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Urban Agglomeration as Catalyst for Regional Innovation:
A Study of Planning Policy Implications in Yangtze River Delta

by

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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of ***MPlan City Planning*** at University College London:

I declare that this dissertation is entirely my own work and that ideas, data, and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

Signature:

Date: 9/6/2022

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Abstract

With the geographical expansion of economic development and the evolution of production method, urban agglomerations have become the new arena for innovative activities. Current research has studied the causation, performance, and synergy of innovative activities within agglomerations from both spontaneous and institutional perspectives. This dissertation chooses the Yangtze River Delta Urban Agglomeration (YRDUA) as the case study. Although previous scholars have examined the evolution of regional innovation in YRDUA, few of them linked the changes with agglomeration policies. This dissertation aims to determine how spatial planning policies influence regional innovation capacity within an urban agglomeration over time. In this context, urban agglomeration is defined as a highly development spatial pattern of cities who compete while also seek collaboration with each other, and regional innovation capacity (RIC) is defined as the acquisition, absorption, and transmission of knowledge and technology that improve the output of products and services within a region.

The study is based on the quantitative analysis of indices measuring innovation capacity and policy reviews. The evaluation framework is selected from the *China Regional Innovation Capability Report* and policies are retrieved from official public websites. Data are processed with the Principal Component Analysis under SPSS. The results indicate that although the ranking of regional innovation capacity did not change, their divergence has significantly narrowed. Further analysis suggests that policies have influenced the determinants and overall performance of RIC. On this basis, it is recommended that future policies aim at promoting regional comparative advantage and further exploring the utilisation of market mechanisms. Further research is needed to establish a more context-specific evaluation framework and identify the policy effect on the trickle-down of innovation capacities.

Chapter 1: Introduction

The scope for economic development has been constantly evolving. In 1943, Schumpeter pointed out that the foundation of production methods is never stationary but based on the incessant destruction of technology breakthroughs. According to Rostow's five stage of economic growth, a self-sustained economy follows the path of eventually moving towards an urbanised entity with concentrated mass production and consumption in cities. The theory, despite being criticised as only generalised from European counties, identifies the move away of production functions from an agricultural-based society to an industrialised one. Moving from Industrial Revolution to an era of globalisation and information technology, Florida, Adler, and Mellander (2017) suggest innovation as the new anchor point to power economic development.

The geographical scale for economic development has been also constantly evolving. Starting at the local level, Marshall noticed that firms in a specific industry tend to gravitate at certain locations to benefit from an increasing scale of returns. Fang and Yu (2017) studied urban agglomeration as an urban spatial organisation where capital, labour and information concentrates. They define urban agglomeration as a highly development spatial pattern of cities who compete while also seek collaboration with each other. As the definition suggests, contemporary cities grow by developing their comparative advantages as specialisation and act as individual market participants with policy interaction. Echoing the point proposed by Adam Smith that expanded markets are the prerequisite for specialisation to increase production and require collaboration, urban agglomeration evolves from city to national level as economic development expands.

Combined the notion that innovation as the new anchor and agglomeration as the scale for economic development, the importance of studying urban agglomeration as the catalyst for innovation has been more than highlighted. As the production method evolves from labour-oriented to knowledge-intensive, Florida et al. (2017) argued that knowledge-based cities and regions have taken over as the new core organising unit for innovative activities. Current research explains the agglomeration of innovation with two ideologies. The first ideology focuses the spontaneous emergence of such agglomerations. These articles usually further stretch the notion of anchor points, such as intuitive feedback among firms, universities and R&D institutes, and social

network, as self-reinforced mechanisms for innovation activities (Carlino and Kerr, 2014; Manso, 2011; Saxenian, 1994; Etzkowitz & Zhou, 2006; Kerr, 2014; Wu, 2018; Saxenian, 1990). The second ideology penetrates from an institutional view. Unlike the view under neoliberalism that government acts as a marginal participant within the free market, this ideology emphasises the role of policies in kick-starting and magnifying the agglomeration of innovative activities. Zhang and Wu (2019) argued that agglomeration is a necessary but not sufficient condition for regional innovation, which means the self-reinforced mechanism is not capable of explaining the agglomeration of innovation. From the welfare state to the state entrepreneurialism, government policies usually act as the context-specific approach in promoting capital and labour accumulation in new locations. However, no matter from which ideology, they both recognise the positive economies of scale of agglomerations.

Despite the rich collection of literature, few of them cut in from a political view and examine the actual effect of planning policies that foster agglomerations on innovation, especially at the regional level. Brenner (2004) concluded from different historical periods that the urban-regional regulations differ under the local, city, regional, and national level. Therefore, linking policies and the performance of regional innovation would provide empirical evidence and facilitate the refinement of the political perspective of agglomeration of innovation.

This dissertation examines the change of regional innovation capacity (RIC) in Yangtze River Delta Urban Agglomeration (YRDUA) and uses associated spatial planning policies to explain the change. For the purpose of this dissertation, regional innovation capacity (RIC) is defined as the acquisition, absorption, and transmission of knowledge and technology that improve the output of products and services within a region (Furman et, al., 2002; Riddel and Schwer, 2003).

YRDUA, which comprises 1 municipality (Shanghai) and 4 provinces (Zhejiang, Jiangsu, and Anhui) is a good case study area due to its intensive innovative activities and strategic importance. Chinese national planning policies have been constantly facilitating the agglomeration of innovation within it during the past decade. Through agglomeration plans in 2010, 2016, 2019 and the 2021 national strategy, the area is gradually promoted to one of the five high quality urban agglomerations to foster economic synergy and spill-over. Therefore, studying the change of YRDUA provides a

paradigm for the evolution of other agglomerations in China.

This dissertation examines the research question **'How do spatial planning policies influence regional innovation capacity within an urban agglomeration over time?'** with four objectives:

1. To explore the effectiveness of the evaluation framework of regional innovation capacity over time.
2. To explain the divergence of innovation capacity between regions.
3. To explore how planning policies influence the change of innovation capacity in objective 1 & 2.
4. To provide implications for future policy formulation on regional innovation capacity.

The following chapters unfold as follows. The next chapter starts with reviewing the scope and evolving anchor point for the agglomeration of economic activities. Then the concept of innovation and its growing significance as the facilitator of contemporary urban agglomerations are introduced. Followed by this is the review of two different ideologies towards the formation of agglomeration of innovative activities. The literature review is then closed with the existing research scopes under the Chinese context. Chapter 3 firstly identifies the research gap and proposes the research aims based on the literature review. It then introduces the case study area and the quantitative approach applied for data analysis. Chapter 4, together with Chapter 5, presents the results and further interprets the data. At last, Chapter 6 concludes the main findings, recognises the limitations, and provides suggestions for further research on this topic.

Chapter 2: Literature Review

2.1 Agglomeration: An evolving geography for economic development

Research on urban agglomeration has become increasingly prominent during the last two decades. As a constantly evolving concept, the definition of urban agglomeration varies.The United Nations define agglomeration as the population contained within the contours of a contiguous territory inhabited at urban density levels without regard to administrative boundaries. Fang and Yu (2017) reviewed the evolution of terms for 'urban agglomeration' over 100 years of scholarly research and summarised it as a highly integrated spatial pattern of developed cities. They illustrated the evolution of urban agglomerations with four expansions (figure 1): stage 1 is denoted by a single metropolitan area, which gradually transits to stage 2 by absorbing nearby suburban areas to form a metropolitan area belt; stage 3 is represented by the connection of three or more cities and their peripheries at the regional level, while stage 4 comprises of an extensive connectivity network within and among metropolitan areas at the national or international level. This dissertation mainly discusses the agglomeration of innovation at stage 2 and 3.

