consumers for designing effective water pricing system in the purpose of sustainable cost recovery⁸. Theoretically, effective water pricing system should provide sustainable financing for preventing the aging and decaying of current water infrastructure in the OECD countries and extending the coverage of

⁸ The International Water Association's definition of sustainable cost recovery refers to "costs that are recovered so that a water services undertaking can achieve and maintain a specified standard of service, both for the present and future generations" (Rouse, 2013b).

improved water services in the developing countries (Seppälä and Katko, 2003). However, a number of obstacles constrain designing effective water pricing system and sustainable cost recovery such as lack of awareness of the broader economic benefits of water supply and sewage services, and concerns about the affordability of full-cost pricing to low-income households (OECD, 2010).

This chapter argues that one of the main reasons for underpricing of water services worldwide and failure of sustainable cost recovery is lack of system-thinking in designing water pricing system for coordinating the three important values of urban water infrastructure - intrinsic value, market value and investment value. Among these three important values, intrinsic value of urban water infrastructure is the most difficult to identify. Here intrinsic value refers to the benefits and impacts that urban water infrastructure can bring. Identifying the benefits and impacts to any kind of infrastructure is “surprisingly difficult”, because they are “diffuse and dispersed” and are “hard-to-quantify” (Rosewell, 2013). Infrastructure is a peculiar category that “enrols a range of objects and functions capable of delivering the spatial outcomes needed for expanding markets together with the property rights needed for infrastructure to deliver its services within urban and other spaces dominated by property rights based on exclusions” (O'Neill, 2013). Market value of urban water infrastructure refers to appropriate pricing of the value of water infrastructure services so that “a water services undertaking can achieve and maintain a specified standard of service, both for the present and future generations” (Rouse, 2013b). Investment value of urban water infrastructure is the value when infrastructure is assessed as asset that can generate reliable long-term revenue stream. Investment value of urban infrastructure has remained inactivated in many cities, since urban infrastructure is generally assumed as public welfare service provided by government. Nonetheless, investment value of urban infrastructure becomes increasingly important nowadays given local governments worldwide are facing stressed fiscal capacity to meet growing demands for urban infrastructure services. There is a global emerging trend ‘financialisation of infrastructure’ which turns large urban infrastructure items into financial products (O'Neill, 2013).

With growing demand for urban water infrastructure services and tightening of public finance for urban infrastructure projects, traditional public sector approaches to infrastructure development which usually start from the belief that the state has unlimited capacity and flexibility in the way it deploys a urban infrastructure project become redundant (O'Neill, 2013). As such, more and more urban water infrastructure services in future have to be delivered by the joint effort of public sector and private sector.

Therefore, system-thinking is critical for designing water pricing system to coordinate the intrinsic value, market value and investment value of urban water infrastructure so that reliable water services can be delivered at affordable price.

This chapter aims to explore the importance of system-thinking in designing water pricing system to coordinate the intrinsic value, market value and investment value of urban water infrastructure through a comparative study of Beijing and London. Since the public sector takes the lead in urban water infrastructure provision in Beijing while the private sector does so in London, this chapter compares different performances between the government-led model of Beijing and the market-led model of London in delivering intrinsic value, market value and investment value of urban water infrastructure. Since water companies in England and Wales provide water supply and sewage services mainly based on watershed division rather than administrative division (Rouse, 2013b), it is challenging to obtain water data specific to London area. There are four private water companies providing water supply services in London and Thames Water is the largest water supply service undertaker in London. Besides, Thames Water provides sewage services to the whole Thames Valley area including London. Therefore, Thames Water is chosen to represent private water companies of London to compare with public water companies of Beijing. Although the data of Thames Water cannot accurately reflect the true performance of water supply and sewage services in London, to some extent it can demonstrate the whole picture for how the market-led model of London performs differently compared with the government-led model of Beijing in coordinating the intrinsic value, market value and investment value of urban water infrastructure provision. For the purpose of simplification, this chapter only focuses on domestic water use and domestic water pricing system.

The chapter is structured as follows. Section two reviews the current literature on value of infrastructure, system-thinking in infrastructure provision, and geography of governance. Section three and section four introduce about water pricing system and governance framework in Beijing and London, respectively. Section five compares different performances of Beijing and London in delivering the intrinsic value, market value and investment value of urban water infrastructure services, followed by analysis for the importance of system-thinking in designing effective water pricing system. The last section summarises the main findings and conclusions of this chapter.

5.2 Literature Review

5.2.1 Value of urban water infrastructure

There is widespread recognition that water infrastructure is special (Bakker, 2003; O'Neill, 2013; Rouse, 2013b; Tortajada and Garc ía-Rubio, 2015). Although water is a key prerequisite for human and economic development (OECD, 2009), it is challenging to understand value of urban water infrastructure. Ultimately, the value of urban water infrastructure is realized by producers and consumers of water services (Frischmann, 2012). This chapter argues that there are three critical elements for the value of urban water infrastructure – intrinsic value, market value and investment value. The intrinsic value of urban water infrastructure is closely related to the nature of the outputs generated by urban water infrastructure. The intrinsic value of urban water infrastructure may be substantial but extremely difficult to measure. Difficulties in measuring and appropriating value generated by urban water infrastructure may result in water management institutions being unable to carry out their functions, and in insufficient funding for investment and maintenance of water infrastructure (OECD, 2009).

On the other hand, urban water infrastructure possesses some characteristics of commodity, though it may be “uncooperative commodity” (Bakker, 2003). Proponents of neoliberal resource management argue that “market environmentalism” – a mode of resource regulation that promises both economic and environmental ends via market means, offers hope of a virtuous fusion of economic growth, efficiency, and environmental conservation (Anderson and Leal, 2001; Christoff, 1996; Hajer, 1995; Hawken et al., 1999; Mol, 1996). Yet water’s geography – specifically its spatiality and biophysical characteristics – underlies the contradictions faced by the architects of market environmentalism (Bakker, 2005). Here in this chapter, market value of urban water infrastructure focuses on sustainable cost recovery – “costs that are recovered so that a water services undertaking can achieve and maintain a specified standard of service, both for the present and future generations” (Rouse, 2013b).

In addition, the urban infrastructure landscape is undergoing financialisation (Torrance, 2008). Infrastructure provisions are increasingly becoming financial products, with cities and regions valued merely on a quarter-to-quarter basis (Babcock-Lumish and Clark, 2005). This emerging trend is labelled as “financialisation of infrastructure” with the privatisation of ownership, financing and operation of infrastructure accompanied by user fees and tolls (O'Neill, 2013). As local governments worldwide are

under financial stress to meet increasing government expenditures, cities will have an enormous appetite for private capital in the coming decades both to finance the renewal of aging infrastructure in developed countries and to accommodate the growing demand for essential services in emerging markets (Stegman, 2008). As such, investment value of urban water infrastructure, though remain inactivated in many cities currently, is becoming increasingly important for urban water infrastructure investment in future.

5.2.2 System-thinking for water pricing system

Although urban water infrastructure has essential value to cities, underpricing of water services and failure of sustainable cost recovery seem to be worldwide phenomena (Hukka and Katko, 2015; Rouse, 2013a). Globally there is a growing funding gap in renewal of aging water infrastructure and the need for future greenfield investment (Hukka and Katko, 2015). Water pricing system is one of the most important components of public policies for the delivery of water and wastewater services in urban areas efficiently, equitably and sustainably (Tortajada and Garc ía-Rubio, 2015). This chapter argues that the worldwide phenomena for underpricing of water services and failure of sustainable cost recovery is mainly because current water pricing system generally lacks system-thinking for coordinating the intrinsic value, market value and investment value of urban water infrastructure. Given the long lifespan and the long lead-time necessary to effect change in urban infrastructure systems including water, energy and transport (Hall et al., 2013, 2014; ICE, 2009, 2010), the feasibility of long-term strategic view on water infrastructure provision is challenged by future uncertainties associated with demographic, economic, environmental, political and technological changes (Faber et al., 2007). As such, the importance of system thinking - taking a long-term and cross-sectoral view of infrastructure provision has been more widely acknowledged in many countries (Hickford et al., 2015). Drawing upon the wisdom of system-thinking on interdependence of infrastructure systems, this chapter argues that pricing system for infrastructure such as urban water infrastructure should take system-thinking into account for coordinating intrinsic value, market value and investment value, since “our conventional methods for appraising long-term investment in infrastructure miss some of the hard-to-quantify benefits that the projects can bring” (Rosewell, 2013).

5.2.3 Geography of governance on urban water services

There have been considerable debates in recent decades about ownership of urban water infrastructure. Some organizations like the World Bank and the International Monetary Fund sustain that private sector can invest capital to improve water infrastructure and bring efficiency to water services. As such, these agencies support the privatisation of urban water services, including it as one of the conditions many developing countries have had to comply with to receive international aid (Goldman, 2005). In 2012, it was estimated that private water companies were providing water services to 962 million people worldwide (Pinsent Masons, 2012). Nonetheless, many scholars argue against the private sector participation in urban water infrastructure provision (Araral, 2009; Barlow and Clarke, 2002; Lobina and Hall, 2008; Shiva, 2008). On one hand, it is argued that private sector participation could detonate a permanent ongoing conflict between public and private interests (Tortajada and Garc ía-Rubio, 2015). In particular, Harvey characterizes privatisation of water services as one example of “accumulation by dispossession” – the enclosure of public assets by private interests for profit, resulting in greater social inequity (Harvey, 2003). Even the World Bank has recognized that concession contracts have not generated a significant number of new water connections (World Bank, 2005). On the other hand, the principles of universality, affordability and access to water supply effectively as well as water’s biophysical character work against the wholesale introduction of price competition and market exchange (Bakker, 2005), which could result into the private sector becoming a dominant actor as the private sector seeks to consolidate its market share.

Nonetheless, there has been growing recognition that public/private debate could achieve nothing but hot air (Rouse, 2013a). Both public and private provision of urban water infrastructure services can work well, given necessary governance frameworks and effective pricing systems for sustainable cost recovery. There is no ‘one-size-fits-all’ model for institutional governance and regulation of water services in different institutional and cultural contexts. The United Nations Development Programme (UNDP) defined good governance as “The exercise of economic, political and administrative authority to manage a country’s affairs at all levels. It comprises the mechanisms, the processes and institutions, through which citizens and groups articulate their legal rights, meet their obligations and mediate their differences” (UNDP, 1997). The benefits and limitations of both public and private provision of urban water

infrastructure services will continue to be debated. There is not a perfect model because robust governance framework and effective pricing system depend not just on economic and governance theories, but also upon local institutional and cultural contexts.

5.3 Governance and pricing system of urban water infrastructure in Beijing

The introduction of the tax-sharing system in 1994, legislated as the budgetary law (预算法), marked a profound transformation in urban infrastructure financing in China (Wang et al., 2011). Under the tax-sharing system, local expenditures in principle were paid by local incomes, and many of central government's obligations such as the provision of urban infrastructure were also devolved downward to local governments. This transformation empowered local governments and made them financially more independent and behaviourally more entrepreneurial (Herrmann-Pillath and Feng, 2004; Wu and Ma, 2005). However, although local governments are granted autonomy for economic development, the budgetary law requires local governments to balance the needs of public spending with their fiscal capacities. Since almost all urban infrastructure services had been provided by central government for more than four decades before the tax-sharing reform in 1994, it is not difficult to understand that it is challenging to conduct marketisation reform for previous public utility services in many Chinese cities. One of the most significant barriers for the marketisation reform in Chinese infrastructure sector is unawareness of market value of urban infrastructure in China⁹. Urban infrastructure sector has often been considered as 'public welfare service' rather than 'service industry' in China, especially for urban water sector. This can be shown from the annual Beijing Statistics Yearbooks where dominant indicators for measuring performances of water supply and wastewater treatment services are focused on 'improvement in quantity' such as annual growth of the length of water mains and sewer rather than 'improvement in quality' such as annual improvement in leakage rates and service quality (BMBS, 2014). Due to this perception of public welfare service, pricing system for urban water infrastructure in many Chinese cities including Beijing is set up by local governments and water price has been kept below the requirement of

⁹ Although most urban infrastructure assets are still state-owned, China is increasingly aware of the important role of market in resource allocation and pledged to let market play a 'decisive' role in the economy in 2013 (Reuters, 2013). On December 2, 2014, China's National Development and Reform Commission (NDRC) issued the Guiding Opinions on Carrying Out Public-Private Partnerships (PPP). Two days later, on December 4, 2014, the Ministry of Finance (MOF) rolled out 30 projects, worth a total of ¥180 billion (about US\$29.32 billion), for possible private investments under the PPP program. These two new initiatives are intended to contribute to lowering government spending and improving public services through a third wave of PPP projects in China (Buchanan, 2014).

full cost recovery for a long time. As shown in Table 1, the water price in Beijing has been remained below ¥4 yuan/m³ in the past decade. Yet the survey conducted by Beijing Development and Reform Commission (BDRC) in 2014 indicates that the cost of water services (including water supply and wastewater treatment) is ¥6.38 yuan/m³ or ¥6.59 yuan/m³ if tax is included (China Business Observer, 2014). This means that until 2014 Beijing government has been subsidising Beijing water companies for their revenue loss due to relatively low water price.

The current phenomenon for underpricing of water services and failure of sustainable cost recovery has much to do with the governance framework for water pricing system in Beijing. As can be seen from Figure 5.1, water price in Beijing currently is regulated and adjusted by BDRC. BDRC is not a regulator dedicated for water pricing but a government agency in charge of price regulation for all important commodities such as food, house, etc. and public services such as education, healthcare, energy, water, transportation, etc. in Beijing. With such a wide range of price regulation, it is doubtful that whether BDRC has sufficient time and comparable expertise to understand what is going on in the water industry in Beijing and thus adjust water price based on in-depth investigation and stakeholder engagement. Although Beijing government set up a government agency dedicated for water affairs - Beijing Water Affairs Bureau (BWAB), it is mainly responsible for regulating the performances of water supply and sewage services in Beijing. BWAB can involve in the water price setting, but the ultimate decision for water pricing is made by BDRC. In the name of public interest and social stability, BDRC has kept the water price far below the standard of full cost recovery. Thus, the Beijing government-owned water companies Beijing Waterworks Group (BWG) and Beijing Drainage Group (BDG) are not financial independent, and the financial objective for these two water companies is ‘break even or meager profit’ (保本微利). Due to distort of true market value of water infrastructure services, BWG and BDG have to rely on fiscal subsidy from Beijing Financial Bureau (BFB) for cost recovery in capital expenditures (CAPEX) and operational expenditures (OPEX). Both BWG and BDG are wholly state-owned companies which have only one shareholder – Beijing State-owned Assets Supervision and Administration Commission (BSASAC). However, this unique shareholder BSASAC never cares about the shareholder return from its owned water companies but only pays close attention to ‘assure and increase the value of state assets’ (国有资产保值增值). Due to the government-led governance framework for water pricing system in Beijing, it is not difficult to understand the current phenomenon for underpricing of water

services and failure of sustainable cost recovery in Beijing.

Table 5.1 shows the structure of domestic water pricing system in Beijing. The water price of ¥4 yuan/m³ was set by BDRC in 2009. With rapid population growth in Beijing and increasing cost of water services, there is increasing pressure for Beijing government to subsidize urban water services. In April 2014, BDRC held the public hearing to discuss proposals for increasing water price in Beijing. As of May 1st 2014, Beijing has abandoned the previous uniform tariff and adopted the new increasing block tariff as its water pricing system.

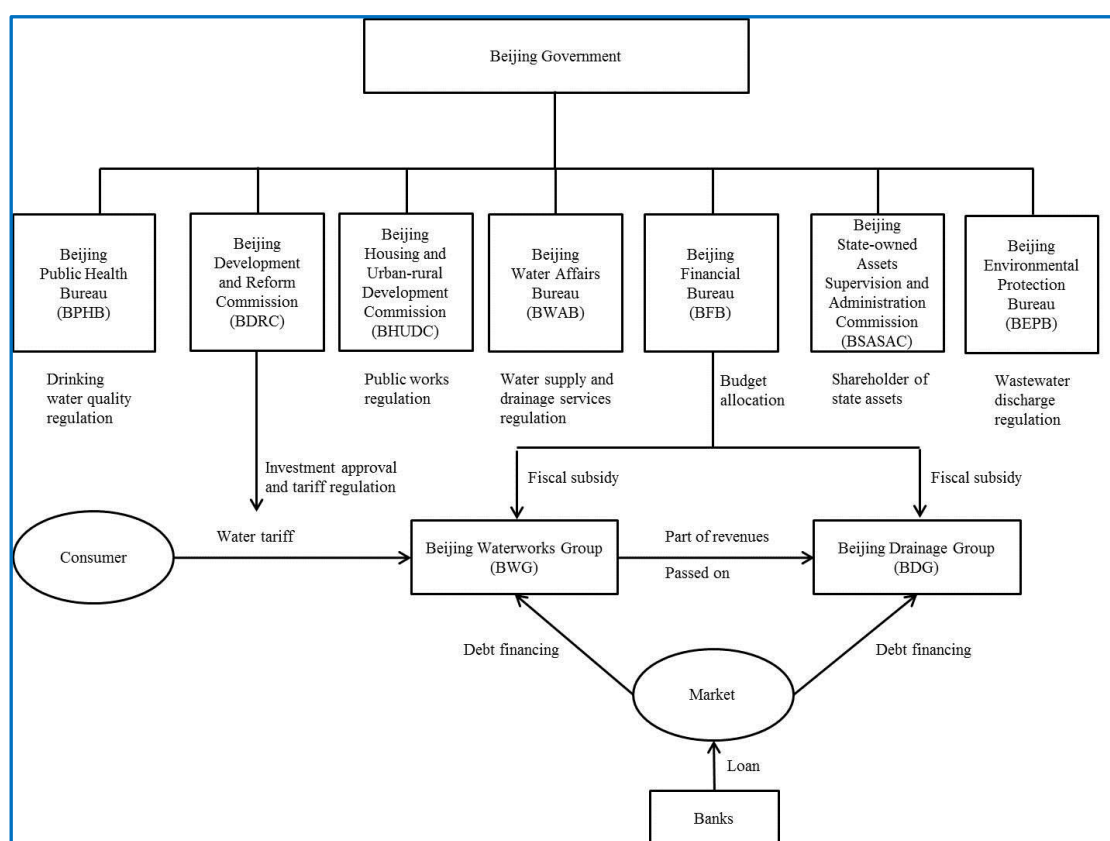


Figure 5.1 Governance framework for water pricing system in Beijing

Source: the author

As shown in Table 5.1, there are three blocks for domestic water pricing system in Beijing. The range of household annual water use amount for the first block is from 0 to 180 m³, which can cover almost 90% of total household water use annually in Beijing. The total water tariff for the first block is ¥5 yuan/m³, which is still below the cost of water services ¥6.38 yuan/m³. The range for the second block is between

181 and 260 m³, which can cover around 96% of total household water use annually in Beijing. The water price for this block is ¥7 yuan/m³, which is slightly higher than the cost of water services. Those households who use more than 261 m³ water per year belong to the third block, and the water price is increased to ¥9 yuan/m³ for this block. In addition, the water pricing system in Beijing mainly consists of three parts: water supply fee, water resources fee and sewage fee. The water resources fee is the charge for water abstraction which is used for protecting raw water environment. The water supply fee and sewage fee reflect the cost for water supply and wastewater treatment services respectively. Yet neither water supply fee nor sewage fee separates the costs for CAPEX and OPEX, thus it is hard to tell whether the increase in cost is caused by the increased cost of capital for infrastructure investment or the increased cost of raw materials for operations. More importantly, due to the ambiguity of water service fees, it is not difficult to understand that why Beijing government is often under pressure from public opinion to increase water price.

Table 5.1 Structure of domestic water pricing system in Beijing (Year 2004-2014)

Year	Tariff type	Block	Household annual water use amount (m ³)	Water supply fee (¥yuan/m ³)	Water resources fee (¥yuan/m ³)	Sewage fee (¥yuan/m ³)	Total water tariff (¥yuan/m ³)
2004-2009	Uniform tariff	-	-	1.70	1.10	0.90	3.70
2009-2014	Uniform tariff	-	-	1.70	1.26	1.04	4.00
		1 st block	0 - 180	2.07			5.00
		2 nd block	181 - 260	4.07			7.00
2014.05.01*	Increasing block tariff	3 rd block	261 -	6.07	1.57	1.36	9.00

Source: the author; (BDRC, 2014)

* In terms of urban water use for public purposes, such as schools, non-for-profit parks, public toilets, social benefit institutions for the elders, the disabled and orphans, etc., the uniform water tariff of ¥6 yuan/m³ is implemented.

5.4 Governance and pricing system of urban water infrastructure in London

The current water pricing system in England and Wales was devised after privatisation of water and sewerage services in England and Wales in 1989. The decision to privatise water was taken by the Conservative Government led by Margaret Thatcher, as part of a policy to move the provision of utility and other services from the public to the private sector. The decision was taken in the strongly held belief that private sector operations are more efficient, although it has turned out that neither public or private ownership alone have guaranteed a more efficient access to the water services (Tortajada and Garc á-Rubio, 2015). In order to provide comfort to investors in privatised network utilities such as electricity, natural gas, railways, telecoms, transport and water that their investments would not be treated unfairly, the regulatory asset base (RAB) model was initially developed in the early 1990s for UK infrastructure industries by Ofwat (the economic regulator of the water industry in England and Wales). Ofwat created the first infrastructure RAB model for the purpose of setting its five-year price cap in 1994 (Stern, 2014b). After privatisation the water industry in England and Wales adopted the five-year periodic review process for setting allowable water service charges¹⁰. The process plays a pivotal role in providing an integrated approach to future planning of water services and in the maintenance of the water and sewerage infrastructure (Rouse, 2013b). RPI-X regulatory framework was designed to impose fixed *ex ante* water price for fixed 5-year periods on the assumption that, as price-takers, the utilities would maximize profits by minimizing costs (Helm, 2009), although it was argued that the problem of RPI-X was to exacerbate gold-plating and cost inefficiency (DTI and Littlechild, 1983). The key concept behind the RAB model is financial capital maintenance (FCM) which addresses the issue of whether the financial capability of the company is being maintained intact. However, the role of the RAB model as a commitment device derives from the quality of its implementation plus the predictability and integrity of the process by which it is revised or redefined, rather than from the definition of the RAB per se (Stern, 2014b).

¹⁰ More details about the five-year periodic review process see (Ofwat, 2014; Rouse, 2013b).

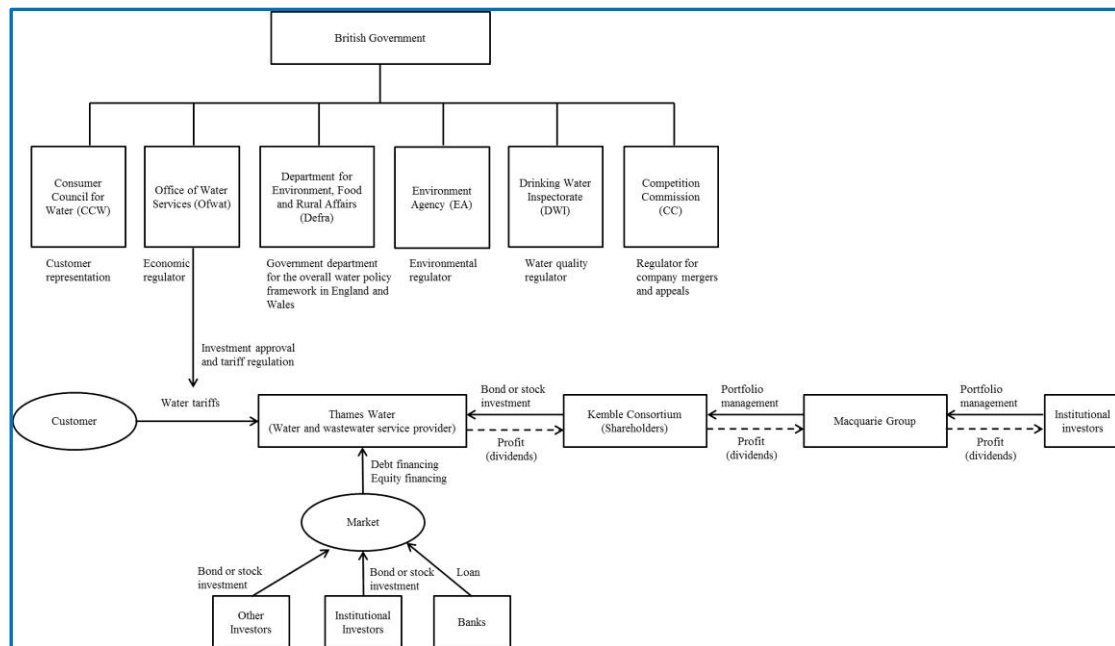


Figure 5.2 Governance framework for water pricing system in London

Source: the author

Figure 5.2 uses Thames Water to illustrate the governance framework for water pricing system in London. It can be seen clearly from the figure that the water company in London is mainly influenced by the two forces: local regulator and global capital. On the one hand, the water company is regulated by economic regulator Ofwat, environmental regulators Environment Agency (EA) and Drinking Water Inspectorate (DWI); on the other hand, the water company has to achieve satisfactory financial performance to attract global capital and to satisfy international shareholders. This separation of market function and environmental function for urban water infrastructure provision was designed in the strong belief that the introduction of market institutions to natural resource management can function as a means of reconciling goals of efficiency and environmental conservation, yet the application of market mechanisms to urban water infrastructure provision is much more limited than had been expected (Bakker, 2005). Price cap regulation, which was designed by Treasury economist Stephen Littlechild in the mid-1980s, was deemed to be “preferable to rate of return regulation [in US] of profits because it is simpler, less expensive and interventionary [sic], and less vulnerable to ‘cost-plus’ disincentive effects” (Littlechild, 1986, 1988). The ‘yardstick’ regulation, which started in the mid-1990s, was largely based on benchmarking methods, including econometric benchmarking of efficiency levels. It operated on the

assumption that the regulator, gathering and comparing information about water companies' performances and required investments, can set an upper limit on water price that motivates water companies to increase profit by improving efficiency (Glynn, 1992). Nonetheless, there were underlying issues for this benchmarking regulation approach – information asymmetry and strategic gaming. There were strong incentives for water companies to show that their situations were 'special' so that the regulator's preferred benchmarking model should not be applied to them. The resulting strategic gaming between companies and regulator, typically with no clear outcome, leads to heavy transaction costs. Water UK, a consortium of water companies in the UK, once commented: "Companies estimate they spent approximately GB £100 million in additional costs and directly employed additional labour equivalent to over 500 employee-years in order to comply with the regulatory requirements of PR09" (Hukka and Katko, 2015). Even Ofwat itself reported that the cost of the reporter function (paid for by companies) was the equivalent of ££1.5 million a year and about ££6 million in a price review year (Defra, 2011).

In addition, since only 28% of households paid for their water on a metered basis in England and Wales, private water companies were unable to measure as precisely the water that was consumed, thus there were inherent weakness in information on water demand and leakage (National Audit Office, 2007). As shown in Table 5.2, for the majority of households that do not have water meters in England and Wales, water is charged in relation to the value and size of the property. The assumption underlying the employment of rateable property values as the base for water charges was made that the value of the property was a good indicator for the family's wealth, despite the fact that the property values are very imperfectly related to family income and to costs imposed on the water infrastructure (Bakker, 2001). This water pricing method, regardless of the water amount used, not only creates cross-subsidies that result in higher bills for the poorer group but also falls short in incentives that drive consumers to save water and companies to reduce leakage. Table 5.3 shows the structure of water pricing system for metered household. In addition to charges for water supply services and wastewater services, there are fixed charges applied according to the size of pipes for the property. Based on the volume used and the total charge, the unit charge for water services provided by Thames Water is around £2.9/m³.

Table 5.2. Structure of water pricing system for unmetered household*

Water pricing system for unmetered household			
Fresh water supply			
	Chargeable value** of property	Pence for each £1 of chargeable value	Charges
Charges for fresh water supply based on value of property	£250	106.76	£266.90
Fixed charge			£30.70
Sub-total			£297.60
Wastewater services			
	Chargeable value of property	Pence for each £1 of chargeable value	Charges
Charges for wastewater services based on value of property	£250	74.56	£186.40
Fixed charge			£53.25
Sub-total			£239.65
Total			£537.25

Source: the author

*Charges for the period from 01 April 2015 to 31 March 2016 (366 days)

**Chargeable values were originally assessed by the Valuation Office, on behalf of the Inland Revenue, and are based on many factors including the size of your home, the amenities you have, number of rooms and where you live. The amount of water you use does not affect your charges.

Table 5.3 Structure of water pricing system for metered household*

Water pricing system for metered household			
Fresh water supply			
	Volume m ³	Pence per m ³	Charges
Fresh water used	49	132.48	£64.92
Fixed charge			£14.15
Sub-total			£79.07
Wastewater services			
	Volume m ³	Pence per m ³	Charges
Used water disposal	49	74.82	£36.66
Fixed charge			£28.18
Sub-total			£64.84
Total			£143.91

Source: the author

*Charges for the period from 27 June 2014 to 20 December 2014 (177 days)

5.5 Comparison and Analysis

5.5.1 Comparison of intrinsic value of urban water infrastructure in Beijing and London

As mentioned above, although the water pricing systems and governance frameworks in Beijing and London are different, the challenges for meeting the requirements of water security in future in these two cities are similarly severe. In Beijing, the average annual rainfall is approximately 585 mm and the average

water resources per capita is around 248 m³/ year which is one eighth of national average and one thirtieth of world average (Pan, 2006). The permanent population¹¹ of Beijing had reached to 21.15 million by the end of the year 2013, though average annual increment of permanent population continued to decrease year by year with a lower growth rate (BMBS, 2014). With population growth and economic development, water security is increasingly becoming the critical constraint for sustainable development of Beijing (Li et al., 2012). Currently, both surface water sources and groundwater sources for urban water supply in Beijing come from rural areas. For surface water, Miyun reservoir and Guanting reservoir are the main surface water sources. Due to the continuous years in drought, three emergent groundwater sources Pinggu Groundwater Source Emergent Project, Juma River Groundwater Source Emergent Project and Huairou Groundwater Source Emergent Project, were built to complement the deficit of surface water in Beijing (Pan, 2006). In addition, the first stage project of the central route of South-to-North Water Diversion Project has already operated, and it is expected to contribute up to one third of total water demand in Beijing once the whole water transfer project is in operation in 2020 (Beijing NSBD, 2009).

In London the task of securing water service delivery in future is also not easy, given the average annual rainfall in London is around 590 mm and the population of London is expected to keep growing to reach about 8.82 million by 2031 (Greater London Authority, 2011). Currently the majority of London's water supplies come from the rivers Thames and Lee, with about 70 per cent of all the water taken from the freshwater River Thames upstream of Teddington Weir. It is then stored in reservoirs around London. The remainder is mostly abstracted from the 'confined chalk', which is concealed below the clay of the London basin. Moreover, the impact of climate change poses a new challenge for Beijing and London in water security. The drought in the 2012 summer in parts of southern and eastern England including London forced the seven water companies to ask their customers to help cut down on their water usage through introducing hosepipe bans (BBC News, 2012). Facing similar challenges for water security, Beijing and London have adopted different models for dealing with it which can be seen from their respective water pricing systems and governance frameworks. The public sector takes the lead in urban water infrastructure provision in Beijing which is called government-led model, while the private sector does so in London which is called market-led model. The government-led model in Beijing and the market-led model in London have led to different priorities in coordinating the value of urban water infrastructure provision.

¹¹ In China, permanent population refers to a group of population who has lived in one specific location for more than six months.

Generally, the government-led model in Beijing focuses more on the intrinsic value of urban water service delivery while the market-led model in London pays more attention to the market and investment value of urban water infrastructure provision.

Table 5.4 compares the intrinsic value of urban water infrastructure provision through comparing the proportion of water bill in annual household income in Beijing and London. Given the first block water tariff in Beijing is ¥5 yuan/ m³ (£0.5 pound/m³) and the annual water use amount for a typical three-person household is assumed to be 180 m³, the average annual water bill for a typical household is ¥900 (£90) in Beijing. According to Beijing Municipal Bureau of Statistics, the median annual income per capita in Beijing is ¥38752 in Year 2013 (BMBS, 2014), thus the median annual household income is ¥77504 (£7750.4). The proportion of water bill in annual household income in Beijing is 1.16%. According to Table 3, the unit charge for water services provided by Thames Water is around £2.9/m³, much higher than that of £0.5 pound/m³ in Beijing. If the annual water use amount for a typical three-person household in London is also assumed to be 180 m³, the annual water tariff in London is around £522. Given the median gross weekly earnings for full-term employees in London in 2013 is £658 (ONS, 2013), the median annual household income is around £61852, thus the proportion of water bill in annual household income in London is approximately 0.84%, surprisingly lower than that in Beijing. The irony is that citizens in Beijing where government-led model aims to keep down the water price need to take out more from their annual household income to pay water bills than citizens in London do where market-led model drives the water companies to deliver water services in affordable prices more efficiently.

Table 5.4 Proportion of water bill in annual household income in Beijing and London

* The

Comparison	Beijing	London
Water tariff * (£/m ³)	0.5	2.9
Annual water use amount for a typical three-person household (m ³)	180	180
Average annual water bill for a typical household ** (£)	90	522
Median annual household income *** (£)	7750.4	61852
Proportion of water bill in annual household income	1.16%	0.84%

ratio for ¥per 1 £ on 31 December 2013 was 9.991. Here, the ratio of 10 is used for simplification.

** Thames Water Annual Report (Year2013/2014)

*** The median annual income per capita in Beijing is ¥38752 in Year 2013 (BMBS, 2014). Suppose there are two main breadwinners in a typical three-person household, then the median household income in

Beijing is ¥77504. In April 2013 the median gross weekly earnings for full-term employees were highest in London, at £558 (ONS, 2013). According to this data, assuming the number of working weeks in a year is 47 weeks, then the median annual income per capita in London is £30926. Suppose there are two main breadwinners in a typical three-person household, then the median household income in London is £61852.

Nonetheless, the intrinsic value of urban water infrastructure provision involves not only affordable water price but also other essential qualities of infrastructure services such as security of water supply. During the drought in 2012, the sustainability director of Thames Water admitted that the company's leakage rates were not 'obscene' but were high, and he attributed it to "partly a consequence of very old pipes – 20% of London's water pipes are over 150 years old" (BBC News, 2012). Surprisingly, he then added: "With this ban [hosepipe ban] we would expect to see up to 150 million litres of water a day saved. To get the same saving from replacing leaky pipes would cost £1.2bn and take 10 years, so we have to be practical about this." (BBC News, 2012). It is true demand management is useful to water companies as a short-term response to critical shortages, but demand management is not always economically efficient for companies (Bakker, 2005). No wonder the expert from the Consumer Council for Water said that "with providers losing billions of litres of water every day, consumers may feel the ban is unfair" (BBC News, 2012). Figure 5.3 compares the annual water leakage in Beijing and London between 2006 and 2011. It can be seen from the figure that although the annual water leakage in London is higher than that in Beijing, the annual water leakage in London has reduced year by year due to the stringent regulation on leakage reduction while the water leakage in Beijing has grown annually nearly reaching to the leakage level of London. The comparison shows that government-led model may fail to protect intrinsic value of urban water infrastructure if stringent regulation and powerful enforcement are not in place, even if the government owns the infrastructure directly in the interest of the public. On the contrary, the market-led model may protect the intrinsic value of water services as long as there is transparent and robust regulation. Protecting the intrinsic value of infrastructure well has more to do with regulation and governance framework than ownership of infrastructure.

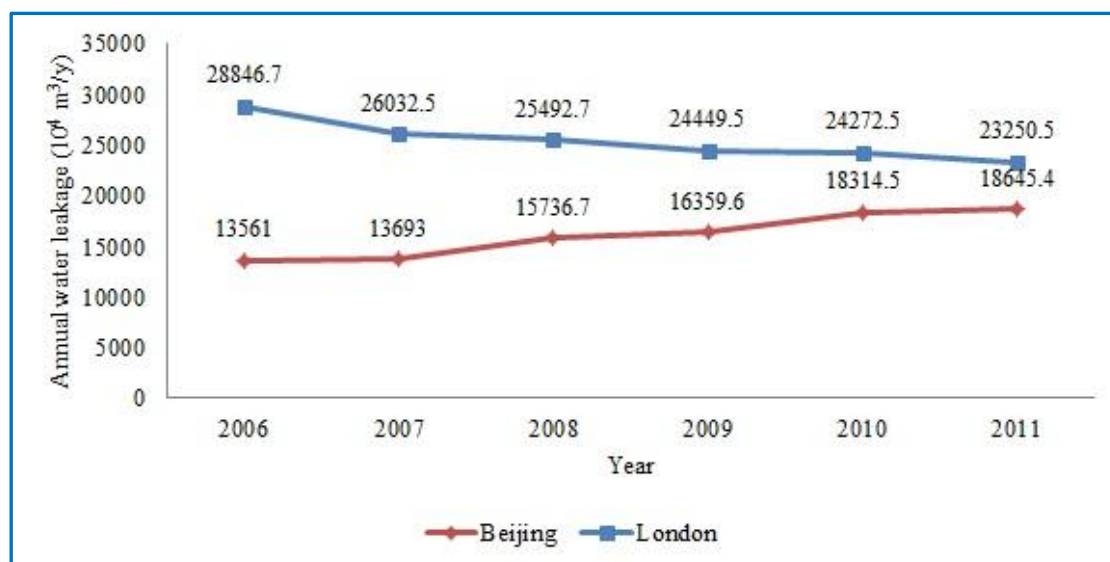


Figure 5.3 Comparison of annual water leakage in Beijing and London

Source: the author; (BWAB, 2012); Thames Water Annual Reports

5.5.2 Comparison of market value of urban water infrastructure in Beijing and London

In terms of market value of urban infrastructure provision, there are significant differences between government-led model in Beijing and market-led model in London. Table 5.5 compares the financial performances of water companies in Beijing and London in 2012. As shown in the table, the business turnover for BWG in 2012 was £189.5 million while the business cost was £264.7 million, and the turnover for BDG in 2012 was £118.8 million while the cost was £155.3 million. The loss of £75.2 million for BWG and £36.5 million for BDG were subsidised by Beijing government. On the contrary, Thames Water Group made a profit of £26 million in 2012 from its business operation, with the business turnover of £1759 million and the cost of £1733 million. The main reason behind this difference is the water price in Beijing was unable to recover the full cost of water services. In 2012, Beijing government conducted a survey about the cost of water services including water supply and sewage services in Beijing. The survey showed that the total cost of water services in Beijing was ¥6.38 yuan/m³ or ¥6.59 yuan/m³ if tax was included. Apparently, the water price of ¥4 yuan/m³ during the period 2009-2014 in Beijing failed to cover the cost of water services. Even the new water price of ¥5 yuan/m³ in the first block of the block water tariff system coming into enforcement from May 2014 in Beijing still cannot achieve the goal of full cost recovery from water bills. If the water price in Beijing were set to be ¥7 yuan/m³ for the purpose of full

cost recovery, the proportion of water bill in annual household income in Beijing would be 1.62%, which is still within the acceptable range suggested by the World Bank that “water should not cost more than 3-5% of disposal income or household expenditure” (Grafton et al., 2015). This means there is still scope for putting up water tariff in Beijing. In addition to raising water price gradually, the Beijing government can use the government subsidy to set up a special municipal water fund for the transparent use of subsidy. The current direct subsidy from Beijing government has given little incentives for BWG and BDG to deliver water services efficiently. With the transparent use of the special municipal water fund, Beijing government can set up the performance benchmark to incentive the water companies to provide water services more efficiently.

As for London, although the numbers in the finance performance of water companies in London look good, water pricing system and regulation should be carefully designed to protect the social and market value of urban water infrastructure provision at the same time. Since the market function and social function for urban water infrastructure provision has been split since privatisation (Bakker, 2003), with private water companies being responsible for market function while regulator being in charge of social function, it is not difficult to understand that there has been underlying ‘strategic gaming’ and information asymmetry problems within the repeat price-setting regulatory reviews between regulator and regulated water companies. Given the nature of the problems, “no definite solution is likely” to fundamentally solve the problems (Stern, 2014a). Some initiatives such as menu regulation and negotiated settlements have been proposed to reduce problems arising from information asymmetry and to reduce the incentives for ‘strategic gaming’ by the regulated companies (Price and Ross, 2014). The effect of these initiatives, however, remains to be seen.

Table 5.5 Comparison of finance performances of water companies in Beijing and London*

Comparison	Beijing Waterworks Group	Beijing Drainage Group	Thames Water	Notes
Business Turnover (£ million)**	189.5	118.8	1759	Year 2012
Business Cost (£ million)	264.7	155.3	1733	Year 2012
Profit/Loss (£ million)	- 75.2	- 36.5	26	Year 2012

* Source: Survey conducted by Beijing government in 2012 (China Business Observe, 2014); Thames Water 2012/2013 Annual Report (Thames Water, 2013)

** The ratio for ¥ per 1 £ is set to be 10 for simplification.

5.5.3 Comparison of investment value of urban water infrastructure in Beijing and London

Regarding investment value of urban water infrastructure, the difference between government-led model in Beijing and market-led model in London is even more significant. Both water companies in Beijing BWG and BDG are wholly state-owned companies which have only one shareholder – Beijing government. In 2009 Beijing State-owned Assets Supervision and Administration Commission (BSASAC) was set up by Beijing government to function as the only shareholder of the wholly state-owned companies in Beijing including BWG and BDG. With the government-led model in Beijing, BWG and BDG actively seek for cooperation with other investors for urban water infrastructure investment. In September 2014, BDG signed an agreement with State Development and Investment Cooperation (SDIC) to create an investment fund dedicated for improving water environment in Beijing. BDG held 70% share of the new company through its assets while SDIC held 30% share through injecting ¥3 billion. Other investors for the new company included Industrial and Commercial Bank of China Limited, Shanghai Pudong Development Bank, and SDIC Fund (Beijing Daily, 2014). It is worthy of note that although capital from these investors was called ‘social capital’ (社会资本), the majority ownership of all these investors are governments or state-owned enterprises. This capital structure to some extent represents the institutional environment for private investment in urban infrastructure in China, which is described as state capitalism with Chinese characteristics (Peck and Zhang, 2013).