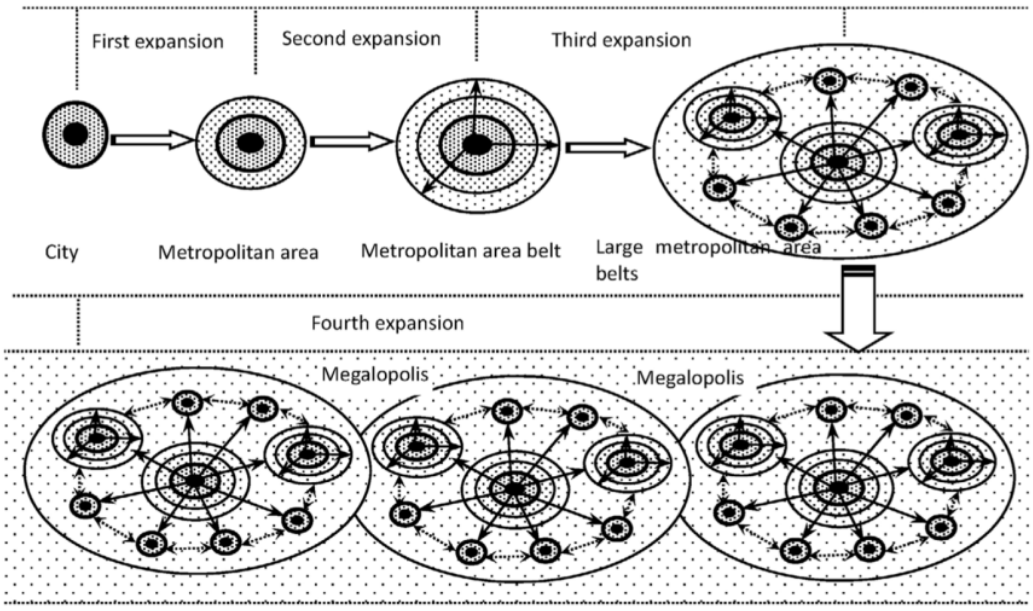

Figure 1: The four stages of urban agglomeration (Fang and Yu, 2017)

The scope on urban agglomeration can be generally dissected under Gottmann's *Megalopolis: The Urbanisation of the North-eastern Seaboard of the United States* published in 1957, where he proposed four primary conditions for agglomerations to occur.

2.11 Spatial proximity and transport convenience

The spatial form of an urban agglomeration identifies one or two urban cores and incorporates peripheral regions following a tier approach. Despite various definitions of the core cities under different contexts, a hierarchical structure which identifies small, medium, and large cities in a cluster is what distinguishes urban agglomeration from other random clustering of towns (Fang and Yu, 2016). Cui (1992) described urban agglomerations as the outcome of industrialisation and city-centred economic development, under which each city has a clear division of function on material provision, finance, or information transmission within the wider urban spatial form (Qi and Duan, 1997). The emphasis on hierarchy of cities could be traced back to the foundation of the free-market economy. In the profound book *Wealth of Nations*, Adam Smith proposed the division of labour as the source of economic growth and stated that "the division of labour depends on market capacity", suggesting for the first time that specialisation of industrial production depends on market expansion, or in longer term, globalisation.

Based on the notion of sprawl, the early clusters of industries rely on the similarity and the spatial proximity of firms. Geddes (1915) explained the over-concentration of economic activities in one place as the consequence of distinctive natural resource advantages and transportation convenience. Mata et al. (2007) concluded that convenient inter-city transportation was more conducive to the formation of urban agglomeration. The significance of transport in facilitating agglomerations is underpinned by the nature of geography, where industrial productions are highly dependent on endowments of natural resources, terrains, coasts, climates etc.

Dating back to 1890, Marshall developed the idea of 'industrial zones', which incorporate a collection of small and medium enterprises with homogenous business lines. The neo-Marshallian clusters noticed that firms benefit from a reciprocal and innovative environment, under which they share the infrastructure and the highly concentrated professional labour pool for production.

However, due to the sameness of production function, its contribution was barely restricted to the exploration of a co-production environment, and it failed to expand the scope to urban externalities. Further developing Marshall's theory, Weber (1909) proposed the second stage for industrial clustering where the concentration of large firms triggered the gravitation of more businesses to one cluster because of the development of technical facilities, mature labour organisation, marketisation, and reduction in production cost. However, despite the inclusion of four more factors, Weber's contribution still lacked exploration on institution, society, culture, and context.

Francois Perroux proposed the theory of 'growth pole' in 1950. By introducing the idea of 'propulsive units', he believed that the growth of one unit would drive up the production capacity of other associated activities outside the unit, eventually 'polarising' the industry to specification. This theory emphasises the role of government in the process of forming and developing industrial agglomerations. It also acknowledged government investment as the driver for industrial clusters and specialised enterprises. The Regional Innovation System (RIS) proposed by Cooke (1992; 2001) addresses external attributes such as the infrastructural and super-structural issues, the culture of localities (Cooke and Morgan, 1998) to diversify the condition of industrial clusters. Further extension of the RIS emphasises the foster of indigenous innovation capacities and incorporated factors such as financial, market, social, intellectual, and human capital to differentiate the conditions upon which place-based agglomerations occur (Zhang and Wu, 2012).

However, from the neo-Marshallian cluster to RIS, they were criticised for not being generic and only exploring factors that affect a confined territory. Overcoming the restriction on spatial proximity, the attention on regional innovation shifts to a relational view that emphasises economic geography and network (Sunley, 2008; Yeung, 2005; Zhang and Wu, 2019).

2.12 Population and economic interconnectivity

Webster and Lai (2003) contended the spontaneous growth within an institutional network as the cause of urban agglomerations. Boschma and Frenken (2006) extended this notion by distinguishing different types of proximity, for example, cognitive and institutional proximities. Going beyond the

geographical scope, the attention shifted to the study of relationship of firms. Todtling (1992) suggested that the performance of leading enterprises within an industrial cluster and their interactions with others significantly affect overall regional innovation performance. Porter (1998) constructed the 'Porter Diamond' for productivity, innovation, and the business environment. In this model, the transformation of the business environment which supports increasingly sophisticated ways of competing results in successive economic upgrading, kick-starts and maintains the prolonged prosperity of innovative clusters. It complements the operation mechanism of RIS and explains why areas with similar endowments can end up with different economic structure and exhibit spatial disparity.

To explain the uneven spatial disparity, the New Economic Geography (NEG) noticed that economic activities are naturally concentrated in specific areas that possess comparative advantages such as natural resources, geographical advantage, large labour pools, or distortive policies (e.g., the decision to build capital city) (Krugman, 1991). Once the region establishes its own competitive advantage, the self-reinforcement mechanism would act as the driver for increasing returns and lead the region into a beneficial cycle. However, Krugman also noted that no economy can sustain increasing returns without structural transformation or policy intervention under NEG. This argument echoes the Schumpeterian perspective that capitalism needs incessant creative destructions as the source of economic change.

Explaining the concentration of economic activities from another angle is the New Urban Economics (NUE) developed by Edward Glaeser in his eminent book *Triumph of the City.* Glaeser (2011) contended that cities are only places where wealth concentrates and people assemble. It is the people who add diversity to the urban economy that are key to urban growth. However, the NUE upholds neoclassical concepts and share their limitations. For example, it negates the effect of public policies in kick-starting metropolitans (Glaeser, 2011; Florida, 2017). The theory uses traditional trade-off ideas, such as the Von Thunen land theory to explain the firms' locational decision. However, this perspective is anti-planning, as Cheshire and Hilbre (2019) pointed out that distortive planning policies such as Green Belt or zoning can be detrimental to housing prices and cause inequality, which contradicts the notion of agglomeration to trickle-down economic benefits

(Harris and Moreno, 2012).

Contemporary studies on urban agglomeration can be seen as a move away from the pure exploration of geographical place advantages to context and people. Notwithstanding whichever approach explains the evolution of urban agglomeration, there is no 'one-size-fits-all' context (Asheim et al., 2011: 899-900. The 'best practices' of growth models should be derived from the institutional history of regions themselves and only performed with the consideration of specific urban environments.

2.2 Linking innovation and agglomeration

Before reviewing the role of cities in facilitating innovation, one needs to understand the common definition of innovation and it is role in economic growth. Defined by OECD's Olso Manual (2005):

An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

For Schumpeter, innovation represented the introduction and commercialisation of goods and service into the market, producing immediate welfare effect and yielding regional and national growth differently (Carlino and Kerr, 2014).

In 1943, Schumpeter pointed out the crisis-prone tendencies of capitalism and the incessant destruction to create new production methods as the fundamental impulse for economic breakthrough. Schumpeter referred innovation as the 'Creative Destruction' which allowed capitalism to reinvent itself, and believed such innovative disruption occurs in cycles to push forward technology evolution (Rosenberg, 2011). In 1982, David Harvey proposed in his book *the Limits of Capital* the idea of 'spatial fix', which he described geographical expansion and restructuring as an insatiable drive of capitalism to overcome crisis tendencies by constantly creating and destroying fixed spaces for accumulation. Combined with Jane Jacob's (1969) point that 'cities have their own dynamism', the focus on urban economic development then leaned

towards the heterogeneity of the urban environment and diversified motivations which sustain the persistent development of urban agglomeration.