The urban water sector in England and Wales after privatisation has witnessed a shift in the pattern of ownership towards more consortia-led, global infrastructure funds (Allen and Pryke, 2013). Thames Water was privatised in 1989 along with the rest of the regional water companies in England and Wales. It was sold off in 2001 to RWE, a German Utilities company, and then in 2006, it was acquired by an international consortium of investors led by the European arm of an Australian bank, the Macquarie Group. The monopoly nature of water provision and the captive revenue stream have the potential to deliver predictable risk-adjusted rate of return over fixed time periods for investors in agreement with the regulator Ofwat. As such, Thames Water’s households become central to a model where the households themselves are the financial asset, a ‘human revenue stream’ (Meek, 2012) which has been packaged and sold to global investors through the techniques and practices of financialisation. The investment value of infrastructure in London has been activated to attract capital from all over the world, and infrastructure has

continued to develop into a significant international asset class, although at a pace not envisaged by Clark (1999) in his early intervention on the ‘rise of pension fund capitalism’.

5.5.4 Geographies of governance: system-thinking for coordinating the value of urban water infrastructure

This chapter argues that system-thinking is needed in designing water pricing system for coordinating intrinsic, market and investment value of urban water infrastructure. In particular, conventional cost-benefit analysis methods for appraising value of infrastructure often “miss some of the hard-to-quantify benefits that the projects can bring” (Rosewell, 2013). Although the “main component parts of the economy” are generally considered as land/natural resources, labour and capital (Marx, 1867; Ricardo, 1817; Smith, 1776), infrastructure is increasingly becoming another critical “component part” for a city to obtain competitive advantages and to attract businesses and talents in the era of globalization. Global flow of businesses and talents would favour residing in the city where transportation system facilitates flow of goods and expertise, communications system enables sharing of knowledge and information, water supply and waste treatment system enhance the quality of life, and energy system supports the everyday dynamics of modern society. The symphony orchestra of all urban infrastructure systems makes a city productive and competitive. In this context, system-thinking is required for evaluating long-term value of urban infrastructure. Unfortunately, “substantial system effects are hidden by current project appraisal methods” (Young and Hall, 2015) as they deal poorly with interdependence of the three value of infrastructure. Too often, infrastructure projects are appraised by cost-benefit analysis in term of short-term market value and investment value, thus decisions are made without much consideration of potential benefits and risks in the long run (Rosewell, 2013). There is an urgent need to rethink what infrastructure means in the context of globalisation, and therefore to “re-assess the criteria for deciding what infrastructure is to be provided, in what form it should be provided, who should provide it, who should pay and who should operate it” (O'Neill, 2010).

The water pricing system in Beijing kept its domestic water price below the requirement of full cost recovery in the past decade. It seemed that Beijing government did so to protect the intrinsic value of urban water infrastructure for the benefit of water consumers. From the viewpoint of Beijing government, water

infrastructure which is considered as public welfare service and basic service should be provided and subsidised by government at affordable prices for its citizens. However, as water infrastructure provision intrinsically belongs to service industry and capital-intensive industry, it is beyond the government's capacity to deliver efficient water services and fill in financing gap for urban water infrastructure development alone. To some extent, private sector participation is needed for performance improvement and project investment for water infrastructure provision. Given the distortion of true cost for water services within current water pricing system in Beijing, the market value of water infrastructure provision in Beijing has not been fully appreciated. Thus few private sector and institutional investors have allocated their capital in water projects in Beijing so far given the lack of transparent water pricing system. Due to non-activated state of market value and investment value of water infrastructure in Beijing, Beijing government has to guarantee the intrinsic value of water infrastructure provision through fiscal subsidy which heavily relies on local tax and land finance. The current financing sources for water infrastructure in Beijing are, however, unstable and unsustainable, given the limited land resources and increasing government spending. From the long run, if the market and investment value is not waken up to attract private sector for efficiency improvement and private investment, the intrinsic value of urban water infrastructure in Beijing may be damaged due to likely underinvestment and inefficient operation in water infrastructure provision.

The water pricing system in London activates the market value and investment value of urban water infrastructure. The price cap adopted by current water pricing system in London drives water companies to provide affordable water services more efficiently. The RAB model employed by current water pricing system in London assures global investors that their past investment 'sinking in' water projects is protected and can be recouped. Alongside the water pricing system is the governance framework for water infrastructure in England and Wales which guarantees the quality and affordability for water services in London. However, the separation of social function and market function of urban water infrastructure in London leads to the underlying 'information asymmetry' and 'strategic gaming' problems between private water companies and regulator. As government completely delegates the market function of urban water infrastructure provision to private water companies, the regulator has to make the price-cap resetting decisions within the bounds of seriously limited information. The decisions were subject to appeal, but the regulated companies were left as recipients of decisions by the regulators. The five-year price-cap resetting

model relies heavily on the cost of capital needed to maintain the value of the RAB model, and considerably depends on econometric and other benchmarking. There was widespread agreement that it had resulted in a costly bureaucratic and legalistic regulatory framework with which increasingly both regulators and regulated companies felt uncomfortable (Stern, 2014a). The failure of coordinating the intrinsic, market and investment value of urban water infrastructure may harm the intrinsic value of urban water infrastructure in London such as being reluctant to reduce water leakage by regulated private water companies, if the serious problems of information asymmetry and strategic gaming in a set of general negotiations between regulator and regulated water companies still exist.

5.6 Conclusion

This chapter explored how to design effective water pricing system and robust governance framework for urban water infrastructure in different institutional contexts. On the one hand, the research contributes to infrastructure literature by demonstrating the importance of system-thinking in designing water pricing system for coordinating the intrinsic, market and investment value of urban water infrastructure. On the other hand, this comparative study of government-led governance framework in Beijing and market-led governance framework in London complements the burgeoning study on ‘geography of governance’ (Pierre and Peters, 2000; Rouse, 2013b; Wood and Valler, 2001).

The water pricing system in Beijing focuses on social equity and universal provision. Yet current water pricing system in Beijing not only distorts the market value and investment value of urban water infrastructure, but also may hurt the intrinsic value of water services in the long run. In order to meet the challenges of water security in Beijing in future, water pricing system should not only protect consumers’ benefits, but also encourage the water companies to bring efficiency and innovation into day-to-day operation. In addition, water pricing system and governance framework in Beijing should be more transparent and robust to attract private sector participation in infrastructure investment and provision.

The water pricing system in London introduces market institutions to natural resource management for reconciling goals of efficiency and environmental conservation (Bakker, 2005). It activates market value as well as investment value of urban water infrastructure. Nonetheless, this separation of market function and environmental function for urban water infrastructure provision leads to the fundamental issues including information asymmetry and strategic gaming between regulator and regulated water

companies (Stern, 2014a). Furthermore, the current five-year periodic review of water pricing system in London can encourage short-term efficiency savings at the potential cost of ensuring that vital infrastructure would be maintained and improved to meet future requirements, long-term sustainability, and customer needs (Hukka and Katko, 2015). Future pricing system and governance framework should take system-thinking into account for designing long-term plan for water infrastructure development in London.

Consistent with recent research advocating the importance of geography in understanding governance (Clifford and Morphet, 2015; McGuirk, 2012; Reed and Bruyneel, 2010), our findings indicate that pricing system and governance framework for urban water infrastructure are strongly linked to local institutional contexts. As “functions are inherently geographical in nature” (Ansar, 2010; Clark and Wójcik, 2007; Dixon, 2012; Rodríguez-Pose and Storper, 2006), complete convergence and integration of forms are “neither inevitable nor can the outcomes of change be expected to be uniform” (Dixon, 2014). As such, water pricing systems and governance frameworks in Beijing and London should improve based on local institutional contexts. This chapter employs the empirical study of Beijing and London to provide useful “geographical lens” for understanding the uneven phenomena on urban infrastructure pricing and governance. The findings of this study conducted in government-led context in Beijing and market-led context in London cannot necessarily be generalised to broader contexts. Nonetheless, the study functions as a trigger to induce more attentions in the burgeoning field ‘geographies of infrastructure governance’.

CHAPTER SIX: THE GEOGRAPHY OF CONTRACT FOR URBAN INFRASTRUCTURE INVESTMENT: A COMPARISON OF URBAN WATER INFRASTRUCTURE PROJECTS IN BEIJING AND LONDON

6.1 Introduction

Contract is crucial for governing the relationships between asset owners and many types of agents that underpin the production of investment activity (Clark and Monk, 2014). It is contracts that dominate modern economic transactions, particularly for infrastructure investment with high fixed cost and complex stakeholder relationships (Stern, 2014). Yet how the government should structure the contract for infrastructure investment remains less clear (Helm, 2013). Infrastructure contracts, designed by countries and cities based on their specific development stages, regulatory environments and financial situations, rely on successful coordination of a nexus of interests possessed by various participants entering and existing the infrastructure project for their own purposes (Likosky, 2010) in the given geographical context. Although some researchers have paid attention to regulations and contracts for infrastructure industries (Chong et al., 2006; Guasch et al., 2007; Levy and Spiller, 1994; Stern, 2003), infrastructure contracts in different geographical contexts have rarely been compared from the perspective of political economy. In particular, few studies have compared China's government-led model where domestic and local political relations play important roles in urban infrastructure development with Britain's regulatory-led model where the state is described either as being 'hollowed out' or subsumed to the powerful operation of global finance forces (Lin et al., 2014). Since "there is always a politics of infrastructure in play" (O'Neill, 2013), this chapter analyses the infrastructure investment models employed by China and Britain for urban water infrastructure investment through comparing contracts of Beijing and London for their large-scale urban water infrastructure projects, which makes contribution to the 'geography of finance' (Clark and Wójcik, 2007) and 'geography of capitalism' (Dixon, 2014), especially current debate on state versus liberal capitalism.

China has changed its urban landscape dramatically through phenomenal urbanization in the past few

decades. China's urban population size expanded from 172 million in 1978 to 731 million in 2013 and its percentage of the total population increased from 17.9% to 53.7% during the past 35 years period. The total area of urban built-up area dramatically increased from 12856 km² to 47855 km², a growth of 270% during 1990-2013 (China State Statistical Bureau, 2014). Yet how China has financed its rapid urbanization remains relatively rudimentary (Wang et al., 2011). In particular, although China has conducted 'reform and opening up' program and embraced market economy since 1980s, local governments in China still play a role pivotal to urban transformation (Lin et al., 2014). The unique government-led model created by China functions as government-led infrastructure contract, leading to a furious debate on 'state versus liberal capitalism' (Bremmer, 2009; Dixon, 2014; Economist, 2012; Ferguson, 2012; Harvey, 2005), or a confusion for the position of China's model in the current spectrum of 'varieties of capitalism' (Peck and Zhang, 2013).

Britain has been altering its approaches to infrastructure along its development history. Two core issues have been mainly focused on: ownership and competition (Helm, 2013). After the Second World War, Britain chose nationalization and monopoly for its infrastructure. After the Thatcherism in the 1980s, Britain chose privatisation and regulated competition for its infrastructure. Privatisation was regarded by its advocates as a solution to the perceived underinvestment and inefficiencies problems of the public sector. Moreover, competition was considered to bring innovation into play for efficiency maximization and cost minimization. In this context, government ceded direct control over infrastructure and the arm's length regulators were created for regulating private infrastructure investment and service delivery. The regulatory model for infrastructure provision also exists in other countries, yet around the world no other country has completely privatized its economic infrastructure, particularly for the water supply and sewerage systems in England and Wales (Bakker, 2003). Although privatisation of the UK infrastructure industry involves the use of regulatory licences, these licences are essentially regulatory-led contracts between public and private sector in terms of their function and content (Stern, 2014).

The aim of this chapter is to investigate the phenomena 'geography of contract' for urban infrastructure investment by comparing government-led contract in Beijing and regulatory-led contract in London. In this chapter, contract specifically refers to the infrastructure contract and its embedded institutional environment for contract enforcement. Two large-scale urban water infrastructure projects in Beijing and London are chosen for the comparative study. The South-to-North Water Diversion Project in

Beijing is a large-scale urban water supply project worth of ¥40 billion (around £4 billion) which aims to alleviate the pressure of water supply in Beijing; while the Thames Tideway Tunnel project in London is a large-scale urban wastewater treatment project with the estimated cost of £4.2 billion which is designed for reducing the amount of combined sewerage overflows (CSOs) discharging directly into River Thames. Discussion for pros and cons of this large-scale project approach in dealing with urban mobility is beyond the scope of this chapter (see Ansar and Pohlers, 2014). Instead this chapter is focused on analysing the difference of contracts for urban water infrastructure investment in Beijing and London. Specifically, the research explores the following research questions:

- (1) Why do Beijing and London choose different types of contracts for financing the large-scale urban water infrastructure projects?
- (2) How does the respective contract function in Beijing and London?
- (3) What are the advantages and disadvantages for the two types of contracts, and how to improve them respectively?

The plan of this chapter is as follows. Section 6.2 summarises the relationship between infrastructure investment and contract by identifying special features of infrastructure investment, emphasising the shift from bilateral contract to relational contract for governing complex relationships that underpin infrastructure investment, and analysing the role of government in contract design for infrastructure investment. Then section 6.3 uses empirical study approach to compare different contracts in Beijing and London for large-scale water infrastructure projects. Advantages and disadvantages for the two types of contracts are discussed in Section 6.4. The chapter ends with a few concluding comments.

6.2 Infrastructure investment, contract and government

6.2.1 Special features of infrastructure investment

Infrastructure investment is widely regarded as promoting economic growth, yet there is no prominent macroeconomic growth theory that fundamentally deals with the economic effects of infrastructure (Carlsson et al., 2013). There are at least four important economic impacts of infrastructure provision that have been identified as crucial to modern economic growth: connectivity, information exchange, agglomeration, and energy efficiency (McKibbin and Henckel., 2010). Although cost-benefit analysis

which is considered as the only viable approach to ‘determine which projects should be implemented’ (Munnell, 1992) is employed currently for assessment of the benefits of infrastructure investment (Lakshmanan, 2011), this case-by-case appraising approach cannot achieve a comprehensive understanding of the economic effects of large-scale infrastructure systems. The conventional methods for appraising long-term investment in infrastructure miss some of the hard-to-quantify benefits that the projects can bring (Rosewell, 2013). In fact, cost-benefit analysis exemplifies the inability of current mainstream economy to account for agglomeration effects, re-emphasizing the need for mainstream economy to take ‘space’ into account (Carlsson et al., 2013).

In addition, unlike conventional economic activity, infrastructure investment is special for its underlying market failures and necessary state intervention¹². What distinguishes infrastructure investment from other economic activities is the wide gulf between average and marginal cost: infrastructure project typically has high fixed cost to sink at the outset, and then comparatively low marginal cost once the project is in operation, and the asset tend to be long lived. These interacted characteristics make this sort of investment risky, as sunk cost¹³ represents a *nonrecoverable* commitment to production in an industry and are ‘irrevocably committed to a particular use, and therefore are not recoverable in the case of exit’ (Clark and Wrigley, 1995; 1997a; 1997b). The investor needs to recoup sunk cost over the lifetime of the project, but once the project is in operation the efficient price is theoretically equal to marginal cost rather than average cost. The investor is therefore exposed to the time-inconsistency problem: being promised that the full costs will be recovered *ex ante*, but being squeezed back down to marginal costs *ex post*. Furthermore, when the long life of the assets is considered, technical progress also comes into play since new technologies may put the assets at risk of stranding (Helm, 2009). In such circumstances, long-term reliable contract is needed as commitment device to provide investors with comfort that their past investments would not be expropriated by opportunism.

6.2.2 From bilateral contract to relational contract for infrastructure investment

Contract theory, grounded in economics and law, focus on binding parties with various interests during the process of economic transactions when there is asymmetric information and uncertain

¹² More details see (Helm, 2009, 2013).

¹³ Sunk cost is a term in economics indicating past cost that has already been incurred and cannot be recovered.

conditions (Stone, 2003). Explaining the significance of contract, Bolton and Dewatripont (2005) suggest that risk and uncertainty can complicate the realisation of planned transactions between well-intentioned individuals. Oliver Williamson (1979) proposes a three-way classification of contracts where each type of contract fits for the particular nature of an economic transaction. The first type is classical contract which corresponds exactly with the “ideal” market transaction in economics. The identity of the parties to a transaction is treated as irrelevant and the nature of the agreement is carefully delimited in classical contract. Since long-term contracts executed under conditions of uncertainty cannot fit comfortably into the classical-contracting scheme, neoclassical contract has been proposed as the second type of contract by Williamson (1979) to resolve disputes in the form of arbitration through third-party assistance. This hybrid type of contract is based on the realisation that some contracts may never be reached unless the settlement machinery provides confidence to both parties. With the progressive increase of the “duration and complexity” of contract, neoclassical adjustment processes are not enough to mitigate the friction of transactions in the complex and uncertain world. In this context, the third type of contract – relational contract has been proposed to take societal and political influences on the transactions into account given the fact that “all contracts occur in the context of a social matrix” (Macneil, 1978). Since the experiences of long-term projects across sectors make clear that all parties for this kind of contracts must prepare for the possibility of renegotiation and failure (Likosky, 2010), attention should be shifted from bilateral contracts towards relational contracts for infrastructure investment.

There are at least three advantages for infrastructure contracts to be structured as relational contracts. Firstly, this type of contracts may extend into time without a specified or required date of termination. Contrasted with bilateral (discrete) contracts which provide a start date and a termination date as well as an explicit accounting of the costs and benefits to be shared between the contracting parties, relational contracts are more complex and multifaceted (Clark and Monk, 2014). Without a specific termination date, there are flexibility remaining with the contract for periodic reviews and renegotiation of the costs and benefits of the project. Secondly, the terms and conditions of relational contract may be subject to revision and renegotiation over time as circumstances change and as parties seek to rebalance separate and mutual benefits within the contract. As such, infrastructure contract can be viewed as a nexus of interests possessed by various participants entering and exiting an infrastructure project for a fixed purpose throughout the life cycle, rather than as a neatly ordered system whereby the contract form itself

determines how all of the actors fit together and relate to one another (Likosky, 2010). Thirdly, relational contract may be a means of economising on the search costs associated with finding other parties who may or may not provide complementary services. Instead of discouraging opportunistic behaviour in the relationship, formal contracts may signal distrust between contractual partners (Ghoshal and Moran, 1996; Macauley, 1963). It is trust ultimately that sustains long-term investment relationships, and contracts only function as the means to create and reinforce trust between contracting parties. In this perspective, contract may best be considered as providing a framework of agreement that can be used as a reference point in all subsequent discussions – both for positive developments and when things go wrong (Stern, 2003). Relational contract can help meeting desired objectives against the costs of breaking with the contract and the search costs associated with finding other contractual partners.

Given the necessity of monitoring and review processes that allow the modification of long-term relational contracts in an ordered and accountable way, regulation for infrastructure industries comes in to provide elements that cannot readily be provided by bilateral contracts (Stern, 2012). It is frequently suggested that competitive bidding for long-term contracts can effectively substitute for regulation by a specialist regulatory agency for utility service industries such as electricity distribution (Littlechild, 2002). Yet Jon Stern (2003) conjectures that regulation and contracts are complements for network industries rather than substitutes so that a regulatory agency allows for better and simpler contracts. He draws the key distinction between regulation by contract and regulation by agency. Regulation by contract is defined as franchise or other long-term contracts, whether between private companies or a private company and a state owned entity, where there is no regulatory or equivalent agency providing external review and revision of terms; while regulation by agency is defined as the regulatory framework where infrastructure industry providers are regulated by an external agency such as an explicit regulatory agency in the UK and US, or a concession contract revision agency in many developing countries. Nonetheless, although regulation can provide a beneficial supplement to an incomplete contract, not all regulatory agencies can meet this goal since it requires transparent and accountable regulation with bounded discretion (Stern, 2003). As such, how the government designing the institutional environment and the contract for infrastructure investment is the key.

6.2.3 The role of government in contract design for infrastructure investment

As mentioned above, the conventional economic approaches such as cost-benefit analysis appear to be inappropriate when it comes to deciding whether and how much infrastructure to provide. Since investment in an infrastructure project has wider economic impact than the project itself such as altering locational decisions for households and companies, improving living standards and residential environments as well as facilitating trade and business by improving transport conditions, decision-making for infrastructure investment should be conducted in a wider context: what sort of infrastructure as a whole is required to underpin the future economy? Answering this question requires an integrated “systems-of-system” strategy to deal with the long-term socio-economic, climate-related and technological challenges as well as the growing interconnectivity between these individual infrastructure systems (Hickford et al., 2015). As it is ultimately the government’s duty to provide infrastructure services to its citizens, only the government can answer this question and bear the risk of the system-wide decisions for sunk cost of infrastructure investment. The question is not whether the government should intervene in infrastructure investment, but how to intervene effectively through appropriate contract design (Helm, 2013).

In this aspect, governments around the world structure different contracts for infrastructure investment based on their conceptions on infrastructure, institutional environments for the design and implementation of infrastructure contract, financial structures for the choice of financing models and other influencing factors. Whereas much of the discussion about contract in law and economics eschews contextual variables, economic geographers emphasise the interaction between theoretical principles and context by suggesting that observed outcomes are best understood at the intersection between theory and practice (Bathelt and Glückler, 2011). As such, this chapter employs empirical study of contracts for greenfield project¹⁴ in Beijing and brownfield project¹⁵ in London through the ‘lens’ of geography (Bathelt

¹⁴ Greenfield projects refer to assets that are generally constructed for the first time at a specific site. They may be in the planning, development, financing or construction stage. Due to lack of maturity of the project and the available project-specific experience, there is a considerably high degree of uncertainty and risk on the cost and revenue side for greenfield projects. Investors in greenfield projects do not generally turn a profit on their investments in the first years of the development and construction phase, but instead are merely required to make payments (Weber and Alfen, 2010).