Friedman (1986) wrote that in the edge of globalisation, the success of urban agglomerations hinges not on the population size but people's ability to involve in global trade and to grab and process information. Glaeser's (2011) believed that an increasingly prosperous world would continue to treasure the innovative enjoyments that cities provide. Harris and Moreno (2012) suggested talented people as the key to economic growth under the narrative of 'creative cities'. They argued that large cities rich in culture and diversity explicitly incubate social and physical conditions within which new ideas and technologies emerge. Krugman (1998) concluded that converting technology to a form of 'public good' accessible to everyone, innovation acts as the propulsion through the integration of elements such as talents, capital, technology, facilities, information, and knowledge. Florida et. al (2017) uphold a similar perspective and described cities as innovation machines and referred them to as 'tolerant places' where creative people gather to generate urban and regional growth through innovative and high-end industries. They argued that that innovation did not stochastically emerge in cities but in fact require them.

However, there are also limits to creative cities. Harris and Moreno (2012) argued the large-scale concentration of innovation in cities creates commercial and residential spaces for large corporates and high earning elites only by sacrificing the creativity, diversity, and plurality of small producers. Concerns on the rising inequality, economic segregation and housing speculation have also been raised (Florida, 2017). Rodríguez-Pose (2020) pointed out the concentration of economic activities to metropolitans exacerbates geographical inequality. While technology revolutions and the change in production method, which require more sophisticated skills and knowledge, widen the income inequality among different social status (Milanovic, 2016).

Florida et. al (2017) noted that the study on the geography of innovation seeks to find out the spatial correlation of innovation and regions, and the processes within which such patterns are shaped. Initial innovation clusters tended to be highly concentrated and localised near universities and corporate R&D centres, typically in the form of tangible innovation such as patents and citations (Jaffe, Trajtenberg, and Henderson, 1993; Buzard and Carlino, 2013). Subsequent studies

on commercial product innovations found they are even more concentrated than tangible innovations (Acs et al., 1994; Florida and Kenney, 1988). For example, R&D activities tend to concentrate in California's Bay Area in the United States (Buzard and Carlino, 2013); 75% of the French R&D workers concentrate in 6 regions in the country (Carrincazeaux et, al, 2001). As such, innovation associated economic development are more likely to form agglomerations and concentrate spatially at a point in time. However, such agglomerations are prone to ebb away as the tangible knowledge assets (such as the popularisation of patents) transfer across space (Ellison and Glaeser, 1999). This explains the successive establishment and destruction of spatial fix, where new fixes are only destroyed or devalued to make way for the new 'spatial fixes'.

The Marshall-Arrow-Rome (MAR) theory emphasises knowledge spill overs within agglomerations. Moving on to research on the regional geography of innovation and knowledge spill overs, Audrestsch and Feldman (2004) indicated that empirical evidence hinted a spatial dimension distribution of knowledge production. Carlino and Kerr (2014) found that innovations are more concentrated than other general economic activities and exhibit spatial movements of clusters over time while maintaining concentration. This is a strong statement as it lends foundation for future studies upon the promotion of innovation across urban agglomerations by policies. While some studies (Rosenthal and Strange, 2001; Ellison et al., 2010; Arzaghi and Henderson, 2008) suggested that knowledge spill-over effects are most localised, dissipating rapidly with distance when one firm locates further away from similar businesses. However, the diminishing margin does not negate the spill-over effects that all firms within an agglomeration enjoy higher returns as the result of concentration (Carlino and Kerr, 2014).

2.3 Spatial ideologies of agglomeration of innovation

Studies on innovation cannot circumvent mentioning entrepreneurship as innovation is a creative and entrepreneurial activity exercised by entrepreneurs. By entrepreneurship, Florida et al. (2017) referred it as the creation of start-ups which grow rapidly and profoundly influence their industries or the whole economy. Research trying to understand entrepreneurship found it follows a similar pattern as innovation, represented by the heavy clustering in places with the regional talent base

and labour market (Evans & Leighton, 1989; Roberts, 1991; Armington & Acs, 2002; Sternberg, 2009).

Based on the Schumpeterian-inspired entrepreneurialism, study on innovation can also be divided into two streams following entrepreneurship. The first branch researches the impact of technological change and diffusion on innovation and emphasises the spontaneous concentration and growth of creative industries; whilst the other one moves from laissez-faire to an institutional approach, highlighting the effect of policies in facilitating regional growth and promoting regional competitive advantage.

2.31 Locational choice and self-reinforced agglomeration

Scott and Storper (2015) views the self-reinforcement of agglomeration as the nature of cities. Incipient discussions on this topic hinge on the spontaneous clustering of innovative activities around 'natural advantages', which can be geographic advantages such as mineral deposits, harbours or historic transport nodes, or intellectual advantages such as the decision to build capital city, concentration of institutions, universities, and R&D centres. von Hipple (1994) pointed out that contextual and uncertain knowledge, especially knowledge, is hard to be transmitted through telecommunications but best via face-to-face. Audretsch (1998) argued that as the term knowledge is vague and hard to codify, transmission cost of information rises with distance. As such, the spontaneous agglomeration of innovative activities has a strong propensity for location choice.

Starting with the self-reinforced and persistent growth of clusters, sustaining mechanisms of agglomerations are explored. Carlino and Kerr (2014) pointed out that the intuitive feedback mechanism within clusters is crucial to the financial industry. They concluded that within financial agglomerations, the co-location of investor, intermediaries and banks helps improve the reputation of participants and encourages long-term cooperation by eliminating the asymmetric information and moral hazard, therefore forming a self-sustained loop through information feedback. Tolerance and wiggle room for failure are also important to maintain growth (Manso, 2011). When the cost of trial and error is high, it is unlikely to have further innovative practices which bring new capital into one agglomeration. Koh et al. (2005) studied the growth mechanisms for science parks. They

observed that constant waves of technological innovation breakthrough, from internet to IT and e-commerce, explains the long prosperity of Silicon Valley, whilst Cambridge science park sustains by further attracting firms, labour, and investment directly in or to the vicinity of the area.

There is a rich base of literature studying the importance of universities and R&D centres as anchoring points for innovation within an agglomeration. First, furthering the Regional Innovation System (RIS) reviewed before, the triple-helix model was proposed to explain the relationship of industry, government, and university to facilitate innovation within the civil society (Etzkowitz & Zhou, 2006). In this model, university plays the leading role in generating intellectual capital to incubate the emergence of innovative ideas. Industry acts as the creator of wealth and realises those innovative ideas into real products and services. Government plays the minimum role as the regulator of standards to safeguard a stable urban environment for such processes to take place and drafts policies afterwards to promote knowledge spill overs. Some studies have suggested a strong positive correlation between local patents and academic R&D activities conducted in the local universities (Andersson et al., 2009; Agrawal and Cockburn, 2003). In addition, studies have revealed that universities would bring researchers and academia who facilitate relevant innovative activities. This is backed by the evidence that the rise of Silicon Valley and Boston as the consequence of proximity to Stanford and MIT (Saxenian, 1994).

Apart from R&D and universities as the anchor point, social network also acts as a significant endowment for agglomeration of innovation. Setting aside innovation, Wu (2018) explained the concentration of rural migrants in Chinese cities through the incentive to build dense social networks. He cited that rural migrant living in the place nicknamed little Hubei in Guangzhou, which is an essentially a migrant enclave of people from Hubei province, are all engaged in textile manufacturing and business. Through the strong place attachment and culture identity, certain group can actively lead the development of one industry and change the urban environment. Looking into the agglomeration of innovation in the United States, Kerr (2010) described how the contributions of Chinese and Indian increased the innovative workforce in the San Francisco Bay Area, and consequently strengthens this spatial concentration and self-sustain the growth of agglomeration through identity. The value of social network is explained by the greater

interdependence and exchange among individuals, as Saxenian (1990) evidenced that areas with more cohesive network tends to have a superior innovative performance compared to more isolated ones.

3.32 Institutional choice and policy-reinforced agglomeration

Overcoming the natural selection of locations for agglomeration, the effect of policies and institutions in forming agglomeration for innovation is reviewed. Before moving on to this topic, it is necessary to look at the wider theoretical environment in which such policies and political activities are incubated. Audretsch (1998) noted that the underlying structure between regions accounts for the gap of economic growth and technological advancement. Therefore, early practices under both the Fordist regime and the socialist regime are discussed.

Spatial Keynesianism is one of the representatives of the Fordist regime established upon John Keynes' profound welfare state theory. With the aim of balancing regional deployment of production capacities and infrastructure and maximising national output, Keynesian policies transfer economic activities from fast growing areas to the lagging ones by stimulating the demand side through large-scale nationalised industries (Pike et al., 2016; Brenner, 2004). Such practices include the promotion of New Towns and compensatory regional policies in most post-war European countries. The later Regionalism under the UK's New Labour can also be seen as an attempt to search for an appropriate scale for policy-intervened agglomeration (Baker and Wong, 2013).

On the other hand, state-led industrialisation dominates the socialist regime in the 20th and is eminent for the developmental state in East Asia. It should be noted that the developmental state does not fully equal redistributive state, as Woo-Cummings (1999) coined it as an interventionist form of political ideology between capitalism and socialism, where the plan-rational capitalists conjoin private ownership with state guidance and the regulatory state protect the public against serve market failures through a series of interventions. Such practices are also seen in some social-democratic countries. The redistribution process allows the government to channel surplus into new areas to avoid overaccumulation and inequality. For example, in Netherlands, when the

growth in the Green Heart (growth centres identified in four major Dutch cities) is taking place at a higher rate than the national average, new development would be channelled to nearby new towns or city-regions (Van Der Valk, 2002; Pieterse et al., 2005).

It should be noted here that both the two schemes strongly depend on the expansion of public spending and uphold the notion of 'accumulation' under 'spatial fix', which is reviewed in the previews section. The accumulation of either capital or human resource is reinforced by the competitive advantages under Paul Krugman's New Economic Geography, which is crucial to foster the initial agglomeration of innovation. The role of policies in the early stage is more of proactively breaking the initial 'spatial fix' and creating competitive advantages out of space, rather than passively counting on the locational choice and the spontaneous accumulation to certain places. However, for both the schemes, there is an embedded crisis in the accumulation process. For the Fordist, it is difficult to break and establish a new spatial fix cycle itself, while for the socialism, the lack of market information causes a lack of effective demand and incentives to mobilise subordinated production units (Wu, 2003).

Amin (1994) suggested a fundamental change in the accumulation regime of advanced economies since the socialist and Fordist regime. Wu (2003) proposed the concept of 'transitional cities' to describe the declining role of policies in shaping urban patterns and the convergence of cities towards the Western neoliberal system. Either like the spatial Keynesianism which only views state intervention as the last resort to market failure, or the redistributive state who proactively dominates the organisation of production and consumption, transitional cities emphasise the policy effect in helping the accumulation process. However, such transitions do not denote complete overhaul of policy intervention or a shift to the production function of 'flexible accumulation' under the neoliberalism, but more of the change to entrepreneurial cities through constellations of institutional reengineering such as productive infrastructure, mega urban projects, land financialisaton etc (Wu, 2003; Zhang and Wu, 2019).

Wu (2003) coined post-Fordist and post-socialist and the product of transitional cities. For a post-Fordist regime, the Enterprise Zones in the UK identified locations to attract inward investors by seeking to remove all the barriers for business (Larkin and Wilcox, 2011). This attitude towards

spatial planning defies Keynesian consensus through privatisation of state-owned enterprises and deregulation of industry but provide more incentives for the agglomeration of innovation and entrepreneurialism represented by the rise of Canary Wharf. Moving further for the UK are the devolution, austerity urbanism and the 'Localism' which abandons regional policies but is criticised as being 'winner selection' and exacerbating regional inequalities (Swain and Baden, 2012). One important note here is that as the urban governance shifts from the managerialism to austerity, the context for operating cities is more than ever financialised and market-led (Peck and Whiteside, 2016).

This phenomenon is also seen in the post-socialist regime and, especially under the Chinese context and characterised by 'State Entrepreneurialism'. Contrary to the belief that planning impedes growth under neoliberalism and individualism, this idea combines the implementation of planning centrality and market mechanism by allowing the state to sustain and outreach its political power by through the market due to the distinct national land ownership in China. Wang and Wu (2020) summarised this approach into three stages: firstly, the city government uses public land as collateral to borrow from the bank, financing the collection of parcels of rural land and basic provision of social infrastructure; then the state actively boost the initial economic agglomeration by setting up industrial zones and providing industrial premises and offices, which consequently are rented or sold with lower-than-market prices; once an agglomeration is successfully formed, the state reaps its gain by selling parcels near the agglomeration which benefits from the rise of land value for commercial and residential development. At the national level, Urban System Plans identify different urban clusters and city-regions with growth potential (Li and Wu, 2012), and regional strategic plans such as Yangtze River Delta Regional Plan subsequently seek to reintroduce a more cohesive order of spatial development by connecting the former created small-scale agglomerations together (Wang and Wu, 2020).

It should be noted that despite the diminishing role of policies in spatial intervention, the post socialist regime does not mean the retreat of state. Instead, cities shoulder greater share of local expenditure including public service and provision of infrastructure through innovative land financialisaton methods such as industrial parks and university towns. Koh et al. (2005) analysed

industrial parks through an institutional lens and concluded that policies have a leading role in the formation and identification of the competitive advantages of industrial parks. The Hsinchu Science Park in Taiwan is an example which benefits from the continuous support of technology start-ups by a government-directed approach. They concluded that the provision of high-quality infrastructure is crucial to signalling R&D operations and attracting foreign investment. Wu (2018) studied government-led university towns as an arena for agglomeration of innovation. He argued that university towns kick-start the process of suburbanisation by attracting more residents to justify the development of infrastructure and landscaping strategy in suburban areas. Again, through a land value capture mechanism, more capital inflow is supposed to support the continuous flourish of such university towns. This approach is unlike the post-Fordist knowledge economy but captures both public and private parities into the formation of agglomeration through entrepreneurial land development and infrastructure provision (Li et al., 2014).

The role of the central government is therefore more about steering the initial agglomeration and market-like activities under its deliberately designed framework and connecting them to form a more evenly distributed spatial pattern through the endorsement of special status in development zones and policy interventions (Wu, 2003; 2018). What is important here is the creation of an institutional environment which sets out the formal rules of the game and fosters a tacit collaborative culture among agglomerations (Williamson, 2000; Dunford and Li, 2010).

Patanakul and Pinto (2014) summarised three conditions for policies to facilitate the agglomeration of innovation: 1) by directly kick-starting new clusters with stringent and focused innovation policies; 2) by providing a basis for innovation through infrastructure, knowledge sharing platforms and injection of quality workforce etc; 3) by creating a favourable environment for firms to voluntarily cluster in a new location. Interestingly, the development pattern under both the Fordist and Socialist regime coins with these three stages, manifested by a declining policy intensity and more inclusion of market-steered activities.

Moving towards today, most policies such as London Plan and Yangtze River Delta Agglomeration Plan now seek the integration and collaboration of cities or regions with a more discretionary and

modest manner, actively promoting innovative activities through good place-making practice. The figure below summaries this process.

	Stage 1: Redistributive	Stage 2: Transitional	Stage 3: Promotional
Fordist Regime (represented by the UK practices)	Spatial Keynesianism	Regionalism	Localism
Socialist Regime (China)	Redistributive State	Land Finance	State Entrepreneurialism

Figure 2: Summary of the policy condition for agglomeration of innovation

2.4 Research scopes on the agglomeration of innovation in China

For the purpose of this dissertation, the author adopts regional innovation capacity as measurement for the agglomeration of innovation. Regional innovation capacity (RIC) is defined as the acquisition, absorption, and transmission of knowledge and technology that improve the output of products and services within a region (Furman et, al., 2002; Riddel and Schwer, 2003). Existing research mostly focuses on the evaluation of innovation capacity at city level from three aspects:

1) Research on the synergy between regional innovation ability and economic development (Gu et, al., 2017; Jia et, al., 2020; Bi and Shi, 2008; Hou et, al., 2016). Gu et, al. (2017) concluded that there is a significant correlation and path dependency between innovation capacity and economic development. The improved innovation capacity increases the degree of regional economic convergence is conducive to the elimination of inequality within an agglomeration.