¹⁵ Brownfield projects refer to assets that are already operational and/or have a predecessor of some description at the same location. These projects may involve the reconstruction, renovation or expansion of existing assets. Since brownfield projects have already gone through the greenfield/development phase, cost and revenue are comparatively easy to evaluate on the basis of historical data and past experience. Investors can expect stable, predictable current cash flows from the very start in the form of dividends or interest payments in a similar way to real estate or fixed-income products. Yet this does not mean every brownfield projects necessarily have low risk and bond-like returns (Weber and Alfen, 2010).

and Glückler, 2013). Based on close dialogue (Clark, 1998) with key individuals and document review, this chapter investigates the phenomena ‘geography of contract’ through comparing how the two cities design infrastructure contracts for large-scale water infrastructure projects.

Before proceeding, it is important to comment briefly on the exposition of the contributions and limits of this chapter. This chapter makes an original contribution to the emerging theme of ‘geography of contract’ which emphasises the understanding of infrastructure contract in different institutional and geographical contexts. However, one major methodological challenge is related to studying the emergence, production, and change of contracts empirically (Bathelt and Glückler, 2013). Contracts cannot be measured by obvious or easily identifiable indicators, but need to be analytically extracted from social practice. This is because they are not identical with rules and regulations but develop from repeated action that is related to them – they are the consequences related to such rules, not the rules themselves. Accordingly, the study of contracts can be conducted through in-depth interviews or observation techniques, as well as other methods that are able to record process information (Barley and Tolbert, 1997). Due to the case-study-based nature of the evidence presented in this chapter, the empirical results are not exhaustively conclusive. More empirical studies are needed in future to promote better understanding of contracts for infrastructure investment in different geographical contexts.

6.3 Empirical study - comparison of contracts in Beijing and London for urban water infrastructure investment

6.3.1 Government-led contract in the South-to-North Water Diversion Project in Beijing

China is facing a serious threat to water security, which is characterised by diverse regional climatic regimes, insufficient and unevenly distributed water resources, frequent floods and droughts, serious water contamination, and relatively poor water governance (Xia et al., 2014). In particular, the cities in the North China have been experiencing moderate to severe water shortages, affecting municipal, industrial, and agricultural needs. The rapid urbanization and economic development in China have led to the fast growth of urban water demands. The total national water shortage in China in 2030 is forecasted to be nearly 200 billion m³, with domestic needs accounting for more than 25% (Avrin et al., 2015). Water-use efficiency, recycling and conservation programs have been implemented to save water, but the water shortage issue

still exists as a barrier for the development of China, especially for those water-intensive industries in North China such as coal, steel, cement and chemical industry (Wu et al., 2014). In this context, cross-region water diversion projects have been undertaken to address lack of water. In particular, the South-to-North Water Diversion Project (SNWDP), presented in Fig. 6.1, aims at diverting about 44.8 billion m³ water annually from the country's longest river - Yangtze River in South China - to relieve domestic, industrial and agricultural water demands in more arid and industrialized areas in North China via the eastern, central and western three routes. By the end of 2014, the amount of ¥254.1 billion (around £25.4 billion) has been invested into the first-phase projects in the eastern and central route, of which most comes from the national fund for critical hydraulic engineering project development (NSBD, 2015).

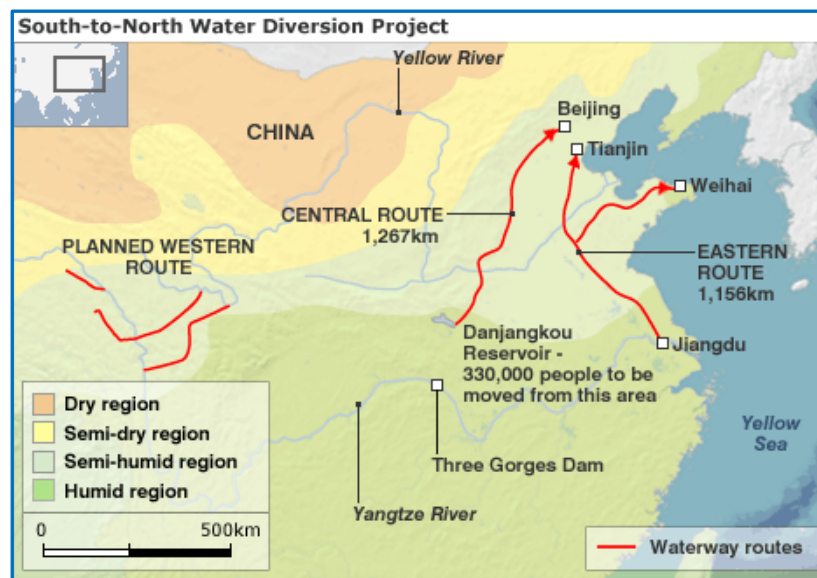


Figure 6.1 The South-to-North Water Diversion Project in China

Source: (BBC News, 2010)

The central route of the SNWDP is about 1267 km long and is designed to transfer water from the Danjiangkou reservoir in Hubei province in South China to cities along the central route in North China including Beijing. While the task of building the main canal systems for the central route of the SNWDP is financed by the central government, cities along the central route are responsible for building and financing the supporting projects for storage and allocation of the transferred water in respective urban areas. Figure 6.2 shows the overall planning of Beijing supporting projects for the SNWDP, which includes building 300 km water mains, building storage tank(s) with capacity of 40 million m³, and expanding total

water supply capacity of 11 water plants to 4 million m³/d (Bi, 2013). There are three phases in construction of these projects. The first two phases have been completed, and the third phase is proposed to complete by 2020 (Beijing NSBD, 2009). Such large-scale infrastructure projects generally involves many stakeholders in terms of project planning, environmental appraisal, land acquisition, compensation and resettlement for migrants, project construction etc., therefore effective contracts may depend on efficient coordination within government (Likosky, 2010). In this context, the Beijing government set up the Beijing South-to-North Water Diversion Project Construction Committee Office in charging of planning and management of project construction, and the Beijing South-to-North Water Diversion Project Investment Centre which is renamed as Beijing Water Investment Centre (BWIC) in 2013 to raise fund for the supporting projects. The BWIC is the Local Government Financing Platform (LGFP) – a Special Purpose Vehicle created by the Beijing government for financing urban water infrastructure projects (Yang, 2014). Figuring out how the BWIC raising fund for this large-scale urban water infrastructure project is the key to understand China's government-led contract for financing its remarkable urban infrastructure development in the past three decades.

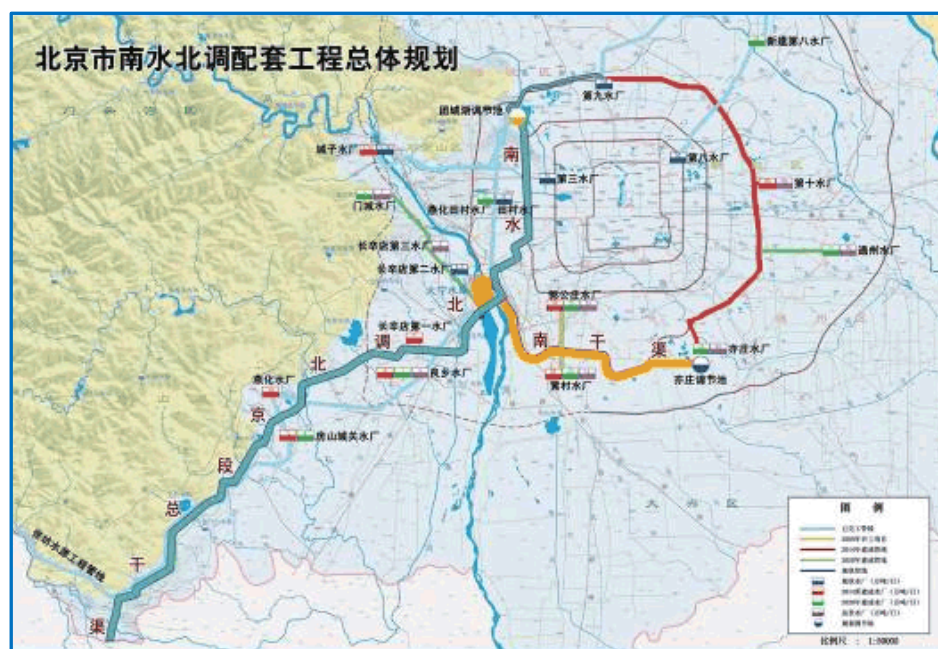


Figure 6.2 The overall planning of Beijing supporting projects for the South-to-North Water Diversion Project

Source: (Beijing NSBD, 2009)

The structure of the asset management industry in China is shown as Figure 6.3. Although China's

asset management industry has grown rapidly from ¥0.5 trillion to ¥4 trillion in 2013, the industry is still well below its long term potential. As shown in Figure 6.3, by the end of 2013 only 3% of China's ¥145 trillion of total financial asset is held in fund management companies (FMC), while 71% of that is deposited in banks (Oliver Wyman, 2014). The financial structure that the bulk of China's financial assets being held in bank deposits gives rise to barriers for urban infrastructure investment in China. On the one hand, the short maturity of bank deposits does not match with the long time horizon of urban infrastructure investment. One single bank cannot bear the risk due to the high sunk cost of urban infrastructure investment and the long lead-time for recouping the sunk cost. On the other hand, the activity of urban infrastructure investment had once been considered as risky for most banks in China – even stated-owned banks, because few banks had sufficient expertise and capacity for risk assessment of urban infrastructure projects given the information asymmetry and complex local contexts for hundreds of cities in China. Before 1994, local governments got used to receiving grants from the central government for local development. The 1994 tax-sharing reform in China devolved the autonomy from the central government to local governments for local development (Herschler, 1995; Toh and Lin, 2005; Tsui, 2005). At the same time, the small proportion of tax bases being left for local governments means that they have to seek other sources for financing their urban development. The process of urbanization in China slowed down during the transition period when China was seeking answers for how to finance its urban infrastructure development.

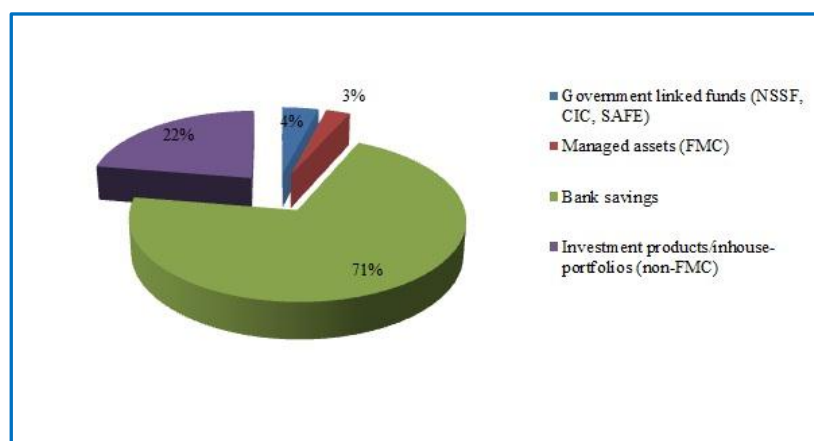


Figure 6.3 The structure of the asset management industry in China

Source: the author; (Oliver Wyman, 2014)

In this context, China set up its national infrastructure development bank – China Development Bank

(CDB) in 1994 to facilitate infrastructure investment. The CDB now has 38 local branches in China and three foreign representative offices in Cairo, Moscow and Rio de Janeiro. At first, the CDB only issued bonds based on the projects designed by the central government. These bonds which have strong political characteristics were not welcomed by market (even state-owned banks) and were allocated compulsorily to the state-owned banks based on the fixed quota to each bank. Due to the historical legacy of receiving grants from the central government, local governments generally considered the CDB bonds as the central government's grants which are not necessarily repaid. The non-performing loan ratio in the CDB had reached up to 33% by 1997. In 1998 the CDB determined to conduct marketization reform including seeking project opportunities autonomously through close cooperation with local governments, bond issuance through market, and monitoring the project progress and loan repayment. By the end of 1999, the non-performing loan ratio dropped dramatically from 33% to 16%. By the end of 2011, the non-performing loan ratio of the CDB was less than 1%, and the asset under management (AuM) of the CDB reached to one trillion dollars which is threefold of World Bank's AuM, making the CDB as one of the largest development banks in the world (Chen, 2012).

More importantly, the CDB solved the problem of how to finance urban infrastructure development through combination of government and market. By employing the development financing model, the CDB co-designed the LGFP model with local governments for financing China's urban infrastructure development. This combination of financial resources in the market and political expertise in the local government for urban infrastructure investment can be considered as government-led contract. The schematic of government-led contract is shown in Figure 6.4. In the first phase, the CDB local branch actively participates into the regional planning with the local government. Under the national industry policy and regional planning, the local government proposes projects to the CDB local branch through integration of local resources as guarantee. Then in the second phase, the CDB local branch assesses the financial viability of the projects based on local economic development level and local credit record. In addition, the CDB local branch coordinates with the local government for credit enhancement through improvement of governance structure of the LGFP – the Special Purpose Vehicle created by local government for funding raise for urban development. In addition, the CDB local branch does not choose projects only based on the economic criteria. For those projects which cannot generate short-term economic benefit but are important for local development in the long run, the CDB local branch will 'hatch'

the projects through the close cooperation with the local government. One option is to arrange other finance sources by the local government for repayment. The other option is to bundle those projects with other profitable projects. In the third phase, given the different nature of the projects (economic benefit or environmental/social benefit), the CDB local branch helps the local government to design different repayment mechanisms, issue CDB bonds for project construction and monitors the progress of the projects. When the projects can generate stable cash flow and the market becomes mature for other investors to come into play, the CDB local branch will exit from the development financing model for financing current projects and seeking next project opportunities. In addition, the CDB local branch cooperates with local government for revision and renegotiation of government-led contract.

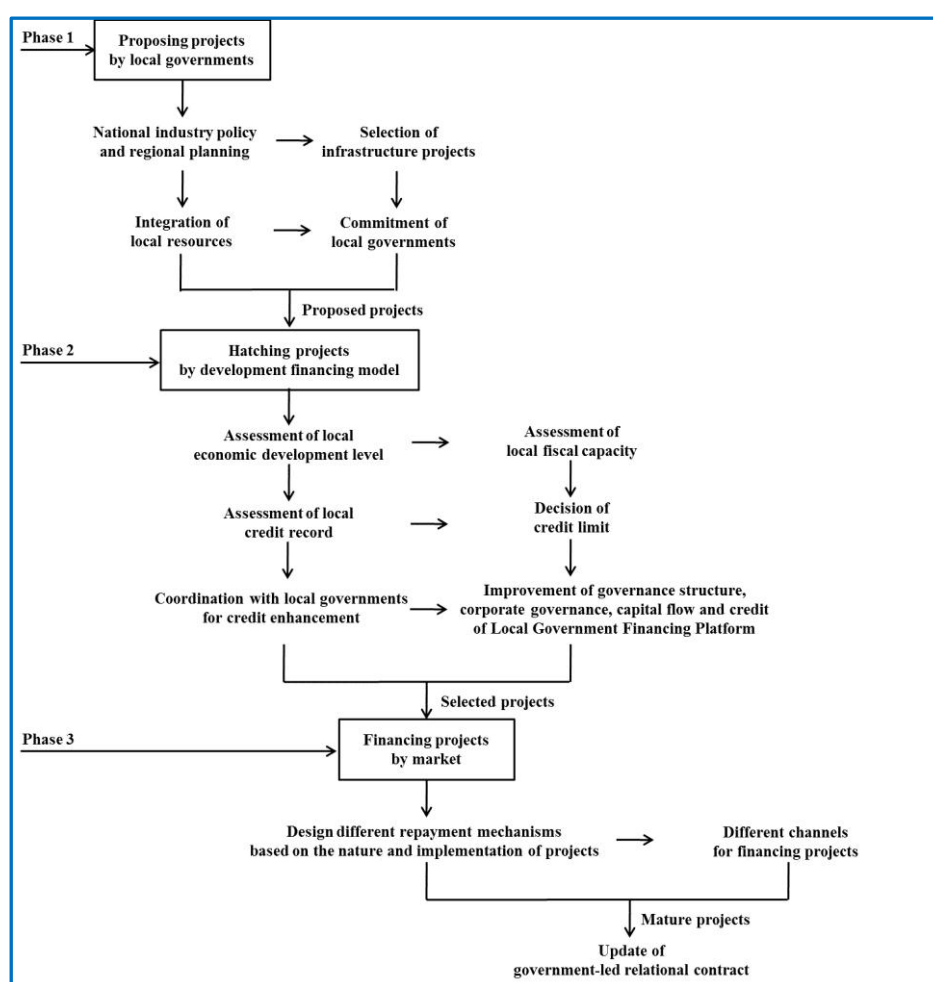


Figure 6.4 The schematic of government-led contract

Source: the author

In terms of financing the Beijing supporting project for the SNWDP, the CDB Beijing branch takes

the lead through the CDB bond issuance and consortium loan. As shown in Figure 6.5, the total capital demand is approximately ¥40 billion (around £4 billion). The Beijing government invests 40% of capital demand (around £1.6 billion) as the capital base of the BWIC, while the remaining 60% of capital demand (around £2.4 billion) is left for the BWIC to solve through market (Bi, 2013). In order for the successful launch of the project development in the construction stage, the CDB Beijing branch together with Bank of China, Agricultural Bank of China, and China Citic Bank formed a consortium to lend ¥5.5 billion to the BWIC. By using the development financing model, the CDB matches the short-term bank deposits with the long-term capital demand for the Beijing supporting project for the SNWDP. In particular, the CDB takes lead in financing the projects when they are in the construction stage, giving financial market a positive signal and maturing the market for other investors. The BWIC can then use future right of charge as mortgage for project finance. For example, with the on-going construction of the water infrastructure assets, the BWIC got another ¥1.8 billion from the Kunlun financial leasing company owned by China Petroleum Corporation through leasing the use right of the assets for 18 years. Furthermore, the BWIC issued corporate bonds which were mainly purchased by domestic insurance companies and National Social Security Fund. The whole projects will be completed by 2020. In the operation phase, the BWIC will use the water fees from the transferred water for repayment. The repayment period is 20 years, and the benefit from transferred water is estimated to be ¥2-3 billion per year. As can be seen, the government-led contract fully makes use of the organizational advantage of local governments in China in coordination and integration of local resources for creation of LGFP model. Local government's LGFP model coupled with the CDB's development financing model function as the government-led contract for contributing to China's rapid urbanization. However, without robust regulation and governance, the LGFP model can also lead to risky off-balance sheet financing activities (Yang, 2014). The advantages and disadvantages of this type of government-led contract will be discussed in Section 6.4.

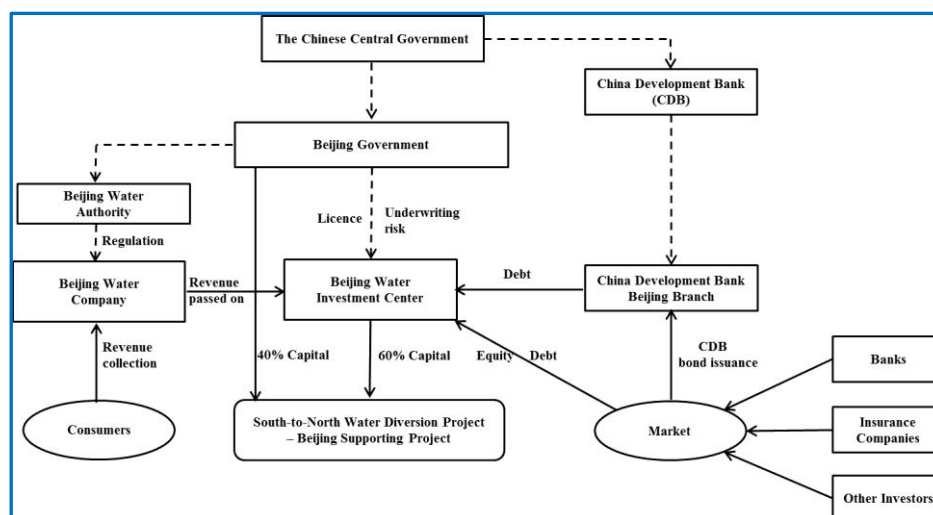


Figure 6.5 The capital flow of the Beijing supporting projects for the South-to-North Water Diversion Project

Source: the author

6.3.2 Regulatory-led contract in the Thames Tideway Tunnel Project in London

Much of London is served by a combined sewerage system which collects both sewage and rainwater within the same pipes. The combined sewers, still in operation today, were designed by Sir Joseph Bazalgette in the mid-1800s. In order to avoid the flooding of streets and properties with raw sewage during intense rainfall events, a series of overflow outlets from the combined sewers were designed and positioned along the River Thames to allow excess sewage and rainwater to spill into the tidal River Thames and its tidal tributaries (together referred to as the Thames Tideway) without treatment. There are now some 57 such outlets in London, known as Combined Sewer Overflows (CSOs). Due to population growth, increased extreme rainfall events, and increased impermeable surface areas in London caused by modern building activity, the CSO discharges have become more frequent and greater in volume over the past few decades. In England and Wales, the Environment Agency (EA) is in charge of supervising CSOs under the terms of the European Urban Wastewater Treatment Directive, the principal legislative instrument regulating wastewater discharges in freshwater bodies in Europe. According to the EA (Environment Agency, 2011), 36 of London's 57 CSOs are classified as having an unsatisfactory environmental impact and as little as 2 mm rainfall can trigger an overflow nowadays. A total of 39 million m³ of raw wastewater is discharged into the Thames Tideway every year because of sewer overflows. On

average each CSO discharges about once a week. These untreated discharges can cause adverse environmental impacts to local aquatic ecosystem and increase risk to human health. In October 2012, the Court of Justice of the European Union ended a 12-year case by ruling that the UK had breached the Urban Waste Water Treatment Directive (91/271/EEC), partly as a result of London's frequent raw sewage discharges into the Thames Tideway. The European Commission is set to levy a fine on the UK Government unless a plan is under way to resolve the situation (Bloomberg New Energy Finance, 2013).