2) Some studies (Huang et, al., 2018; Xu and Cheng, 2006; Wang and Liang, 2016) extend the first scope to seek the determinants resulting in the spatial difference of innovation capacity by comparing cities. Albeit the New Economic Geography and New Urban Economics hold different opinions, core cities in an agglomeration usually have a significant impact on determinants. For example, Beijing possesses an affluent number of scientific research institutions and universities

with strong knowledge generation ability. The Yangtze River Delta agglomeration relies on Shanghai's foundation in manufacturing and the overarching city-industry integration. The Pearl River Delta has established a complete industrial chain for its electronic information and technology innovation industries between cities (Economic Daily, 2019). These evidence leads to a conclusion similar to the heterogeneity of the urban environment that areas built their own characteristic regional innovation systems.

3) Studies (Jiao et, al., 2017; Liu, et, al., 2020) also examine the spill-over effects of economic activities from affluent cities to surrounding relative lagged-behind areas within an urban agglomeration. It is found that the spill-over of innovation knowledge has a certain spatial distance, which means the trickle-down effect has a limited radiation range.

Chapter 3: Methodology

3.1 Research gap and objectives

Most of the studies reviewed in Chapter 2.4 focused on the relationship between cities within an agglomeration. However, with the promotion of regional economic integration and urban sprawl, the disparity of economic development between cities enlarges, therefore making comparisons at the city level not always intuitive. In addition, as discussed in the literature review that self-reinforcement and policy intervention are both able to facilitate the development of agglomeration, while very few studies focus on explaining the difference of innovation capacity from a policy perspective. As such, this dissertation identifies the following research gap based on literature review:

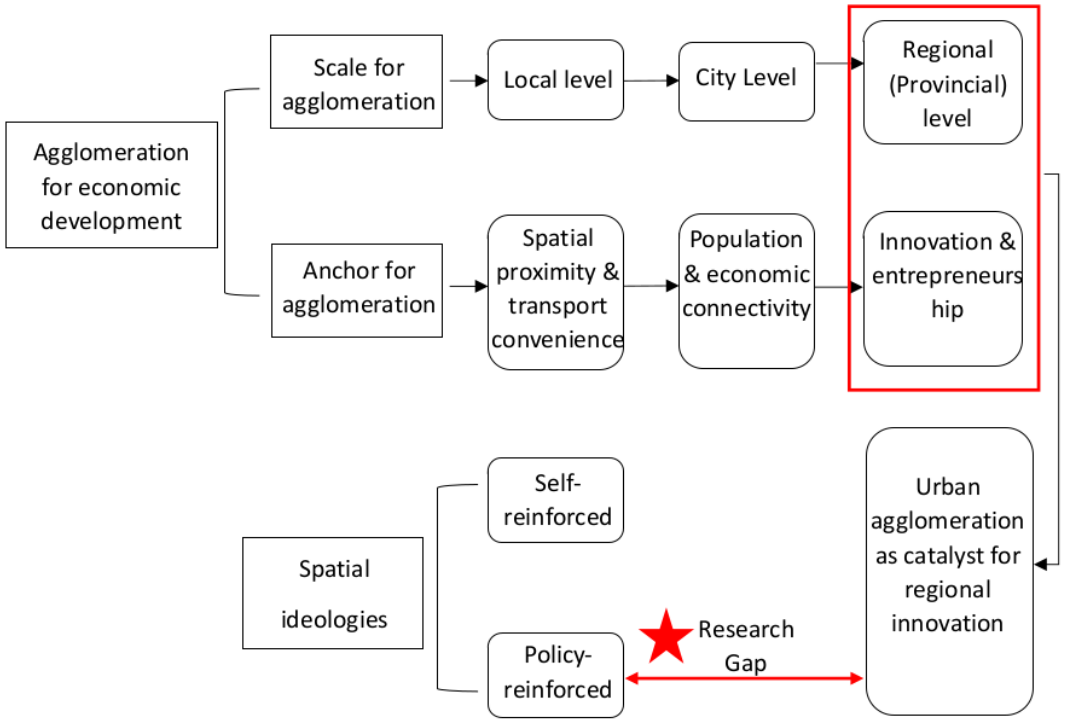

Figure 3: Identifying the research gap from literature review

This dissertation examines the spatial-temporal evolution of innovation capacity at the regional (or

provincial) level (i.e., stage 3 of the agglomeration model) in YRDUA. A hybrid methodology of literature review and quantitative analysis is adopted. First, the effect of policies is mainly reflected by the numerical changes of factors measuring innovation capacity. Then, relevant policies and literatures are reviewed to support the data results and future predictions. The table below summaries the linkage between research objectives and methodology:

<table>
<tr><th>Research Question</th><th>Research Objectives</th><th>Methodology</th><th>Research Procedure</th></tr>
<tr><td rowspan="4">How do spatial planning policies influence regional innovation capacity within an urban agglomeration over time?</td><td>1. To explore the effectiveness of the evaluation framework of regional innovation capacity over time.</td><td rowspan="2">Quantitative analysis</td><td rowspan="4">1. Short review of the evaluation framework and selection of data.
↓
2. Data processing to generate rankings for innovation capacity and its determinants.
↓
3. Preparation of charts to further analyse the data in Procedure 2 and demonstrate objective 1 and 2.
↓
4. Review of relevant policies and reports to answer objective 3.
↓
5. Implications of the trend and advice on future policy formulation (Objective 4) based on Procedure 3 and 4.</td></tr>
<tr><td>2. To explain the divergence of innovation capacity between regions over time.</td></tr>
<tr><td>3. To explore how planning policies explain the change of innovation capacity in objective 1 & 2.</td><td rowspan="2">Policy review</td></tr>
<tr><td>4. To provide implications for future policy formulation on regional innovation capacity.</td></tr>
</table>

Table 1: Research Structure

3.2 Research Area

Yangtze River Delta Urban Agglomeration (YRDUA) is selected as the case study for this dissertation. It is selected for two reasons – its economic priority and national strategic importance. YRDUA is one of the 19 national level urban agglomerations in China. It comprises 1 municipality (Shanghai) and other 25 cities from Zhejiang, Jiangsu, and Anhui Province. This dissertation will analyse data at the municipal and provincial level. As one of the most developed and well research regions with the largest concentration of population, it contributes one fourth of the national GDP and is home to some of the most advanced biopharmaceutical technology in China.

The prototype of the YRDUA is Shanghai Economic Zone established in 1982, with a primary focus on light industry, machinery, transport and imports and exports. With the settlement of original pillar industries and the growing force in finance and biologic science, the Chinese state council approved the *Yangtze River Delta Regional Plan* in 2010 to transform the region into a global centre for modern services and advanced manufacturing. In 2018, it was appointed as the national strategy; in 2021, the *Fourteenth Five-Year Plan* identifies it as one of the five high quality urban agglomerations to foster economic synergy and spill-over.

Figure 4: Map of the research area - YRDUA (Source: Xia et al., 2019)

3.3 Quantitative approach

3.31 Evaluation framework

The evaluation model for regional innovation capacity gradually moves from sole emphasis on self-reinforcement to the wider political context. Jiao et, al. (2017) argued that Chinese governments mainly promote regional innovation capability by formulating relevant fiscal and industrial policies. Therefore, some evaluation models (Jiao et, al., 2017; Wang and Liang, 2016; Bi and Shi, 2008) predominantly emphasise the conversion of skills into products and focus on the relationship between input and output of labour and capital. Prajogo and Ahmed (2006) studied the relationship between innovation stimulus, capacity, and performance. They concluded that although the effect of innovation stimulus on performance is mediated through capacity, it is still crucial for organisations to develop the behavioural and cultural context and practices for innovation. Subsequent models also consider the impact of environment such as social benefits, economic environment, educational resources, financial support, social informatization. (Jia et al., 2020; Hou et al., 2016; Gu et al., 2017). Frameworks studying innovation capacity at national or regional level may also incorporate factors such as international competency and macroeconomic condition etc.

However, there is not a common framework for evaluation. As cities went through industrial upgrade (e.g., Suzhou Industrial Park transformed from manufacturing to telecom and biotech; the expansion of Zhangjiang Biotech Park in Shanghai), major indicators such as capital, intelligence, and information flow geographically will significantly alter the spatial pattern and correlation of the innovation capacity of each city (Hou et, al., 2016).