In this context, the UK has a duty in law to limit pollution from CSOs. In fact, as early as 2001, Thames Water (the sewerage undertaker for almost the whole of London) together with the Department for Environment, Food and Rural Affairs (Defra), the EA and the Greater London Authority (GLA) began the Thames Tideway Strategic Study (TTSS) to assess the environmental impacts caused by CSOs and propose solutions for improvement. The Water Services Regulation Authority (Ofwat) took part to this effort as an observer. According to the TTSS (Thames Water, 2005), the preferred option was a 7.2m diameter storage and transfer tunnel with a capacity of 1.5 million m³, known as Thames Tideway Tunnel (TTT). Despite of controversies about the rationality of this large-scale tunnel project approach, the UK government confirmed its commitment to a tunnel option in September 2010 but announced that the development consent for the project should be dealt with under the Planning Act 2008, the regime for nationally significant infrastructure projects in the UK (Bloomberg New Energy Finance, 2013). With the government's go-ahead, Thames Water started developing more detailed options and conducting consultations with relevant stakeholders. In September 2014, development consent was granted by the UK government for the TTT project to be built and operated (GOV.UK, 2014). Construction is expected to start in 2016 and be completed by 2023. The 25km long tunnel will run from the Action Storm Tanks in West London to the Abbey Mills pumping station in East London, with a storage capacity of 1.25 million m³ and an internal diameter of 6.5m in the west London increasing to 7.2m through central and east London (shown in Figure 6.6).

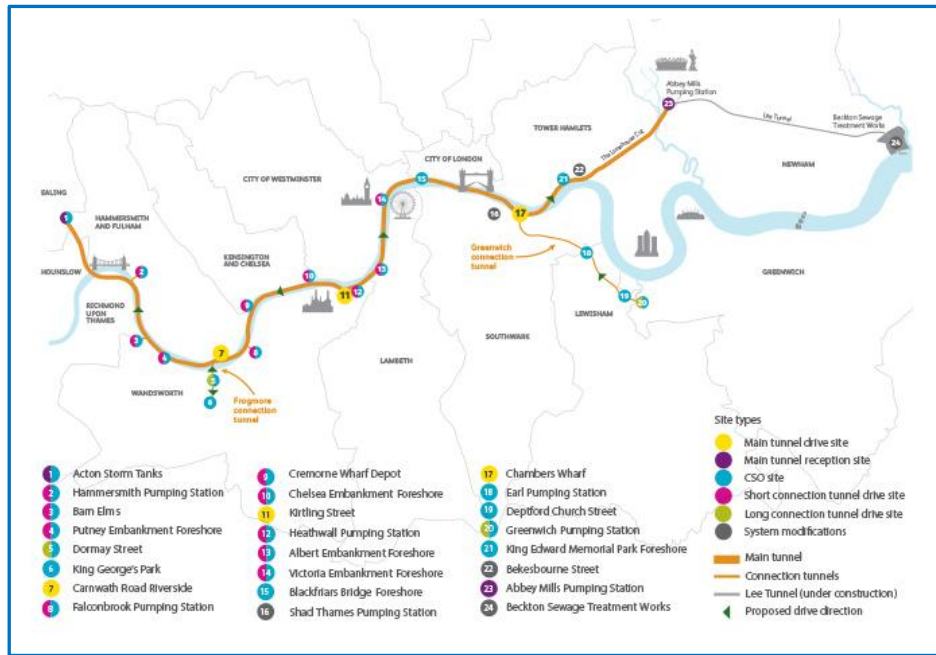


Figure 6.6 The route of the Thames Tideway Tunnel Project in London

Source: (Thames Tideway Tunnel Ltd, 2014b)

The latest cost estimate for the TTT project stands at £4.2 billion (2011 prices), which is much more than typical UK water infrastructure projects (Thames Tideway Tunnel Ltd, 2014b). Since Thames Water’s gearing has significantly increased to 77.4% of the company’s regulatory capital value by March 2013, it would jeopardise Thames Water’s credit rating if the water company finances the tunnel on the strength of its balance sheet alone. As a consequence, Thames Water discussed with Ofwat and Defra to determine alternative financing models for the tunnel – an independent and separately licensed Infrastructure Provider - Thames Tideway Tunnel Limited (TTT Ltd) that is privately financed and funded by customers. The TTT Ltd will have its own licence with revenues determined by the regulator Ofwat, and will collect bill payments for the tunnel via Thames Water. This is a new privately financed infrastructure model. As the chairman of the TTT Ltd Sir Neville Simms puts it “Using a separate vehicle to deliver a project isn’t new. But what is new is that we are creating a separate regulated infrastructure provider alongside the regulated Thames Water business with separate investors.” Whether this regulatory-based contract can become the model for future private infrastructure investment remains to be seen. Nonetheless, this regulatory-based contract for financing infrastructure assets derives from the regulatory asset based (RAB) model employed in the UK for regulating its privatised utility assets.

In the early 1990s, Ofwat created the first RAB model for the purpose of setting its five-year price limits. Over years the RAB model has been spread to other privatised network utilities and has become the major commitment device for protecting investors against retrospective ‘asset-taking’ and prospective asset-stranding. The key concept behind the RAB model is financial capital maintenance (FCM) which addresses the issue of whether the financial capability of the company is being maintained intact (Stern, 2014). At the price-setting periodic reviews, the regulator (e.g. Ofwat) determines whether the capital expenditure in the previous period has been efficiently conducted, and then transfers the efficient number into an asset base – RAB. This RAB is the aggregate of the efficient capital expenditure in the previous period plus an initial value for the purchase of the existing assets (Helm, 2009). Based on this asset base RAB, the regulator sets the price cap in the next period for furthering the consumer objectives and ensuring that regulated network utilities are able to finance the proper carrying out of their regulated businesses by maintaining their FCMs intact. The RAB integrity for protection of private investors has attracted many institutional investors for infrastructure industries in the UK, as public and private pensions are now important sources of individual retirement income in many Anglo-American countries. Since the baby-boom generation has moved through the workforce, as more workers have become entitled to participate in pension and insurance schemes, and as benefit levels have increased in proportion to paid wages, pension and insurance funds have grown astronomically in terms of their total funds and in terms of their significance with respect to other sources of savings and investments (Clark, 1997). This can be shown from the structure of the asset management industry in Britain (Figure 6.7), with the proportion of pension and insurance funds accounting for around 56% of total financial assets. The RAB model in the UK provides comfort to these institutional investors in privatised network utilities that their investment would not be treated unfairly.

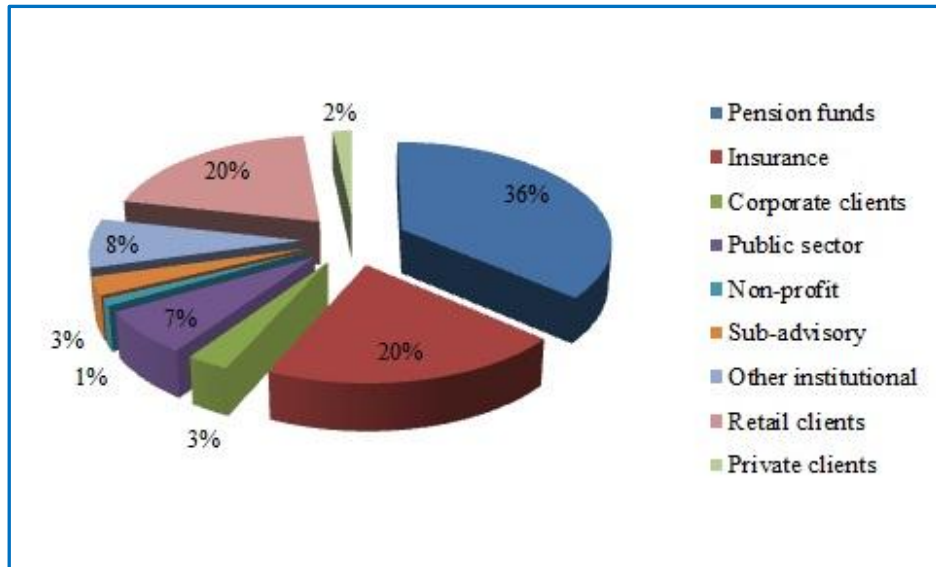


Figure 6.7 The structure of the asset management industry in Britain

Source: the author; (Investment Managment Association, 2014)

However, the importance of the RAB model as a commitment device is not only in its existence. It arises primarily out of the regulatory context in which they are set, updated and revised. As the process of regulatory involves dealing with complex relationships among stakeholders who underpin the provision of urban infrastructure services, the RAB model and its associated regulatory context can be considered as regulatory-led contract. The success of this type of regulatory-led contract mainly depends on the quality of its implementation plus the predictability and integrity of the process by which it is revised or redefined (Stern, 2014). The schematic of regulatory-led contract is shown in Figure 6.8. With regard to water industry, the UK government needs to obey the EU environment directives and transfer the directives into its national water policies. In the first phase, the regulators determine the measurable objectives based on the EU environment directives and national water policies, and demand water companies to take measures to meet these requirements. The water companies choose a project plan from various options based on cost and benefit analysis, and propose the project plan to the regulator Ofwat. In the second phase, Ofwat assesses whether the proposed project plan meets the requirements of environmental regulations. Then by conducting periodic review for price and performance, Ofwat determines the efficiency factor of the water company in the previous period and transfers efficient capital expenditure into the RAB model. Based on the new RAB account number and the proposed capital expenditure in the next period, Ofwat negotiates with the water company and then set the price cap for the next period to ensure the water company is able

to carry out its function as well as protect customers' benefits. After the new RAB model and the new price cap have been set, the regulated project can access to market for fund raising in the third phase. Special repayment mechanism and government guarantee for contingent risk are designed for critical infrastructure projects to keep down the cost of capital and to attract private sector, especially institutional investors. The regulator Ofwat cooperates closely with the water company and updates the regulatory-led contract every five-year period.

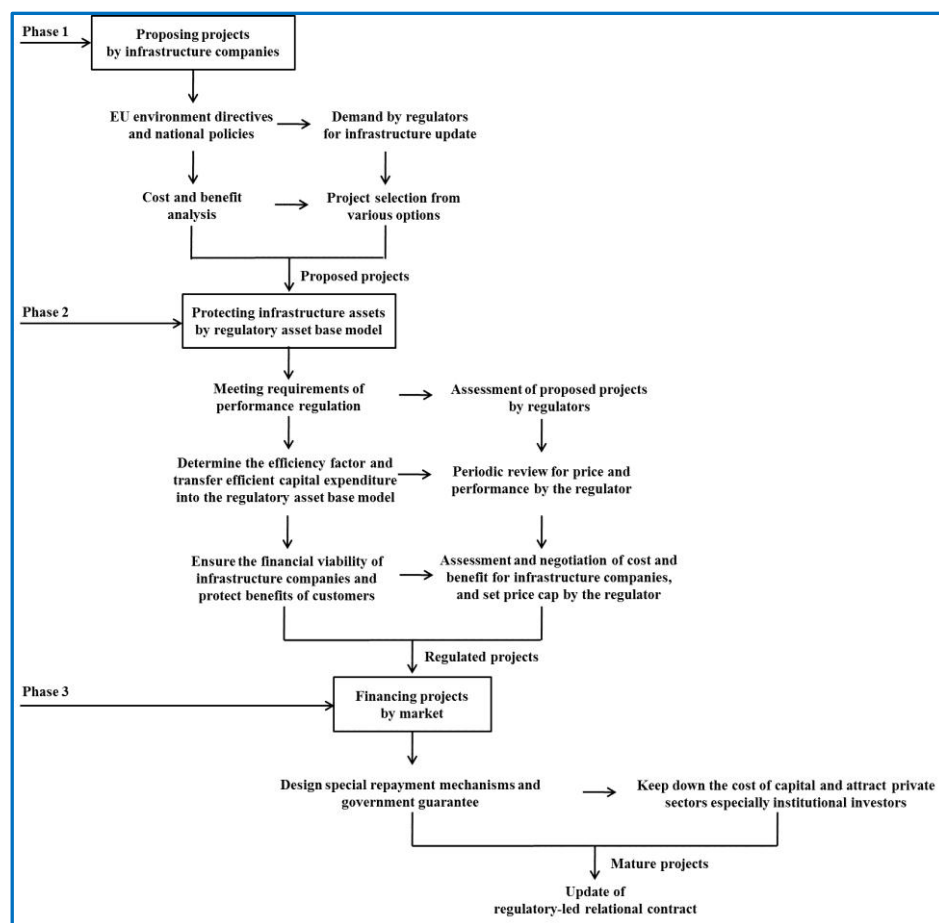


Figure 6.8 The schematic of regulatory-led contract

Source: the author

In regard to financing the £4.2 billion TTT project, around £1.4 billion of the construction cost will be financed by Thames Water and £2.8 billion by the new company TTT Ltd (shown in Figure 6.9). The project's cost will be spread across Thames Water's 15 million sewerage customers, including those outside London. Thames Water's draft business plan for 2015-2020 shows average household bills rising

by £40 per year, before inflation, over the period to pay for the tunnel. The cost of the project could add a maximum of £70 - £80, before inflation, to average bills by the early 2020s compared to 2011 (Thames Tideway Tunnel Ltd, 2014a). Thames Water will enter a contract with TTT Ltd under which it will collect revenues and pass them on. The financing structure for the new company TTT Ltd will be determined by the winning bidder but could include sterling bond issuance, bank lending and loans potentially from the European Investment Bank. The equity risk profile of TTT Ltd will be similar to a business-as-usual regulated water/wastewater company in England and Wales, although there may be a premium required by the market due to the new company being the first of a kind. Nonetheless, the shortlist of interested consortia had been reported to shrink to just two by the end of last year – in spite of the government offering guarantees to keep financing costs down (Infrastructure Investor, 2015). The bid winners are expected to be announced in May 2015, and the effect of regulatory-led contract in financing this new large-scale infrastructure projects remains to be seen.

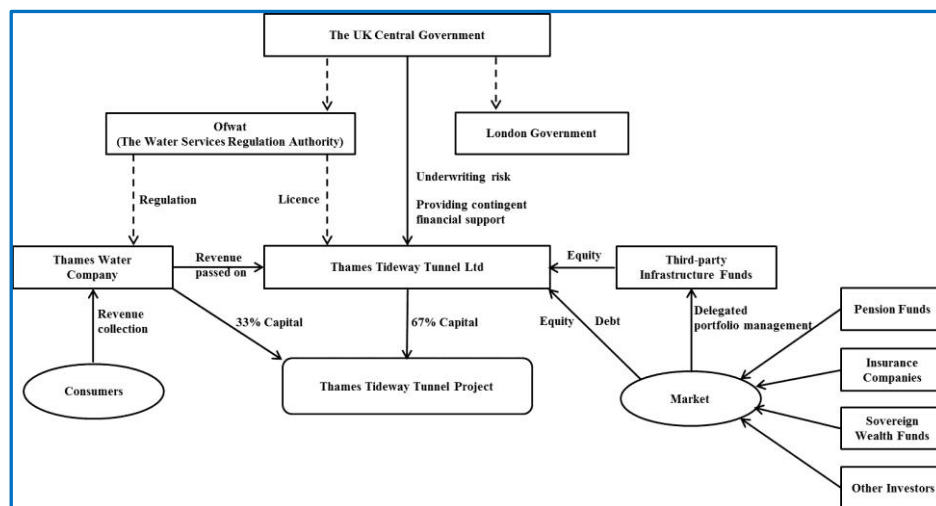


Figure 6.9 The structure of the Thames Tideway Tunnel Project in London

Source: the author

6.4 Comparison and Discussion

Table 6.1 Comparison of large-scale urban water infrastructure projects in Beijing and London

City	Project	Purpose	The inventory of projects	Total investment amount	Financing source	Recouping source
Beijing	South-to-North Water Diversion Project - Beijing Supporting Project	To relieve the pressure of water supply in Beijing	1) Construction of 300 km water mains; 2) Construction of storage tank(s) with capacity of 40 million m ³ ; 3) Expansion of total water supply capacity of 11 water plants to 4 million m ³ /d	¥40 billion (~£4 billion)	1) Beijing Government - ¥16 billion (~£1.6 bn) - 40%; 2) Beijing Water Investment Center (SPV) - ¥24 billion (~£2.4 bn) - 60%*	water fees from sale of transferred water
London	Thames Tideway Tunnel Project	To relieve the pressure of sewerage overflow in London	1) Construction of a main tunnel of 25 km long with a diameter of 7m; 2) Construction of two additional connection tunnels for reaching five remote intercepted CSOs; 3) Construction of a number of shorter tunnels for connecting CSOs to the main tunnel	£4.2 billion	1) Thames Water Company - £1.4 bn ~33%; 2) Thames Tideway Tunnel Ltd (SPV) - £2.8 bn ~67%;**	increase in their sewerage bills from Thames Water's commercial and residential customers

Source: the author

* In the construction phase, the Beijing Water Investment Center (BWIC) uses the future right for water charging as pledge for project finance; in the operation phase, the BWIC uses the water fees from the transferred water for repayment. The due of repayment is 20 years, the benefit from transferred water is estimated to be ¥2-3 billion per year

** The government is considering providing some form of contingent financial support during the construction phase to safeguard the project against exceptional risks

The comparison of large-scale urban water infrastructure projects in Beijing and London is shown in Table 6.1. Both cities have similar urgent demands for financing urban water infrastructure projects: the South-to-North Water Diversion Project - Beijing Supporting Project aims to relieve the pressure of water supply in Beijing while the Thames Tideway Tunnel Project intends to relieve the pressure of sewerage overflow in London. Although this style of large-scale project approach for dealing with urban water risk has aroused much controversies (Ansar and Pohlers, 2014; Berkoff, 2003), decision-making for infrastructure investment is often needed for management of trade-offs between benefits and costs (Johnson and Handmer, 2002). It is the government ultimately making decisions for trade-offs and bearing the risk of sunk cost for large-scale infrastructure projects both in Beijing and London. Since the market cannot commit future customers or taxpayers to pay for the sunk cost of infrastructure investment, contract is required by investors before sinking their capital, and only the government can be the ultimate guarantor of the contract (Helm, 2009). Therefore, government plays a crucial role in infrastructure investment. Nonetheless, how the role of government in infrastructure investment should be best structured has remained less clear. The diversity of structuring the relationship between government and market for infrastructure investment around the world makes up the ‘geography of contract’ for infrastructure investment. Through comparison of government-led contract in Beijing and regulatory-led contract in London, this chapter emphasizes that Infrastructure contract in a specific geographical context should be understood in the specific environment in which they are set, updated and revised for dealing with complex relationships among stakeholders who underpin the provision of urban infrastructure services.

Government-led contract in Beijing combines local government’s organizational ability and LGFP’s entrepreneurship for urban infrastructure investment. Firstly, since large-scale infrastructure projects generally involve many stakeholders in terms of project planning, environmental appraisal, land acquisition, compensation and resettlement for migrants, project construction etc., government-led contract takes advantage of local government’s organizational ability in consolidating local resources and coordinating different key government departments for the successful implementation of infrastructure investment. The Beijing government oversees the overall implementation of its water infrastructure project through creation of its own project construction committee office and specific LGFP – the BWIC. Secondly, government-led contract offers government guarantee for bearing the sunk cost of infrastructure investment while gives autonomy to the government’s LGFP for fund raising through market mechanism.

Local governments in China used to develop urban infrastructure based on how much money they got from the central government; now they prefer to raise funds for urban infrastructure proactively based on how much infrastructure they want to develop. This entrepreneurship of LGFP speeds up China's urbanization but at the same time has accumulated debt risk for local government where robust regulation system is absent. Thirdly, since infrastructure has a critical and often irreversible role in locking in patterns of development (Carlsson et al., 2013), government-led contracts can shape urban landscape and growth patterns by integrating the elements of a city and activating potential growth of a city. Although private capital for urban infrastructure investment has increased in China, local government still plays a strong role in guiding how the city should be developed for its future. On the one hand this government-led contract prevents the private sector involvement stripping the infrastructure sector of its counter-recessionary qualities (O'Neill, 2010); on the other hand it avoids danger in substituting private gain for public good as the major driver in investment decision-making in shaping cities (Hebb and Sharma, 2014).