As this dissertation mainly studies at the regional level, it adopts the evaluation framework form *China Regional Innovation Capability Report (2020)* (Table 2). The advantage of this model is it is relative authoritative and factors most of the explanations for regional innovation in the literature review, including innovation anchor point, network, environment, and growth potential. However, despite the major 20 indices being constant over years, some of the variables counted in each index may be slightly different. Therefore, this dissertation selects the index layers of this evaluation model as variables and use quantitative approaches to examine whether it properly calculate

regional innovation capacities.

Target Layer	Rule Layer	Index Layer[1]
Regional Innovation Capacity (RIC)	Knowledge Output (Z_1)	Local government R&D investment (Z_{11})
		Patent and copyright (Z_{12})
		Research paper publication (Z_{13})
	Knowledge application (Z_2)	Scientific research collaboration between scholars (Z_{21})
		Technology transfer between firms (Z_{22})
		Foreign Investment (Z_{23})
	Corporate Entrepreneurship (Z_3)	Corporate R&D investment (Z_{31})
		New product design ability (Z_{32})
		Technology update expenditure (Z_{33})
		New product sales revenue (Z_{34})
	Innovation Environment (Z_4)	Infrastructure for innovation (Z_{41})
		International and domestic trade (Z_{42})
		Labour force quality (Z_{43})
		Financial loans (Z_{44})
		Entrepreneurship level (Z_{45})
	Innovation Performance (Z_5)	GDP performance (Z_{51})
		Industrial structure (Z_{52})
		International competency of industries (Z_{53})
		Employment rate (Z_{54})
		Sustainable development (Z_{55})

Table 2: Innovation Capacity Evaluation Framework

(Source: *China Regional Innovation Capability Report*)

[1] The full list of variables for index layers provided in Appendix B. Some variables may be slightly different over time, but the general category is the same.

3.32 Data selection and processing

Although the original report has an overall score for regional innovation capacities, it synthesises each layer with a subjectively allocated weight for each component. To eliminate the external weight attachment, this dissertation uses Principal Component Analysis (PCA) to re-synthesise layers and construct the evaluation function. PCA is a multivariate technique that analyses a data table in which observations are described by several inter-correlated quantitative dependent variables (Abdi and Williams, 2010). The more information one principal component contains, the higher its weight is. Although PCA is a common approach to calculate weights and derive comprehensive scores for ranking, Wang (n.d.) argued that more information does not necessarily equal higher significance. Some variables may reflect huge difference among samples but have little significance, and therefore, sometimes it would be more rationale for scholars to allocate weight themselves. However, as the objective of the dissertation is to examine policy effects on regional innovation capacity, it would be more proper to remove any subjective weight allocations. For example, if one unevenly assigns the environmental condition for innovation with a higher weight, it may amplify its impact on the overall score by undermining others, therefore raising bias interpretation of the policy effect on innovation effect. In addition, as the relative importance of difference factors change over time, the corresponding weight should also alter.

This dissertation selects 2011 and 2020 as time nodes for comparison. In 2010, the Chinese state council official rolled out *Yangtze River Delta Regional Plan,* and therefore, 2011 is selected as the ground for comparison. 2020 is selected as it uses data in 2019 and therefore circumvents the impact of COVID-19 on major economic indicators. The time series data are retrieved from *China Regional Innovation Capability Report (2011)/ (2020)* respectively. Original data of the report was retrieved from published statistic year books and government reports, with missing data being smoothed.

The sample size includes all 31 provinces and municipalities in Mainland China. All data are processed with SPSS Statistics V28, then the relevant data for provinces (and Shanghai as the municipality) as applied to the final equation. The detailed data processing procedure is as follows:

Step 1: Standardise all variables (z-score) in SPSS.

Step 2: Synthesise the three layers of indicators in the evaluation framework from the bottom-up to determine the weight coefficients. Taking the index layer for year 2020 as example:

2.1. conduct PCA to all raw variables Z_i $(i = 11,12, \dots 55)$ in each index layer.

2.2. select the first m principal components $Z_{i1}, \dots, Z_{im}$ decided by the eigenvalues.

2.3. use the variance contribution a_m of each principal component as weight to construct the function $Z_{ij} = a_1F_1 + a_2F_2 + \cdots + a_mF_m$, where F is the principal component score.

2.4. calculate the score for each index layer with the function in 2.4 for ranking.

Step 3: Repeat step 2 for rule layer to generate the function for regional innovation capacity.

Step 4: Repeat step 1-3 to generate scores for the year of 2011.

3.33 Research Ethics

1. The evaluation framework and data are retrieved from national publications with proper reference.

2. All data and indices are secondary and open to public access.

3. All official documents or reports published by the state or private consultancies will not be falsified to favour ideal arguments.

4. All resources in Chinese will be translated into English properly.

Chapter 4: Preliminary Results

4.1 Appropriateness of the evaluation framework

The outcome of evaluation functions is attached in Appendix A. The result shows that the evaluation framework adopted is appropriate for the analysis of regional innovation capacity. After conducting PCA to the 20 variables in index layers for 2011 and 2020, it is found that $Z_{11} - Z_{13}$, $Z_{21} - Z_{23}$, $Z_{31} - Z_{34}$, and $Z_{41} - Z_{45}$ perfectly synthesise into four components, reflecting Knowledge Output (Z_1), Knowledge Application (Z_2), Corporate Entrepreneurship (Z_3), and Innovation Environment (Z_4) respectively. Although $Z_{51} - Z_{55}$ was synthesised into two components ($Z_{51} - Z_{54}$ as one and Z_{55} as another), the factor sustainable development (Z_{55}) is negatively correlated with Innovation Performance (Z_5). The value of sustainable development reflects carbon emission and use of electricity and coal resources, meaning the higher the value is, the lower the level of innovation activity is. The five rule layers then perfectly converges into one principal component reflecting regional innovation capacity. As such, the PCA result is considered as rational.

Guadagnoli and Velicer (1988) concluded that variables that would clearly define a particular component will load highly. For this dissertation, all PCA results demonstrate a loading value higher than 0.7, which is higher than Guadagnoli and Velicer's suggestion of 0.6 for small sample size. In addition, all results show a KMO sampling adequacy larger than 0.5 and a Bartlett's significance less than 0.05. Therefore, the classification of evaluation framework is deemed overall conducive.

The following content sets out the primary scores for the rule layers and target layer.

4.2 Rule layer scores

Before starting comparison, it should be noted that all scores follow the Z-score distribution. The increase or decrease of scores primarily indicate the direction of the corresponding change. As the goal of this dissertation is to study the spatial-temporal gap, the scores therefore reflect the increase of decrease of gaps between regions.

Regions	Year	Rule Layer Indicators									
		Knowledge Output (Z_1)		Knowledge Application (Z_2)		Corporate Entrepreneurship (Z_3)		Innovation Environment (Z_4)		Innovation Performance (Z_5)	
		Score[2]	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Shanghai	2020	1.313	2	2.963	1	0.875	4	0.747	3	1.645	2
	2011	1.671	1	3.012	1	1.539	3	-0.50	4	0.927	2
Jiangsu	2020	1.426	1	1.146	2	1.797	1	1.594	1	1.948	1
	2011	1.516	2	2.023	2	2.686	1	2.368	1	2.269	1
Zhejiang	2020	0.789	3	0.171	3	1.353	2	0.979	2	0.694	3
	2011	0.438	3	0.380	3	1.772	2	1.333	2	0.807	3
Anhui	2020	0.258	4	-0.87	4	0.884	3	-0.54	4	0.374	4
	2011	-0.47	4	-0.72	4	0.082	4	0.090	3	-0.27	4

Table 3: Rule layer scores of regions in YRDUA (2011/ 2020)

Overall, the rankings of the four regions remain the same with minor fluctuations. Shanghai has seen declines in most of the rule layer indicators in the past decade, especially its Z_3, and Z_5 which have dropped for over half a point. Despite a slight drop in Z_2, its Knowledge Input remains the first by a margin of almost more than 2 points with other regions. However, Shanghai has significantly improved its innovation environment from 2011 to 2020, reflected by an increase of 0.8 points in Z_4 and dramatically closing the gap with the leaders. Interestingly, for Jiangsu, even though its overall performance keeps strong with four indicators ranking the first, it has experienced declines in all the five aspects. Notably, its Z_2, Z_3, Z_4 and Z_5 dropped by 0.877, 0.889, 0.774, 0.321 respectively, thereby substantially losing the distinct advantages to other regions. Zhejiang has seen a steady performance with all indicators remaining the same ranking. However, although its Z_1 improved by over 0.3 points, the other four indicators dropped by 0.1 to 0.4 points to different degrees. For Anhui, there is generally a rising trend. Despite slight decrease in Z_2 and Z_4, its other three indicators all experienced an obvious increase, especially Z_3. The overall increase

[2] Negative scores do not indicate negative performance but only the relative position of regions.

therefore offsets the decrease and closes Anhui's gap with other regions in most aspects.