Nonetheless, government-led contract has its flaws without robust regulation system in place. This government-dominated model may easily lead to 'strategic misrepresentation' (Flyvbjerg, 2006) in infrastructure investment owing to complex principal-agent relationships. A case in point is the irrational exuberance of LGFPs in China after the 2007 global financial crisis and their reckless off-balance sheet financing for local development of infrastructure and real estate have caused debt risks for some local governments (Yang, 2014). Yet this does not mean that government-led contract and its LGFP model should be totally abandoned. Instead, improvements such as transparent measures of accountability that reward right decisions and punish wrong decisions should be implemented to make use of local government's organization ability while at the same time to keep local government's investment activities within market discipline. For this purpose, China has already approved changes to the budget law allowing ten wealthier local governments to issue bond for urban infrastructure investment directly (Reuters, 2014). In addition, although the overall debt level of China's local governments remains manageable (British Embassy Beijing, 2014), longer-term sustainability requires further reform for infrastructure investment, especially involvement of the private sector and institutional investors for efficiency improvement and maturity matching. In this aspect, China is encouraging local governments to adopt Public-Private Partnerships (PPPs) for urban infrastructure investment (China News, 2015). However, a robust regulation

system should be set up to protect the interests of both private investors and consumers. In this regard, Beijing should learn from London's experience in how to set up regulation system for making infrastructure assets attractive for private sectors and institutional investors while at the same time protecting customers' benefits.

Regulatory-led contract in London guarantees the sunk cost of urban infrastructure investment through RAB model – the regulatory capital value (RCV) and the placing of regulators' duty to ensure that the functions of infrastructure services can be financed. Infrastructure assets are entrenched as ring-fenced assets that can generate long-term stable revenue streams. The risk for private investors that their investment may be expropriated by opportunism has been effectively mitigated by regulatory-led contract. By providing explicit guarantees to the RAB, regulators in effect transfer equity risk of sunk cost from private investors to customers (Helm, 2009), as customers are forced by regulators to pay for the sunk cost of infrastructure investment. In the case study of TTT project in London, the regulator Ofwat will grant the winning bidder a licence which allows it to recoup the project's cost from Thames Water's 15 million sewerage customers including those outside London. It is no wonder institutional investors from all over the world have been fanatically interested in British existing infrastructure assets (brownfield infrastructure projects) protected by the RAB model. However, as there is no explicit mention of RABs in UK primary legislation or in regulatory licence, this regulatory-led contract relies crucially on regulators keeping to the spirit as well as the letter of RAB commitments (Stern, 2014). If UK regulators were seen by private investors as violating that spirit, then the RAB's credibility as a commitment device could quickly disappear – and would probably be virtually impossible to retrieve.

However, since urban infrastructure assets are ring-fenced by RAB commitment for private investors, regulatory-led contracts may cause 'splinter urbanism' (Graham and Marvin, 2001) if government ceases to exercise elements of control. The power of global finance is threatening the cohesiveness of a city and causing the city to splinter between those who have the private means to use the city's infrastructure and enjoy its resources, and those who do not (O'Neill, 2010). In the UK, privatisation and liberalization of infrastructure did improve efficiency – notably in operating costs, but a quarter of a century later, these fundamental changes to the UK infrastructure have not fulfilled their expectations, as Britain's infrastructure has not become the envy of other European countries who have followed more conventional paths (Helm, 2009). Without coherent overarching infrastructure policy, the result is an infrastructure

system which is not fit-for-purpose and may actually be detrimental to long-term development of the British economy (Helm, 2013). But this does not mean regulatory-led contract and RAB model should be put aside. Instead, the UK government should consider how to play a crucial role in structuring coherent overarching infrastructure policy for shaping the future landscape of the country and its cities. The UK government has already published its National Infrastructure Plan to outline the government's vision for the future of UK economic infrastructure. Although national policy statements provide a route forward, further reform is necessary for more definition and clarification of the role of the government in entrenching and formalizing the decisions for infrastructure investment.

6.5 Conclusions

This chapter explores the phenomena 'geography of contract' for infrastructure investment through comparison of government-led contract in Beijing and regulatory-led contract in London for financing large-scale water infrastructure projects. To the best knowledge of the author, it is the first study that compares China's infrastructure investment model where local political power plays an important role in guiding urban development with Britain's infrastructure investment model where the state is described as 'hollowed out' and subsumed to irresistible global finance power in shaping urban landscape. Whereas much of the discussion about contract in law and economics eschews contextual variables (Clark and Monk, 2014), this chapter investigates the specific contexts where the infrastructure contracts are designed, revised and implemented. Through empirical study of comparing contracts in Beijing and London for urban water infrastructure investment, the research contributes to variegated capitalism (Dixon, 2010) and geography of finance (Clark and Wójcik, 2007).

The research finds that it all comes down to perspective on infrastructure investment. Urban water infrastructure provision is considered as public welfare service provided by state-owned company in Beijing while it is considered as private commercial business provided by regulated company in London. As such, Beijing adopts government-led contract in financing the large-scale water infrastructure project and London employs regulatory-led contract to do so. Both types of contracts have advantages and disadvantages. While government-led contract in Beijing is good at coordinating local resources for successful project implementation and using the infrastructure sector of its counter-recessionary qualities to stimulate the economy, lack of robust regulation for infrastructure investment may lead to moral hazard

of local governments for irrational borrowing thus may incur risks to the whole national financial system. One option is to allow local governments to issue bonds for infrastructure investment under the supervision of the central government. Another option is to encourage local governments to adopt PPPs for infrastructure investment. Yet this requires setting up robust regulatory framework for private investors and customers, and London's experiences can be a good reference point. Regarding regulatory-led contracts in London, it is misleading to assume that private provision of infrastructure services in Britain 'hollows out' the state and ceases the government's control on infrastructure investment. Instead, the government exercises implicit and powerful control for infrastructure investment and service delivery through arm's length regulatory agency and regulatory framework. Further reforms are needed to clarify the role of the government and regulators in infrastructure planning for the long-term development of the economy.

This chapter has implications for study on infrastructure contract. Infrastructure investment is a special economic activity due to its high sunk cost at the outset and long lead-time for cost recovery. Contract is thus necessary for infrastructure investment since it functions as a bridge between government and market. In this sense, infrastructure contract is better described as relational contract which is a means of governing relationships among infrastructure stakeholders than bilateral contract being simply an instrument that opens and closes at certain dates and times based upon a priori defined costs and benefits (Clark and Monk, 2014). More importantly, infrastructure investment is unique because too often we rely on 'strategic misrepresentation' such as 'If you build it, they will come' to guide our infrastructure development which leads to many wasteful investment (Flyvbjerg, 2006); or miss bigger picture such as 'don't see the forest for the trees' to focus on efficiency and competition of individual infrastructure sector which ignores the fact that infrastructure has wider difficult-to-quantify impacts on the whole economy (Rosewell, 2013). In this sense, how to structure infrastructure contracts is really an art to make full use of the advantage of public sector (government) in guiding infrastructure investment for the long-term growth and that of private sector (market) in bringing efficiency and innovation into infrastructure investment. This chapter is only a start to investigate infrastructure contract through the comparative study of government-led contract in Beijing and regulatory-led contract in London, which limits generalising findings to larger scope. More case studies can be conducted in future contributing to 'geography of contract' through exploring how infrastructure contracts are structured in different geographical contexts.

CHAPTER SEVEN: CONCLUSION

7.1 Introduction

Infrastructure has become one of the priorities in the agenda of governments around the world after the GFC in 2007. Governments in OECD countries urge reinvesting in upgrading aging infrastructure to help economic recovery but face public fiscal constraint and credit crunch. With rapid population growth and continued urbanisation, it is no longer taken for granted that governments in emerging markets and developing economies have unlimited capacity to finance urban infrastructure provision for meeting growing demand. More private capital is required for urban infrastructure investment in both the Global North and South. In particular, long-term institutional investors such as pension funds, insurance companies and sovereign wealth funds have competitive advantages in markets for infrastructure assets due to their unparalleled scale and long-time horizons (Clark et al., 2011). Nonetheless, a variety of constraints are preventing these investors from taking up their dominant positions in the market for private infrastructure investment. Furthermore, although institutional investors currently have mainly invested in infrastructure assets in OECD countries, they are having a growing appetite for the riskier prospect of investing into the emerging markets. However, few studies have analysed in detail how the political, legal and governance framework as well as other informal relationships in emerging markets might influence urban infrastructure investment and the performance of service delivery, nor compared the extent to which these issues in emerging markets differ from those factors in developed countries.

This thesis fills in this gap by comparing urban water infrastructure investment and governance between Beijing and London from the perspective of economic geography. It provides a series of meaningful and thought-provoking comparisons on investment models, institutional governance, pricing system and relational contract in Beijing and London through different ‘geographical lens’ (Bathelt and Glückler, 2013). Theoretically, the thesis makes contribution to institutional turn (Amin, 1999; Bathelt and Glückler, 2013; Martin, 2000) and relational turn (Bathelt and Glückler, 2003; Boggs and Rantisi, 2003; Yeung, 2005) in economic geography through investigating uneven landscape of urban water infrastructure investment and governance in different institutional and cultural contexts. Furthermore, the thesis functions as a trigger for provoking more theoretical and empirical studies to contribute to the burgeoning field of ‘Geography of Infrastructure’ (O’Neill, 2010, 2013; O’Brien and Pike, 2015).

This chapter firstly summarises the principal findings of each of the four substantive chapters and their respective contributions to literature. Then the chapter highlights the broader implications from the thesis for understanding infrastructure investment and governance from the perspective of economic geography. The chapter also illustrates some practical implications for providing platforms for governments, multilateral development banks, regulators, investors, infrastructure companies and other stakeholders on cooperation and knowledge exchange for sustainable infrastructure investment and governance in future. Finally, the chapter suggests possible directions for future research.

7.2 Principal Findings and Contributions to Literature

Infrastructure is the source of almost continuous study and criticism (Helm, 2013). Nonetheless, comparative studies on infrastructure between Global North and South remain rudimentary (Lin et al., 2014; Wang et al., 2011). As such, the thesis has been structured as four substantive chapters in order to achieve a better understanding of spatial difference of urban infrastructure investment and governance in Global North and South. Recognising the importance of investment model, institutional governance, pricing system and contract in urban infrastructure investment and service delivery, the thesis has employed the empirical study and case study methodology to compare these key issues in urban water infrastructure of Beijing and London. In this way, the research has addressed the overarching objectives and research questions set out in the introduction chapter.

This section presents the principal findings and contributions to literature from the four core chapters of the thesis in accordance with the four main research aims outlined in Chapter One.

AIM 1: *To examine how investment models in Beijing and London vary for urban water infrastructure investment and what the underlying institutions are for the different landscape of urban water infrastructure investment in Beijing and London.*

In the era of globalisation, cities have been (re)developing their investment models for urban infrastructure investment in order to achieve competitive advantages in attracting global capital and business. Nonetheless, little effort has been made on comparing the various trajectories of investment models for urban infrastructure investment in the context of different political economies, especially the

dialogue between Global North and South. Chapter Three investigates the spatial difference of the underlying institutions and urbanisms in Beijing and London through comparing LGFP model in Beijing and RAB model in London for urban water infrastructure investment of the two cities. Based on the work of Bathelt and Glückler (Bathelt and Glückler, 2013) on conceptual exploration of ‘institutions’ in economic geography, Chapter Three conceives institutions as stabilizations of mutual expectations and correlated interaction built on rules and regulations to explore the emergence and evolution of investment models for urban water infrastructure investment in Beijing and London. Interviews were conducted with local governments, regulators, water companies, consumers and other stakeholders as well as a critical review of relevant documents was carried out for better understanding the institutions and urbanisms underlying the various trajectories of investment models for urban water infrastructure investment in Beijing and London.

Chapter Three finds that institutions with characteristics of local contexts have influence on the function and evolution of the LGFP model in Beijing and the RAB model in London as “institutions have a history and a geography as well as a functional logic” (Clark and Wójcik, 2007). Furthermore, the functions of LGFP model in Beijing and RAB model in London are influenced not only by industry regulations explicitly but also by social interactions implicitly, since “institutions are viewed as correlated and relatively stable social interactions between economic agents that develop upon rules and regulations in rather contingent ways” (Bathelt and Glückler, 2013). In addition, the spatial difference of investment models for urban water infrastructure investment represents the various urbanisms underlying the LGFP model in Beijing and the RAB model in London. The urbanism behind the LGFP model can be described as “strategizing urbanism” to the extent that it has been actively pursued and practiced by local governments for fulfilling political and economic goals. On the contrary, the urbanism behind the RAB model can be viewed as “financialisation urbanism” that it has been shaped by local governments which exploit the force of global capital to fulfil political goals and global financial industry which grasps global investment opportunities in various geographic jurisdictions to get their expected risk-adjusted rates of return.

Theoretically, Chapter Three studying the spatial difference of investment models for urban water infrastructure investment contributes to ‘Geography of Finance’ (Clark and Wójcik, 2007) or financial geography, a subfield of economic geography in recognition of the limitations of the efficient market

hypothesis for explaining situations where information asymmetry and market imperfection are present. Given “an urgent need and a unique chance to push the agenda of a geographic take on finance” (Benner et al., 2011; Sokol, 2013; Wójcik, 2009), Chapter Three argues that the diversity in the landscape of infrastructure investment and governance could be injected into the conceptualisation of economic geography to provide a solid analytical handle on infrastructure studies. By illustrating the heterogeneity in investment models and institutions for urban water infrastructure investment in Beijing and London, the chapter has also contributed to a growing body of literature on ‘geographies of money and finance’ (Clark, 2005; Hall, 2010, 2011, 2012; Martin, 2010) and the ‘institutional turn’ in economic geography (Martin, 2000; Martin and Sunley, 2010).

AIM 2: *To explore the effects of different institutional governance in Beijing and London on urban water infrastructure investment and service delivery.*

Both Beijing and London are facing serious challenges for water security given population growth and economic development as well as the impacts of climate change. However, to some extent, the water crisis is largely a governance crisis, since managing and securing access to water for all is not only a question of financing and technology, but is also a matter of good governance (OECD, 2012). In line with the second aim of the thesis, Chapter Four served to explore the effects of different institutional governance in Beijing and London on urban water infrastructure investment and service delivery. One major methodology challenge is related to studying the emergence, production and change of institutions empirically, because institutions cannot be measured by obvious or easily identifiable indicators but need to analytically extracted from social practice (Bathelt and Glückler, 2013). Therefore, in-depth interviews or close dialogue (Clark, 1998) with key individuals in local governments, regulators, water companies and other stakeholders were conducted to investigate the institutional governance and regulation of urban water infrastructure in Beijing and London.

This chapter finds that institutional governance and regulation of urban water infrastructure in Beijing and London are strongly linked with the investment models for urban water infrastructure investment and the performance of water service delivery in the two cities. With the command and control regulatory framework, the primary goal of the water utility in Beijing is to safeguard public interest and the key

incentives are political goals. Yet the top-down decision making process and multi-agency governance structure in Beijing often produce “outcomes that have little concrete effect” (Lieberthal, 1997). It is suggested in the chapter that appropriate incentive system and market mechanism should be brought into the water industry in Beijing for improving efficiency and bringing in innovation to urban water infrastructure provision of Beijing. On the contrary, the main incentives for private water companies in London are profit maximisation within the standards required by regulators. But information asymmetry and interests inconsistency between regulator and regulated water companies have led to ‘strategic gaming’ (Stern, 2014) and high transaction costs within bureaucratic regulatory framework (Hukka and Katko, 2015). New initiatives such as menu regulation and negotiated settlements are proposed in the chapter to reduce the problems arising from information asymmetry and to reduce the incentives for strategic gaming by the regulated companies.

Chapter Four devotes the comparative study of institutional governance of urban water services in Beijing and London to current debate on state capitalism versus liberal capitalism or ‘Geography of Capitalism’ (Dixon, 2014). State capitalism is a form of capitalism in which the state acts as the dominant economic player and uses markets primarily for political gain (Bremmer, 2009). Liberal capitalism, on the other hand, is a form of capitalism based on liberal market economies with minimal state involvement in the allocation of goods and services (Hall and Soskice, 2001). It is argued that while the great economic conflict of the twentieth century pitted capitalism against Marxism, the battle of the twenty-first century will be characterized by state versus liberal capitalism (Choate, 2009). Nonetheless, by illustrating institutional governance and regulation of urban water infrastructure in Beijing and London, the chapter argues that it is an unhelpful oversimplification to divide the world into “state capitalism” and “liberal capitalism” camps, as the reality is that most countries are arranged along a spectrum where both the intent and the extent of state intervention in the economy vary. There is no point in the debate on public versus private ownership for urban water infrastructure provision, as both models can function well provided that effective institutional governance and regulation are in place (Rouse, 2013). The chapter echoed with the emerging ‘variegated capitalism’ (Dixon, 2010) and fills in the gap for better understanding ‘capitalism with Chinese characteristics’ (Peck and Zhang, 2013).

AIM 3: *To analyse the performances of different water pricing systems in Beijing and London in*

coordinating intrinsic value, market value and investment value of urban water infrastructure services.

Pricing system, which aims to balance diverging environmental, social, economic and financial objectives for urban water services, is at the core of sustainable urban water infrastructure provision (OECD, 2009). Nonetheless, underpricing of water services seems to be a worldwide phenomenon. Chapter Five argues that one of the main reasons for failure of sustainable cost recovery for urban water services is lack of system-thinking in water pricing system for coordinating the intrinsic value, market value and investment value of urban water infrastructure. By using a mix of quantitative and qualitative methods, Chapter Five investigates performances of different water pricing systems in Beijing and London in delivering intrinsic value, market value and investment value of urban water infrastructure services.

The chapter finds that both water pricing systems in Beijing and London failed in coordinating intrinsic, market and investment value of urban water infrastructure. The failures have much to do with different institutional governance of urban water infrastructure in the two cities. Due to the command and control regulatory framework and strategizing urbanism, Beijing government has kept down its domestic water price for years to provide water services to citizens with relatively low price. Nonetheless, since distorted pricing system cannot reflect the true market value of water services, water companies in Beijing have few incentives in achieving efficiency in urban water infrastructure provision while few private investors have invested in this market. The government-led model of Beijing focuses on intrinsic value of water services through public provision but fails to activate market and investment value of urban water infrastructure provision through market mechanism. By contrast, in favour of “market environmentalism” (Anderson and Leal, 2001), water pricing system in London has activated the market and investment value of urban water infrastructure to drive water companies to provide affordable water services more efficiently and to attract international capital for financing urban water infrastructure provision in London. Nonetheless, the geographical characteristics of ‘natural monopoly’ of urban water infrastructure prevent the wholesale introduction of price competition and market exchange, thus cause difficulty in fully realising market value of urban water infrastructure as water is an “uncooperative commodity” (Bakker, 2003). In addition, the skewed distribution model of financialised water infrastructure in London has engineered benefits more towards investors than customers (Allen and Pryke, 2013).

The comparison of water pricing system and governance framework for urban water infrastructure in

Beijing and London in Chapter Five contributes to ‘Geography of Governance’ (Liverman, 2004; Seldadyo et al., 2010). With a disciplinary core that embraces human-environment relations and regional difference, geography can take a leading role in important emerging themes in environmental management such as commodification of nature and the reworking of environmental governance to include consumers, corporations, environmental groups, and transnational institutions (Liverman, 2004). Chapter Five comparing pricing system and governance framework in Beijing and London has contributed to political and intellectual debate concerning whether and how to put a price on environmental services and who should make environmental decisions. In particular, pricing nature and governing the environment are important elements of the discussions of how to respond to processes of globalization, financialisation and global environmental change as well as their impacts on people around the world.

AIM 4: *To understand different contract designs in Beijing and London for financing large-scale urban water infrastructure projects.*

Contract is crucial for governing the relationships between asset owners and many types of agents that underpin the production of investment activity (Clark and Monk, 2014), particularly for infrastructure investment with high fixed cost and complex stakeholder relationships (Stern, 2014). Since “there is always a politics of infrastructure in play” (O'Neill, 2013), the success of infrastructure contracts rely on coordination of a nexus of interests possessed by various participants entering and exiting the infrastructure project for their own purposes (Likosky, 2010). Nonetheless, few studies have considered institutional factors when studying contracts for infrastructure industry, especially with little attention on the uneven geographical phenomenon between Global South where the state plays a crucial role in urban infrastructure investment and Global North where the state is described either as being “hollowed out” or subsumed to the powerful operation of global finance forces (Lin et al., 2014). Chapter Six has made contribution to filling this gap by analysing government-led contract in Beijing and regulatory-led contract in London for financing large-scale water infrastructure projects.

The chapter finds that the difference in contract design for infrastructure investment is related with the heterogeneity in institutional governance and political economy of Beijing and London. Urban infrastructure has been considered as tools for boosting political achievements in China while for

generating stable revenue streams in Britain (Allen and Pryke, 2013; Lin et al., 2014). In addition, different contracts have been designed for urban infrastructure investment because of the difference in the structure of asset management industry of Britain and China. As bank deposits have accounted for 71% of total financial asset of China by the end of 2013 (Oliver Wyman, 2014), national infrastructure bank and urban infrastructure development companies have been created in China to match short-term bank deposits with long-term urban infrastructure projects. Since pension and insurance funds have grown astronomically in terms of their significance with respect to other sources of savings and investments (Clark, 1997), accounting for 56% of total financial assets in Britain (Investment Management Association, 2014), the arm's length regulators and regulatory asset base model have been created to provide comfort to institutional investors in privatised network utilities that their investment would not be treated unfairly.

Chapter Six shows that both contracts for urban infrastructure investment in Beijing and London have advantages and disadvantages. Government-led contract in Beijing combines local government's organisational ability and LGFP's entrepreneurship for urban infrastructure investment. However, this government-dominated model may lead to 'strategic misrepresentation' (Flyvbjerg, 2006) and local debt risk due to reckless off-balance sheet financing. Transparent measures of accountability that reward right decisions and punish wrong decisions should be implemented to keep local government's investment activities within market discipline. In London, infrastructure assets are entrenched by regulatory-led contract as ring-fenced assets that can generate long-term stable revenue stream. Nonetheless, the power of global finance is threatening the cohesiveness of a city and causing 'splinter urbanism' (Graham and Marvin, 2001; O'Neill, 2010). The UK government should play a crucial role in long-term infrastructure plan to avoid danger in substituting private gain for public good as the major driver in investment decision-making in shaping cities (Hebb and Sharma, 2014).

Chapter Six has made contribution to 'Geography of Contract' (Clark and Monk, 2014) through exploring relational contract for urban water infrastructure investment in Beijing and London. According to the three-way classification of contract proposed by Oliver Williamson (1979), infrastructure contract should be considered as relational contract as "all parties for this kind of contracts must prepare for the possibility of renegotiation and failure" (Likosky, 2010). Since "all contracts occur in the context of a social matrix" (Macneil, 1978), the comparative study of infrastructure contracts in Beijing and London in this chapter has contributed to the emerging theme of 'geography of contract' which emphasises the

understanding of infrastructure contract in different institutional and geographical contexts.

7.3 Broader Implications

7.3.1 Understanding infrastructure investment and governance from the perspective of economic geography

As the substantive chapters in this thesis have shown, infrastructure investment and governance is highly contextual. The comparison of investment models, institutional governance, pricing systems and infrastructure contracts for urban water infrastructure in Beijing and London in the thesis have indicated that geography matters for infrastructure investment and governance. As such, economic geography can play a leading role in understanding infrastructure investment and governance in different institutional and geographical contexts. Compared with research conducted by mainstream economists, economic geography is a discipline more inspired by the empirical world around us than by cathedrals of theory (Clark, 2007). Since the empirical world is sufficiently different from time-to-time and place-to-place to allow for understanding of heterogeneous economic and social processes, economic geography provides a spatial, temporal and relational framework to organise in-depth enquires on complex system such as infrastructure (Ansar, 2010).

As the methodology section of Chapter One has shown, economic geography is “a sub-discipline of geography and a growing field of economics” which is concerned with “the spatial configurations of firms, industries, and nations with the emerging global economy in all its manifestations” (Clark et al., 2000). In particular, economic geography has over the years gone through ‘institutional turn’ (Amin, 1999; Bathelt and Glückler, 2013; Martin, 2000) and ‘relational turn’ (Bathelt and Glückler, 2003; Boggs and Rantisi, 2003; Yeung, 2005) which have broadened the remit of the subject. Based on the work of Torrance (2007), Sharma (2012), and O'Neill (2013), this thesis has argued that understanding highly contextual activity such as infrastructure investment and governance requires the methodology of economic geography which emphasises the institutional and relational contexts. For many years, research in finance was dominated by the efficient markets hypothesis so that it ruled out so-called irrational behaviour and the circumstances of different places and different times. Nonetheless, the thesis has shown that the efficient markets hypothesis cannot explain why Beijing and London have chosen different models for urban water infrastructure

investment and governance, and how these different models can exist and function in the two cities. The theory-first logic of economics and political science has left those disciplines without sufficient experience to deal with the intersection of cognition and context (Clark, 2007). The discipline of economic geography could be at the very centre of research on infrastructure investment since there is “an urgent need and a unique chance to push the agenda of a geographic take on finance” (Benner et al., 2011; Sokol, 2013; Wójcik, 2009).

7.3.2 Building platform for exchanging knowledge on sustainable infrastructure investment and governance

The various trajectories of urban infrastructure investment and governance in Beijing and London compared and analysed by this thesis have important practical implications for investors who are interested in infrastructure assets. Although institutional investors in OECD countries have growing appetite for the riskier prospect of investing into infrastructure in the emerging markets, few studies have analysed in detail how the political, legal and governance framework as well as other informal relationships in emerging markets might influence infrastructure investment (Sharma, 2012). The rapid and continued urbanisation in China drives Chinese government to launch new initiatives which are intended to contribute to lowering government spending and improving public services through a third wave of PPP projects in China (Buchanan, 2014). This provides unique opportunities for institutional investors in OECD countries to invest in and benefit from urban infrastructure development in China. Nonetheless, before reaping from infrastructure investment in emerging markets, more work should be done to get OECD institutional investors familiar with political, legal and governance frameworks which are different from those in OECD countries. This thesis has made contribution to filling this gap and provided some meaningful insights on infrastructure investment and governance in China to OECD investors. Furthermore, as China will become one of the world’s biggest cross-border investors by the end of this decade, with global offshore assets tripling from \$6.4tn now to nearly \$20tn by 2020 (Anderlini, 2015), this thesis has also contributed to providing meaningful exploration on urban water infrastructure investment and governance in the UK.

In addition, the comparative study between Beijing and London in this thesis has contributed to

opening dialogues between Global North and South on infrastructure investment. The comparative study on institutional governance of urban water infrastructure in Beijing and London in Chapter Four has been awarded 2nd place in the 2013 Paper Competition in the 2013 Annual Meeting of Association of American Geographers (AAG) in Los Angeles, US (See Annex 6). The whole doctoral research has won excellent award for its contribution to dialogues between Global North and South (See Annex 7). In order to facilitate academic exchange on infrastructure, I co-organised a special session “The Geography of Urban Infrastructure” in the 2014 Annual Meeting of AAG in Tampa, US. The session have four sub-sessions “The Geography of Urban Infrastructure I: Infrastructure, ownership, and financial markets”, “The Geography of Urban Infrastructure II: Infrastructure, governance, and networks”, “The Geography of Urban Infrastructure III: Infrastructure, planning, and urban growth”, and “The Geography of Urban Infrastructure IV: Infrastructure, mechanisms, and institutional arrangements”. The session has run successfully and has attracted 20 presenters from all over the world to exchange knowledge on infrastructure in America, Australia, Britain, China, Kenya, Korea and Nigeria. Chapter Three of the thesis has been used for a presentation in the session for understanding the investment model for urban infrastructure investment in China.

Since there is such an intimate relationship between finance academics and finance practitioners, the former cannot afford to ignore the latter (Clark, 2007). Consequently, platforms are needed for exchanging knowledge about how and why infrastructure markets are internally differentiated and knowledge about the nature and persistence of differences between infrastructure markets. As such, I co-organised an international workshop on “Infrastructure Investment in Emerging Markets and Developing Economies: System-Thinking for New Institutions and Global Challenges” on 2 July 2015 in St Catherine’s College, University of Oxford. The workshop has brought together experts from Asian Infrastructure Investment Bank (AIIB), World Bank, IFC, OECD, World Economic Forum, Turkish Treasury G20 Investment and Infrastructure Working Group and academia to discuss challenges and solutions to mobilising infrastructure investment in Emerging Markets and Developing Economies (EMDEs). In particular, the workshop has focused on i) how multilateral financial institutions can function effectively as platforms to mobilise the private sector and institutional investors for infrastructure investment in EMDEs; and ii) how we can move from projects-thinking to systems-thinking for infrastructure, and fully appraise the macro-economic, societal and environmental benefits and impacts of these investment pathways. Based on

the success of the workshop, I am working with colleagues to establish the Oxford University International Infrastructure Consortium (OXIIC) which aims at bringing together experts from international organisations, governments, academia, financial institutions, and other public and private sectors to share their information and knowledge in the field of infrastructure. The front covers of the workshop programme and report are attached in the Annex 8 and 9.

7.3.3 Asian Infrastructure Investment Bank

The thesis emphasises the significance of understanding the investment models and governance frameworks for infrastructure in Emerging Markets and Developing Economies (EMDEs). Currently EMDEs are facing a massive infrastructure deficit. According to World Bank (2014), over 1.3 billion people still live without electricity, 60 per cent of the world's population lack internet access and at least 768 million people lack access to safe drinking water. An additional US\$1 trillion of annual investment in low and middle income countries will be required through 2020 to meet the infrastructure demand from industry and households. Faced with such a large infrastructure deficit and tight public finances, governments in EMDEs have no way of closing the financing gap using public funds alone. Attracting private capital to complement public funds is vital to providing governments with the long-term liquidity they need for infrastructure. However, the real challenge is not simply a matter of money but a lack of bankable projects. Further, whilst unlocking funds from different sources such as those in the private sector is an area of priority for financing the infrastructure deficit faced by EMDEs, it must be recognised that simply increasing the amount invested in infrastructure may not deliver the potential to foster strong, sustainable and balanced growth. Therefore, reinvigorating the supply of infrastructure in EMDEs requires work to establish a more supportive enabling environment for sustainable investment. In this context, new multilateral financial institution Asian Infrastructure Investment Bank (AIIB) has been proposed to facilitate infrastructure development.

The AIIB will be a new multilateral financial institution designed to provide financial support for infrastructure development and regional connectivity in Asia. The purpose of the Bank is to: (i) foster sustainable economic development, create wealth and improve infrastructure connectivity in Asia by investing in infrastructure and other productive sectors; and (ii) promote regional cooperation and partnership in addressing development challenges by working in close collaboration with other multilateral

and bilateral development institutions. Under its Articles of Agreement, the AIIB's functions include: (i) promoting public and private investment in the Asia region for development, in particular for infrastructure and other productive sectors; (ii) utilizing the resources at its disposal for financing such development in the region; and (iii) encouraging private investment that contributes to economic development in the Asia region, in particular in infrastructure and other productive sectors, and supplementing private investment when private capital is not available on reasonable terms and conditions.

7.4 Future Research

In recognition of the limitations of this research outlined in Chapter One of the thesis, this section discusses the avenues for future research.

This research has compared and analysed urban water infrastructure investment and governance in Beijing and London from the perspective of economic geography. In order to move forward the emerging field 'Geographies of infrastructure', more empirical and comparative studies between Global North and South should be conducted on other economic infrastructure sectors such as energy and transport as well as social infrastructure sectors such as schools and hospitals. While Chapter Five of this thesis has highlighted the importance of system-thinking in pricing system for coordinating the intrinsic value, market value and investment value of urban water infrastructure, future research should also focus on how cross-sector strategies for infrastructure provision can be integrated into decision-making for infrastructure investment given the growing interconnectivity between these individual infrastructure systems.

As described in Chapter One, this thesis mainly applies a multi-method qualitative approach to observe and analyse the heterogeneous trajectories of urban water infrastructure investment and governance in different institutional and cultural contexts. Although qualitative methodology especially close dialogue has virtues of understanding the heterogeneous expectations and behaviours underlying different infrastructure markets, future research should develop the qualitative methods further and incorporate quantitative methods into analysis. In terms of qualitative methods, future work should include more stakeholders especially citizens relevant to infrastructure for better understanding the nature of infrastructure provision. With more data regarding infrastructure investment and service delivery becoming available, quantitative analysis should be carried out to complement the qualitative research.

Given the gap between growing demand for infrastructure investment and governments' tightening

fiscal capacity in the coming decades, an important direction for future research is how to mobilise private capital especially institutional investors into infrastructure investment. However, the real challenge is not simply a matter of money but a lack of bankable projects. Therefore, reinvigorating the supply of infrastructure in EMDEs and the upgrade of infrastructure in OECD countries require work to establish a more supportive enabling environment for private investment. As Chapter Five of the thesis pointed out, infrastructure has not only intrinsic value for improving connectivity and enhancing living standards but also market value for bringing efficiency and innovation to improve productivity of infrastructure sectors as well as investment value for attracting global capital for local development. Therefore, how to conduct institutional innovation to turn infrastructure assets in different geographical contexts into financial products for institutional investors from all over the world is a very important research area for economic geography to come into play. In this perspective, there are many potential cooperative research opportunities with AIIB, New Development Bank, Global Infrastructure Hub (GIH), Global Infrastructure Facility (GIF) and other global initiatives.

Finally, infrastructure is not only a financial product but also a service to the public. Public expectations on the performance of infrastructure services will affect the market value and investment value of infrastructure, thus affect the rate of return on infrastructure assets to institutional investors. Whilst unlocking funds from different sources such as those in the private sector is an area of priority for financing the infrastructure deficit faced by EMDEs, it must be recognised that simply increasing the amount invested in infrastructure may not deliver the potential to foster strong, sustainable and balanced growth. Infrastructure investment strategies need to take into account that infrastructure assets are interdependent and constitute a wider system; therefore the conventional project-centric approach adopted by many development agencies may lack the “systems-thinking” that is needed for ensuring the long-term development of EMDEs. How to assess the risks in environmental, social and governance aspects for infrastructure provision and how to incorporate these risks into the decision-making process of infrastructure investment are important research directions in future.

APPENDIX

Appendix 1: Abbreviations

Appendix 2: List of Interviewees

Appendix 3: Letter of Introduction

Appendix 4: Research Ethics Approval

Appendix 5: Fieldwork Plan

Appendix 6: Interview Questions (Sample)

Appendix 7: Certificate for Paper Competition Award

Appendix 8: Certificate for Excellent Doctoral Research Award

Appendix 9: Front cover of the Oxford Infrastructure Workshop Programme

Appendix 10: Front Cover of the Oxford Infrastructure Workshop Report

Appendix 1: Abbreviations

AIIB	Asian Infrastructure Investment Bank
AIP	Alternative Investment Products
BDG	Beijing Drainage Group
BDRC	Beijing Development and Reform Commission
BEPB	Beijing Environmental Protection Bureau
BFB	Beijing Financial Bureau
BHUCD	Beijing Housing and Urban-rural Development Commission
BOT	Build-Operate-Transfer
BPHB	Beijing Public Health Bureau
BSASAC	Beijing State-owned Assets Supervision and Administration Commission
BWAB	Beijing Water Affairs Bureau
BWG	Beijing Waterworks Group
BWIC	Beijing Water Investment Centre
CAPEX	Capital Expenditures
CBRC	China Banking Regulatory Commission
CDB	China Development Bank
CME	Coordinated Market Economy
CSOs	Combined Sewerage Overflows
Defra	Department for Environment, Food and Rural Affairs
DWI	Drinking Water Inspectorate
EA	Environment Agency
EMDEs	Emerging Markets and Developing Economies
EU	European Union
FCM	Financial Capital Maintenance
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GLA	Greater London Authority
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
LGFP	Local Government Financing Platform
LME	Liberal Market Economy
NRC	National Research Council
OECD	Organisation for Economic Cooperation and Development
Ofwat	Office of Water Services (Water Services Regulation Authority) ¹⁶
OPEX	Operational Expenditures
OXIIC	Oxford University International Infrastructure Consortium
PPP	Public-Private Partnership
RAB	Regulatory Asset Based
RPI	Retail Price Index
SESS	Social-Ecological Systems
SNWDP	South-to-North Water Diversion Project
TTT	Thames Tideway Tunnel
TTT Ltd	Thames Tideway Tunnel Limited
UK	United Kingdom
UN	United Nations
VoC	Varieties of Capitalism
WRMPs	Water Resource Management Plans

¹⁶ On 1 April 2006, the Director General was replaced by the Water Services Regulation Authority. The name "Office of Water Services" is no longer used, as it had no legal basis.

Appendix 2: List of Interviewees

Beijing

- 1) Dr. Cao Nan, Director, Water Quality Monitoring Centre, Beijing Waterworks Group Company Limited
- 2) Chang Jiang, Deputy Director, Research Centre, Beijing Drainage Group
- 3) Interviewee who asked to be anonymous, Beijing Water Investment Centre
- 4) Dr. Cao Jianting, Senior Engineer, Water Strategy Research Division, Water Resources and Hydropower Planning and Design General Institute, Ministry of Water Resources
- 5) Interviewee who asked to be anonymous, Beijing Water Affairs Bureau
- 6) Liang Hengyi, General Manager, Multi-operations Division, Beijing Infrastructure Investment Co., Ltd
- 7) Wu Jun, Senior Business Manager, Overseas Business Department, China Construction Third Engineering Bureau Co., Ltd
- 8) Jiang Ketao, Director, Division II (Mining & Infrastructure), Global Cooperation Department, China Development Bank
- 9) Liu Kun, Deputy Director, Risk Management Division, China Development Bank Beijing Branch
- 10) Li Zhaoli, Customer Services Division II, China Development Bank Beijing Branch
- 11) Bao Qi, Senior Investment Manager, Alternative Investment Department, China Life Asset Management Company Limited
- 12) Jiang Tiejun, Deputy Director, Investment Department, National Council for Social Security Fund
- 13) Su Weidong, Deputy Director, Special Project Team, UBS SDIC Fund Management Co., Ltd.
- 14) Bo Luo, Great Harvest Asset Management Centre
- 15) Prof. Xue Lan, Dean, School of Public Policy and Management, Tsinghua University
- 16) Prof. Wang Can, School of Environmental Science and Engineering, Tsinghua University
- 17) Prof. Yu Chaoqing, Institute for Global Change Studies, Tsinghua University
- 18) Prof. Hu Angang, School of Public Policy and Management, Tsinghua University
- 19) Prof. He Xiaofeng, Director, Financial & Industrial Development Institute, Peking University
- 20) Prof. Li Guoping, Dean, Beijing Development Institute, Peking University
- 21) Prof. Yang Kaizhong, School of Government, Peking University
- 22) Prof. Chai Yanwei, College of Urban and Environmental Sciences, Peking University
- 23) Prof. Zhang Haibin, School of International Studies, Peking University
- 24) Prof. Hu Jiye, China University of Political Science and Law
- 25) Prof. Zheng Bingwen, Director, The CASS Centre for International Social Security Studies, Chinese Academy of Social Science
- 26) Dr. Pan Jiahua, Institute for Urban and Environmental Studies, Chinese Academy of Social Science
- 27) Dr. Liu Weidong, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Science
- 28) Zhang Yongsheng, Development Research Centre of the State Council

London

- 1) Cathryn Ross, Chief Executive, Ofwat
- 2) Pete Duell, Economic Regulation Analyst, Anglian Water Services Limited
- 3) Steve Kaye, Head of Innovation, Anglian Water Services Limited
- 4) Interviewee who asked to be anonymous, Greater London Authority
- 5) Prof. Michael Rouse, former Chief Head, Drinking Water Inspectorate
- 6) Interviewee who asked to be anonymous, Environment Agency
- 7) Martin Stanley, Former Chief Executive, Competition Commission
- 8) Interviewee who asked to be anonymous, Macquarie Bank
- 9) Dr. David Johnstone, Thames Water
- 10) Interviewee who asked to be anonymous, Water UK
- 11) Richard Sharp, Principal & Group Leader, ARUP
- 12) Francis R Budge, CH2M HILL
- 13) Prof. George Yarrow, Regulatory Policy Institute, University of Oxford
- 14) Prof. Fulong Wu, Bartlett School of Planning, University College London
- 15) Prof. Bent Flyvbjerg, University of Oxford
- 16) Dr. Atif Ansar, University of Oxford
- 17) Prof. Jon Stern, London City University

- 18) James Wardlaw, Partner, Campbell Lutyens
- 19) Mark Fulton, Founding Partner, Energy Transition Advisors
- 20) Marjory-Anne Bromhead, Former Manager, Environment and Natural Resources, World Bank
- 21) Brian Minns, Manager, Sustainable Investing, Addenda Capital
- 22) Cate Lamb, Head of Water, CDP
- 23) Mark Mansley, Chief Investment Officer, Environment Agency Pension Fund
- 24) Michael Wilkins, Managing Director, Infrastructure Finance, Standard & Poor's Rating Services
- 25) Bernard Sheahan, Director, Infrastructure & Natural Resources, International Finance Corporation
- 26) Marie-Sybille Connan, Allianz Global Investors
- 27) Alex Wong, Senior Director, Head, Global Strategic Infrastructure Initiative, World Economic Forum

Appendix 3: Letter of Introduction

SCHOOL OF GEOGRAPHY AND THE ENVIRONMENT
INTERNATIONAL GRADUATE SCHOOL

Director: Professor Gordon L Clark, FBA, DSc

OUC, South Parks Road, Oxford OX1 3QY United Kingdom
Contact: Ruth Saxton (Research Degrees Co-ordinator)
Tel: +44(0)1865 275890 ruth.saxton@ouce.ox.ac.uk



Dear Sir or Madam,

I am a DPhil student in the School of Geography and the Environment at the University of Oxford. As my research is related with studying the governance frameworks for urban infrastructure provision in London and Beijing contexts, I intend to carry out fieldwork in Beijing from 1st July to 31st August with my supervisor's approval, which is an important part of my DPhil research. I have made full preparation for the fieldwork in Beijing, such as research proposal, risk assessment for the fieldwork, and insurance arrangement. I hope that my fieldwork in Beijing can obtain you and China Scholarship Council's strong support.