Looking at the five indicators one by one, the absolute gap of Z_1, Z_3, Z_4 and Z_5 has notably narrowed by 0.973, 1.682, 0.734 and 0.965 points respectively. For Z_2, apart from the large drop of Jiangsu, the general ranking and gap remain unchanged; however, there is a declining trend for all regions. For Z_1, Jiangsu and Shanghai are still competitive, while their advantage is gradually challenged by the strong increase of Zhejiang and Anhui. For Z_3, Anhui has seen a robust increase while other regions are declining. Looking at Z_4 and Z_5, the decline of Jiangsu in these two factors is accompanied by the remarkable rise of Shanghai. Hence, it is extrapolated that there has been a move away of innovative capital and labour from Jiangsu to Shanghai.

Therefore, it is concluded that the four regions have generally seen a closing gap in the five rule layer indicators. Apart from Z_2, the decline of some regions is always accompanied by a robust rise of the left-behind ones.

4.3 RIC scores

Regions	2020		2011	
	Score	Rank	Score	Rank
Shanghai	1.652	2	1.518	2
Jiangsu	1.753	1	2.501	1
Zhejiang	0.887	3	1.102	3
Anhui	0.11	4	-0.228	4

Table 4: RIC scores of regions in YRDUA (2011/ 2020)

Table 4 compares the innovation capacity of the four regions in 2011 and 2020. Although the overall ranking does not change, there is a tendency for the gap between region's innovation capacity to close. The absolute difference between the highest and the lowest region declined drastically from 2.729 in 2011 to 1.643 in 2020. This decline is largely explained by the plummet of Jiangsu's score

for over 0.7 points and the elevation of Anhui's for over 0.3 points. Looking at the gap between regions, Shanghai has experienced an average growth of 0.88% annually and will be highly expected to surpass Jiangsu next year if the growth continues. For Zhejiang province, although its score declined during the last ten years, it is expected to maintain the third position in the next decade due to the large disparity with the second and fourth. The descent of top and the rise of bottom indicates more balanced development to a degree. Although Jiangsu remains the top, there is a tendency for Shanghai to take over as the new urban core.

Combining the overall result with the changes in rule layers, some interesting phenomena have been noticed:

(1) From the perspective of indicators, the divergence within each of them narrows. However, some of them have experienced stronger fluctuations than others and the highest value for all indicators dropped.

(2) From the perspective of regions, the divergence closes as well. Although the overall ranking did not change, Shanghai is expected to take over Jiangsu in the upcoming years. In addition, we are expected to see a clearer division of the production of innovation in recent years.

The following chapter aims to explore the causes of the above-mentioned changes and explain them by interpreting theories and policies, after which some future advice on spatial planning policy formulation will be provided.

Chapter 5: Analysis and Discussion

The main policies reviewed and adopted in this chapter are *Yangtze River Delta (YRD) Regional Plan 2010, Yangtze River Delta Urban Agglomeration (YRDUA) 2016,* and *Yangtze River Delta Regional (YRD) Integration Planning Outline 2019*.

5.1 Determinants of RIC

(1) Key determinants of RIC are now more policy oriented.

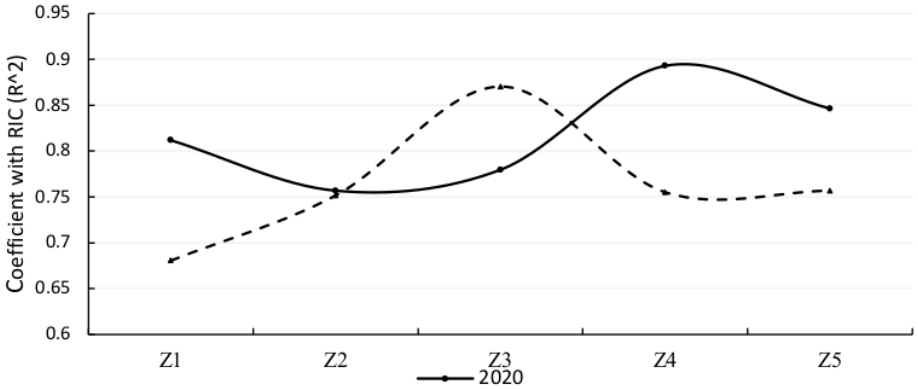

Chart 1: Coefficient of the rule layers and RIC in 2020 and 2011

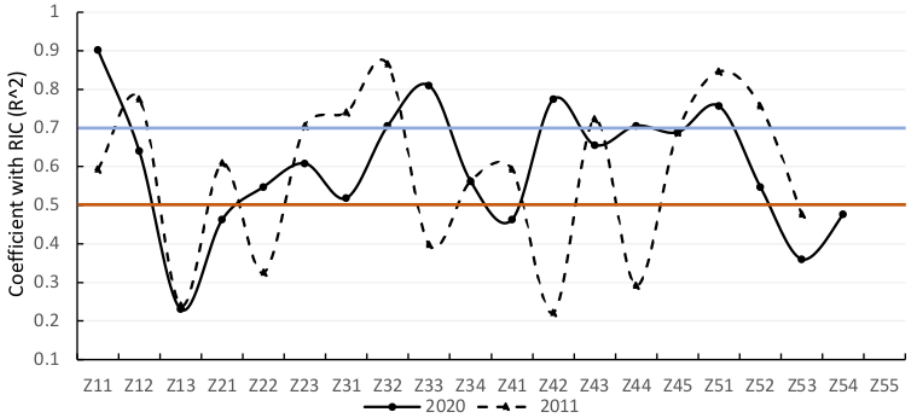

Chart 2: Coefficient of the index layers and RIC in 2020 and 2011[3]

Charts 1 and 2 illustrate the proportion of the rule layer and index layer indicators in explaining the

[3] Data for Z54 in 2011 and Z55 in both years are not included due to insignificance (two-tailed value large than 0.001).

regional innovation capacity. R-squared is a measure of the goodness of fit of a model (Casella, 2002). The higher its value is, the better a variable is at explaining the innovation capacity. For this dissertation, a value of at least 0.5 is deemed as useful and 0.7 is deemed as strong (Moore, Notz, and Flinger, 2013).

From the macro level, all five rule layer indicators are still robust in evaluating regional innovation capacity with correlations over 0.75 in 2020. Whist the effectiveness of Z_3 slightly dropped by less than 0.1 point, those of Z_1, Z_4 and Z_5 have significantly improved, indicating a more comprehensive performance of the framework. Such changes represent an evolution of innovation activities from input to output stage. The lead of Corporate Entrepreneurship (Z_3) in 2011 prepared firms with competitive new products and foster an innovative ambiance among firms, hence resulting in a stronger correlation of Innovation Environment (Z_4) and Innovation Perfromance (Z_5) in 2020. Knowledge Output (Z_1) also improved, largely because of national 5-year plans promoting more government investment into technology and innovation.

From the micro level, Table 5 summarises the changes of index layer indicators.