Sincerely yours,

Yin Yang

Student's signature:

Yin Yang 04/May/2012

Supervisor's signature:

[Signature]
3/5/2012

Appendix 4: Research Ethics Approval

SOCIAL SCIENCES & HUMANITIES
INTER-DIVISIONAL RESEARCH ETHICS COMMITTEE

Hayes House, 75 George Street, Oxford. OX1 2BQ
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ethics@socsci.ox.ac.uk www.socsci.ox.ac.uk

Co-ordinator of the IDREC
Social Sciences Divisional Office



Monday, 28 May 2012

Yin Yang
School of Geography and the Environment

Dear Yin,

Research Ethics Approval

Ref No.: SSD/CUREC1A/12-123

Impacts of governance framework on urban infrastructure provision - the case of water utility in London and Beijing

The above application has been considered on behalf of the Social Sciences and Humanities Inter-divisional Research Ethics Committee (IDREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to the IDREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly approval has been granted.

Should there be any subsequent changes to the project, which raise ethical issues not covered in the original application, you should submit details to the IDREC for consideration.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'K. Dally'.

Kathryn Dally

cc: Prof Gordon Clark, School of Geography and the Environment
Ruth Saxton, School of Geography and the Environment

KD/EB

Appendix 5: Fieldwork Plan (Sample)

Time: 01 July – 31 August 2012 (8 weeks)

Location: Beijing, China

Outline of the work to be undertaken in Beijing

There are three stages for the field work to be undertaken in Beijing:

Stage 1 – Understanding investment and governance issues of water infrastructure in Beijing (3 weeks)

- Interviews with experts in **Beijing Waterworks Group** for understanding investment and governance issues of water supply and water reuse in Beijing
- Interviews with experts in **Beijing Drainage Group** for understanding investment and governance issues of urban drainage and wastewater treatment in Beijing
- Interviews with experts in **Beijing Water Authority** for understanding the regulatory environment and pricing mechanism in Beijing for water infrastructure investment and governance
- Related data and information collection, combined with extensive internal and external document reviews

Stage 2 – Exploring the underlying reasons for investment and governance models in Beijing (3 weeks)

- Based on the initial understanding in the first stage, in-depth exploration will be conducted for analysing the underlying reasons (institutions and relationships) for water infrastructure investment models and governance frameworks in Beijing
- Interviews with experts in **Tsinghua University, Peking University, the Development Research Centre of the State Council** to learn about the underlying institutions and relationships of water infrastructure provision in Beijing
- Participate into the research project of **Beijing Drainage Group** and **Tsinghua University** for in-depth investigation of water infrastructure provision in Beijing

Stage 3 – Investigating the potential role of institutional investors for infrastructure in Beijing (2 weeks)

- Interviews with experts in **institutional investors in Beijing** for understanding the potential role of institutional investors in water infrastructure investment in Beijing
- Discussions with experts in **Tsinghua University, Peking University, the Development Research Centre of the State Council** for investigating the potential role of institutional investors in urban water infrastructure provision in Beijing

Data and information to be collected

- *Data and information related to **water infrastructure provision** in Beijing*
 - Capacity and demand of urban water infrastructure in the past few years
 - Performance of urban water infrastructure provision in the past few years
 - Demand for water infrastructure in the next few years
 - Measures proposed to meet the demand in the next few years

- *Data and information related to **water infrastructure investment** in Beijing*
 - Investment performance on water infrastructure in Beijing in the past five years
 - Current investment models and financing sources for water infrastructure
- *Data and information related to **institutional investors** in Beijing*
 - Current situation of institutional investors in infrastructure
 - The potential role of institutional investors in infrastructure investing
 - The potential role of institutional investors in responsible investment
- *Data and information related to **water utility** in Beijing*
 - Evolutionary history of Beijing Waterworks Group
 - Evolutionary history of Beijing Drainage Group
 - Relationships between water utility, government, regulator, investor and consumers
 - Corporate governance of water utility
- *Data and information related to **regulatory environment** in Beijing*
 - Past and current regulatory frameworks for water infrastructure provision
 - Past and current water price mechanisms

Appendix 6: Questions and Notes from Sample Interview

Purpose of interview: understanding the water situation, investment models, regulatory environment and pricing mechanism for urban water infrastructure provision in Beijing

Interviewee: Interviewee who asked to be anonymous, Beijing Water Affairs Bureau

Interview time and location: 7 August 2012, Beijing, China

Thank you for your time for my interview. Firstly, I would like to briefly introduce to you about the focus of my research and the purpose of this interview. My PhD research aims to compare the investment models and governance frameworks of urban water infrastructure provision in Beijing and London, and to investigate the underlying institutions for the difference. The purpose of this interview is to understand the regulatory environment and pricing mechanism for urban water infrastructure provision in Beijing. This is my letter of introduction written by my supervisor at the University of Oxford (Appendix 3). And this is my research ethics approval letter approved by the University of Oxford (Appendix 4). Please feel rest assured that I will not expose any sensitive data and information in my thesis without your consent. Also I will choose not to expose your identity in my thesis if you are not willing to. As you may have already read my interview questions that I emailed to you several days ago, my interview is focused on understanding the institutions and relationships for urban water infrastructure investment and governance in Beijing, rather than on specific data.

Interview questions

- 1) Could you briefly introduce current water situation of Beijing?
- 2) Which water infrastructure projects have been conducted in the past five years for meeting the challenges of water security?
- 3) How does Beijing finance these water infrastructure projects?
- 4) What is the main function of Beijing Water Authority in urban water infrastructure investment and governance in Beijing?
- 5) How many government agencies are there involved in water infrastructure regulation in Beijing?
- 6) Could you introduce the decision-making process for urban water infrastructure investment in

Beijing?

- 7) What is the relationship between Beijing water companies and Beijing Water Authority?
- 8) Could you briefly introduce water pricing mechanism in Beijing? Who determines water price in Beijing? What are the advantages and disadvantages of current water pricing system in Beijing?
- 9) The storm on 21st July 2012 has caused severe disruption of traffic in Beijing. What do you think are the main causes for this consequence caused by the storm?
- 10) What main measures did Beijing government take to solve this problem?

Note from the interview¹⁷

- 1) Beijing is a megacity in shortage of water resources. It is located at North China which is at the semi-arid and semi-humid zone. The annual average precipitation in Beijing is less than 600mm. Given the current population of about 20 million in Beijing and growing population, water scarcity has already become the main constraint for the development of Beijing. But sometimes water would become 'redundant' and cause trouble, because the rainfall is uneven within a year, and most of rainfall happens during the flood season from June to September. For example, the storm which happened on 21st July two weeks ago 'poured' more than one fourth of the whole year's precipitation in Beijing within one day. The current drainage system in Beijing cannot cope with such strong storm concentrated in a short time, so most of urban areas in Beijing were flooded, causing much loss.
- 2) In the past five years, Beijing has invested about ¥52 billion in urban water infrastructure development in the six main areas:
 - (1) Improvement of water supply capacity and demand management – developing the supporting projects for the South-to-North Water Diversion Project including building water mains, water allocation tanks, water plants, etc; implementing the strictest water resources management system in Beijing. The water production capacity has increased from 40.4 billion m³ in 2008 to 49 billion m³ in 2012. The water consumption per 10⁴ GDP has decreased from 31.6 m³ in 2008 to around 21 m³.
 - (2) Improvement of wastewater treatment capacity and water recycling – building Lugouqiao

¹⁷ The note for the interview has been collated and organised again after each interview. The relevant data from interview or document review has also been added to the note with the consent of interviewees.

wastewater treatment plant, Wujiachun wastewater treatment plant and Shahe wastewater treatment plant; building the network of water recycling; improving the level of wastewater recycling. The rate of wastewater treatment has increased from 79% to 83%. The rate of water reuse has reached to 61%, and reclaimed water has become the second largest water source for Beijing contributing to one fifth of the total water use in Beijing.

- (3) Improvement of water environment of rivers in Beijing – improving the water environment of River Beiyung, River Yongding, and River Chaobai.
 - (4) Improvement of water source protection of Beijing – increasing the water inflow of Miyun reservoir and improving the water quality of Miyun reservoir;
 - (5) Improvement of flooding protection capacity – improving the flood monitoring and early warning system;
 - (6) Improvement of urban agriculture – promoting water-saving irrigation technology in rural areas in Beijing.
- 3) Generally there are four financing channels for urban water infrastructure projects in Beijing. Firstly, we set up a special water fund for Beijing and around 10% of the Beijing government revenue from state-owned land leasing is allocated to the water fund each year. Secondly, we set up Beijing South-to-North Water Diversion Project Investment Centre which has already raised ¥11.4 billion for the supporting projects. Thirdly, Beijing water companies raised around ¥5.7 billion themselves for developing urban water infrastructure. Furthermore, the district governments in Beijing have attracted around ¥1 billion for water infrastructure development through BOT, BT and other PPP approaches. The last five years were the five years with the most investment amount in Beijing's water infrastructure investment history.
- 4) Beijing Water Authority was established in May 2004. We have three levels of water management within the Beijing region: municipal level, district level and town level. In the municipal level, Beijing Water Authority is responsible for managing water resources, water supply and water pollution within the municipality and coordinating six district authorities. In the district level, the District Water Authorities are in charge of water management within their own jurisdictions and coordination of ten town water management stations. In the town level, the water management stations are responsible for the management of water resources, water supply and water pollution

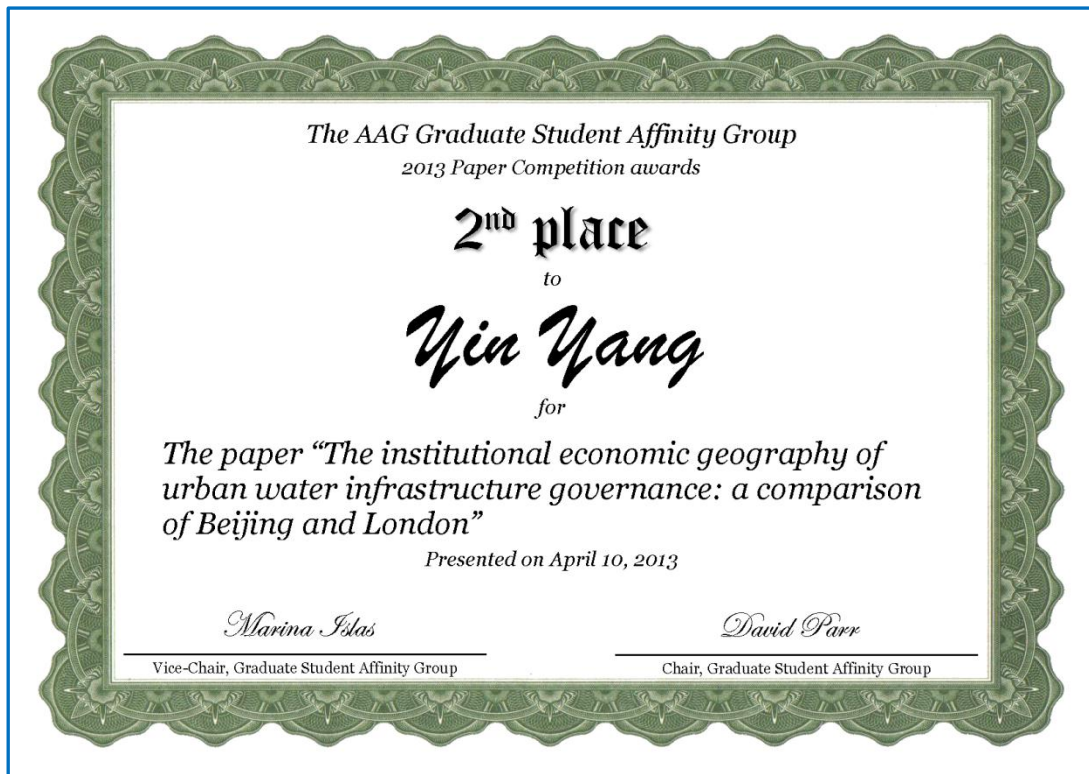
within their respective regions.

- 5) There are at least six government agencies regulating water infrastructure in Beijing. For example, Beijing Public Health Bureau is responsible for regulation of drinking water quality; Beijing Environmental Protection Bureau is in charge of the water environment protection in Beijing; Beijing Development and Reform Commission regulates the water price and approves or rejects the proposed water infrastructure projects; Beijing Financial Bureau is responsible for allocating government funding to water companies or specific water infrastructure projects; Beijing State-owned Assets Supervision and Administration Commission is in charge of preserving and increasing the value of state-owned water infrastructure as well as high-level personnel management of state-owned water companies. Beijing Water Authority is the only government agency dedicated for water infrastructure regulation in Beijing. But we need to cooperate with other government agencies for water infrastructure investment and governance in Beijing.
- 6) Generally speaking, Beijing Water Authority announces the five-year planning for water infrastructure development in Beijing every five years. Beijing water companies like Beijing Waterworks Group and Beijing Drainage Group then need to report their proposed water infrastructure projects to Beijing Development and Reform Commission for approval. If approved, water companies need to report their project budget to us for cost accounting. Then we notify Beijing Financial Bureau to allocate corresponding funding to specific water infrastructure projects if appropriate. The remaining capital demand should be solved by water companies themselves either through bank loan or bond issuance.
- 7) There are two main water companies in Beijing: Beijing Waterworks Group is responsible for water supply and water reuse services in Beijing, while Beijing Drainage Group is in charge of wastewater treatment, wastewater recycling and drainage services in Beijing. Both water companies are wholly state-owned companies and the shareholder for both companies is Beijing State-owned Assets Supervision and Administration Commission. Meanwhile, both water companies are regulated by Beijing Water Authority on the performance of their water infrastructure provision.
- 8) The current water pricing system was determined in 2009. Beijing Development and Reform Commission is the government agency determining water price in Beijing. Beijing water price

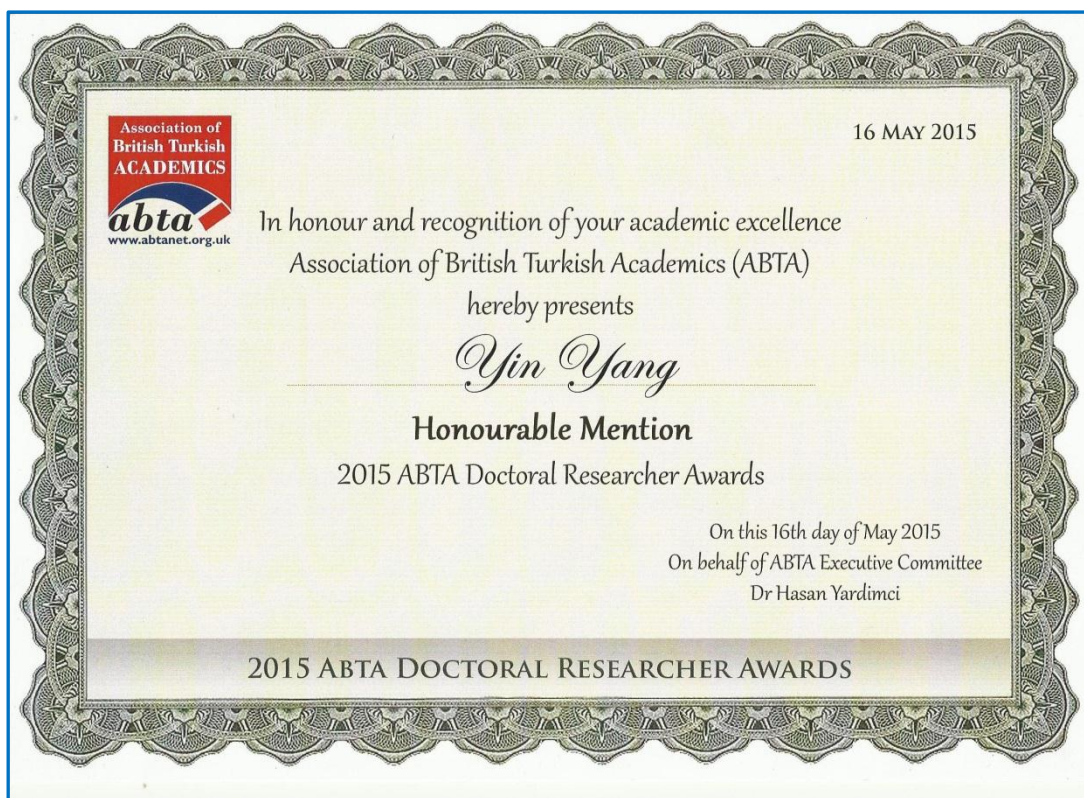
was set based on the principle of affordability and social stability. But it was relatively low for water companies' cost recovery, so we are thinking about reform of current water pricing system. But it is, you know, unrealistic to achieve full cost recovery within a short time, say one year or two years. The water pricing reform is a gradual reform which needs several years process.

- 9) There are several reasons for failure in dealing with the storm on 21st July in Beijing. One of the reasons is the extreme weather event. As I mentioned earlier, the storm poured more than one fourth of the whole year's precipitation in Beijing within one day, which is the largest amount of rainfall since 1952. The current drainage system in Beijing cannot cope with such strong storm. Another reason is the failure in cooperation of different government agencies. Beijing Meteorological Bureau did not inform us in advance to take measures on the possible severe consequences of the storm. They also did not notify the transport agency for traffic dispersion. In addition, there is something wrong with our urban planning. We installed impermeable materials for the pavements and roads, which is not favourable for runoff of rainwater.
- 10) Beijing government paid highly attention to the drainage system in Beijing after the storm. We plan to invest ¥3.5 billion to improve current drainage system in the next three years. At the same time, we intend to dredge the rivers in Beijing to improve the flow capacity of rivers. In addition, we are improving the monitoring and early warning system for extreme weather and flood prevention.

Appendix 7: Certificate for Paper Competition Award



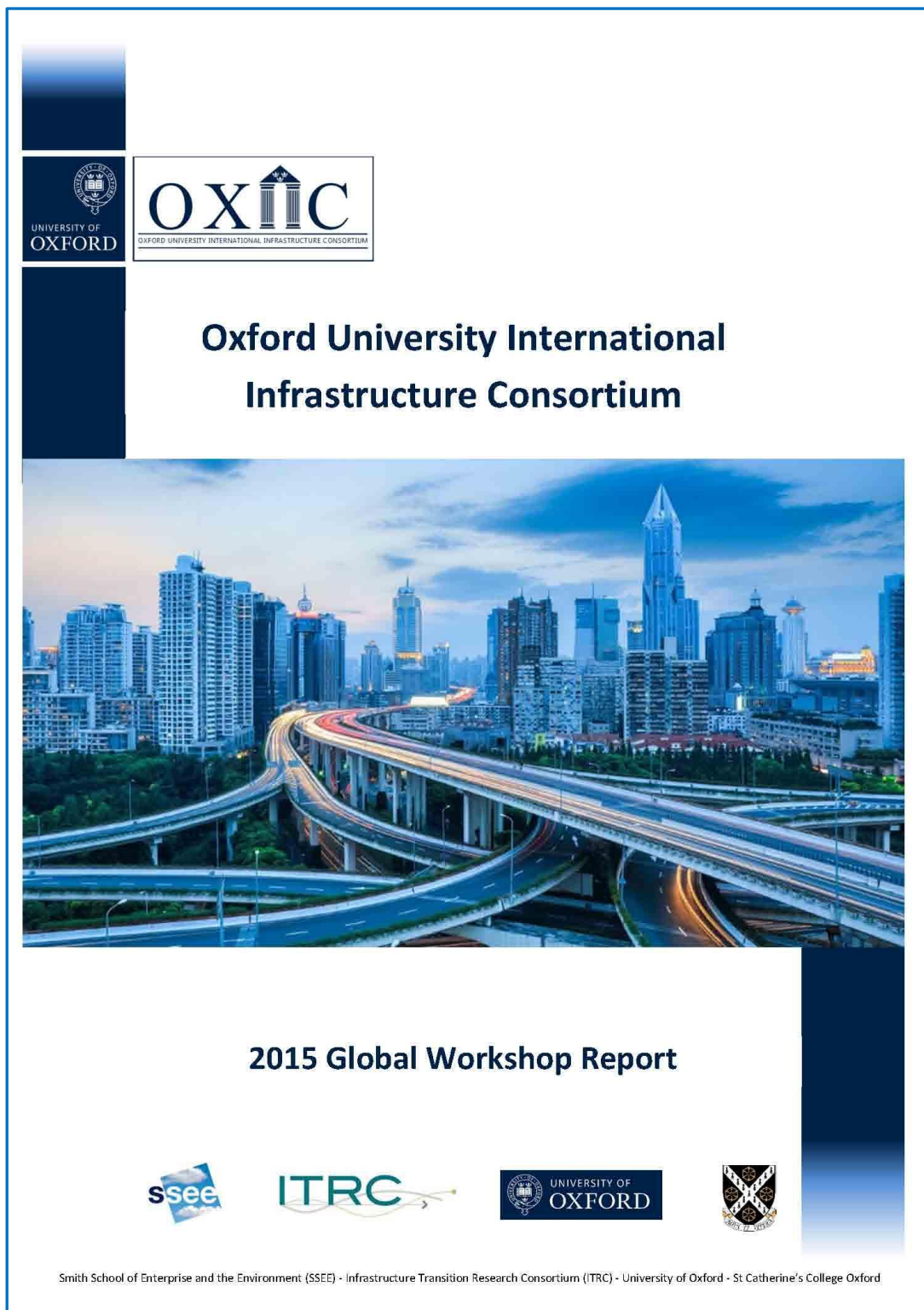
Appendix 8: Certificate for Excellent Doctoral Research Award



Appendix 9: Front cover of the Oxford Infrastructure Workshop Programme



Appendix 10: Front Cover of the Oxford Infrastructure Workshop Report



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