Local government R&D investment (Z_{11})	↑	New product design ability (Z_{32})	↓
Technology transfer between firms (Z_{22})	↑	Infrastructure for innovation (Z_{41})	↓
Technology update expenditure (Z_{33})	↑	Labour force quality (Z_{43})	↓
International and domestic trade (Z_{42})	↑	GDP performance (Z_{51})	↓
Financial loans (Z_{44})	↑	Industrial structure (Z_{52})	↓
Employment rate (Z_{54})	↑	International competency of industries (Z_{53})	↓
Patent and copyright (Z_{12})	↓	Research paper publication (Z_{13})	-
Scientific research cooperation among scholars (Z_{21})	↓	New product sales revenue (Z_{34})	-
Foreign Investment (Z_{23})	↓	Entrepreneurship level (Z_{45})	-
Corporate R&D investment (Z_{31})	↓	Sustainable development (Z_{55})	-

Table 5: Summary of the change of the coefficient of index layer indicators

The key determinants (defined as whose coefficient level is greater than 0.7) of the index layers

have reshuffled in the past ten years, led by local government investment (Z_{11}), new product design ability (Z_{32}), technology update expenditure (Z_{33}), international trade (Z_{42}), financial loans on innovation (Z_{44}) entrepreneurship level (Z_{45}), and GDP performance (Z_{51}). Interestingly, Z_{11} and achieved an R^2 of over 0.9, representing an extremely strong correlation with regional innovation capacity. Z_{33}, Z_{42}, and Z_{44} has extraordinary improvement, soaring from the insignificant level straight to the strong level.

Policies have played a leading role in this change. The key determinants of 2020 can be divided into two groups: the new (Z_{11}, Z_{33}, Z_{42}, and Z_{44}) and the convention (Z_{32}, Z_{45} and Z_{51}). For conventional factors, despite the decline, the new products of innovation, the number of large enterprises and the overall GDP remain crucial in deciding the output, transformation and environment for regional innovation capacity. For the new determinants, firstly, all YRD Plans have constantly address the position of enterprises as the main body of innovation from 2010. The 2010 *YRD Regional Plan* clearly set out the goal to construct an enterprise-oriented technological innovation system by increasing government spending and subsidising tax and fiscal expenditure on innovation. In terms of boosting international and domestic trade, it encourages the development of modern logistic and service industry through the construction of aviation and port transportation nodes and refinement of financial market system. The *YRDUA Development Plan 2016* continues to reinforce this sector through the exploration in free-trade port areas and rule of laws, aiming to establish institutional mechanisms that are compatible with international trade and investment regulations. In addition, it continues to improve the financial environment for innovation, requiring stricter financial regulatory cooperation between provinces to jointly prevent illegal fund-raising and improve the credit system.

It should be noted that Labour force quality (Z_{43}) is important in explaining RIC in both years. Glaser (2011) concluded that it is the people, rather than place, is the key growth factor. He used the rise of the 'consumer city' to explain the reasons that creative people gravitate to certain places. Under his thought, cities are only places that offer diversified entertainment opportunities and higher living conditions with the attempt to assemble people. Ren et al. (2021) studied the net flows of young talents in Chinese cities. They concluded that although YRDUA remains as the top attraction

for university graduates, Shanghai has suffered a net outflow of talents due to harsh population control measures. Since 2010, all national plans have positioned Shanghai as the urban core of YRDUA, however, it would be hard for Shanghai to expand its dominance with no new high-quality labour force injection. Fortunately, things changed in the 2016 Plan. Apart from rolling out policies to attract young talents and enhancing education quality, it foresightedly raises the problem of the lack of inclusiveness of cities. Due to the unique Chinese Hukou system[4], the intra-urban discord between citizens and non-citizens may poses the risk of discrimination and hinder further inflow of high-quality labour force. On top of alleviating residency policies for domestic citizens, the 2016 Plan also appoints Shanghai as the pilot city to relax the entry restrictions for international migrants with special talents or skills in shortage. Should the benchmark for citizenship lower in the future, Z_{43} would gain an even higher importance.

(2) More variables now jointly contribute to RIC as the result of policy intervention.

Of the 20 index layer indicators, there are now more variables that are useful, and the number of throughs is also fewer. In 2010, there were 7 indicators below the 0.5 level, but in 2020 this number has dropped to 6. Employment rate (Z_{54}) has gained significance albeit still being not useful.

Most interestingly, the 2016 Plan starts to accelerate the incubation of technology-focused SMEs and innovative enterprises through the knowledge transfer from successful large enterprises and the establishment of knowledge-sharing platforms such as technology exchange centre and patent resource information base. This is directly reflected in the notable rise of technology transfer between firms Z_{22} above the useful level. The *YRD Integration Planning Outline 2019* even further promotes the transfer between firms to science parks. Koh et al. (2005) identified science parks as effective policy resorts to boost innovation; however, the lack of initial technology and labour endowment means it would be hard for new science parks to kick-start the incipient research activities. To overcome this problem, the 2019 Plan proposes an inter-provincial industrial park cooperation method by actively leading mature science parks to establish branch parks or shared

[4] A form of household registration of residency. Residents only gain the citizenship and are entitle basic education, health, pension and social housing benefits with a registered Hukou of a city. Partially similar to an immigration approach.

ownership parks in relatively left-behind regions. Through this process, provinces are supposed to synergise together to promote cross-border production and sharing of innovative technologies.

For other factors ranging from 0.5 to 0.7, although there have been some fluctuations, most of them remain above the useful level except Z_{21} and Z_{41}. Albeit policies have been mentioning Infrastructure for innovation (Z_{41}) since 2010, as Z_{41} is mainly measured by the number of internet and mobile phone users and this field has almost been saturated, it has not seen obvious change and now becomes useless. New product sales revenue (Z_{34}) faces the similar situation. However, it should be noted that recent policies directions tend to incorporate technology incubate platforms as innovation infrastructure, therefore, its relevant significance may surge in the upcoming decade. Sustainable development (Z_{55}) is still not even significant in 2020 partially because China now still follows an 'economic first' development path. Even the *YRDUA Development Plan 2016* listed resource management and ecological protection issues as an urgent problem. However, the lack of implementation mechanism of the Ministry of Land and Resource and the non-statutory position of these planning policies lead to minimum incentives of local governments to address these issues (Wang and Wu, 2020).

It should also be noted that despite an overall improvement of knowledge output Z_1, Research paper publication (Z_{13}) continues to underperform in the past decade. Xu, Xie and Rao (2020) divided innovation activities into two phases: first, universities and research institute transform capital into knowledge by generalising them into research publication; then enterprises apply these ideas into products with the aim of maximising profits in the marketplace. Combined with the low performance of technology cooperation between scholars (Z_{21}) and patent and copyright (Z_{12}), it is deducted that regions in YRD have stagnated in creating new innovative knowledge. Policies have also corroborated this deduction to a certain degree. *YRD Regional Plan 2010* and *YRDUA Development Plan 2016* both support the cooperation among universities, research institutes and enterprises to jointly transfer knowledge into products. The Triple-Helix model pointed out university plays the leading role in generating intellectual capital to incubate the emergence of innovative ideas (Etzkowitz & Zhou, 2006). Studying the success of the Silicon Valley, Ren et al. (2021) concluded that the collaboration between universities and industrial clusters is conducive

not only to direct research output but also the transformation of it into products. Although the 2016 advocates to build world-class university clusters focusing on fundamental and original research, it is still not strong today partially due to the geographical boundary of universities. Currently, the deployment of China's innovation industries is still strongly policy inflicted, therefore resulting in a discordance between university research activities and local industrial structure. This weak link indicates that while China is deeply engaged in existing innovative technologies of other countries, it is still weak in producing new intellectual property rights.

The weakness of new knowledge output is also seen in the drop of Corporate R&D investment (Z_{31}). Xu, Xie and Rao (2020) found that although YRDUA leads the national average in corporate R&D investment, the proportion of fundamental research investment is low in terms of the structure of R&D expenditure. They pointed out that this could constrain the future advancement of high-level R&D abilities, causing a shrinkage of technology accumulation, knowledge creation and application. They also suggested that despite the drop of Corporate and the increase of government in R&D investment, their proportion is still distorted. Future policies should place more emphasis on R&D efficiency rather than only quantum of investment and proactively.

Foreign investment Z_{23} also suffered a decline of importance, and this trend is expected to continue. Wu (2018) pointed out the urbanisation in China in the past decades hugely hinged on land finance as the source of capital income. Due to the national ownership of land in China, its cheap labour cost, and globalisation, local governments have strong incentive to sell land to private real estate developers in exchange for money to build infrastructure and factories to attract foreign investors. The foreign investment in manufacturing has boosted the China's GDP growth and moulded it into the 'world factory'. However, such practice is a race to the bottom as it exacerbates regional inequality and soars the housing prices. In addition, such development is extremely prone to external crisis (COVID-19 has proved this point) as it hugely relies on international trade. As the state council proposed the 'Dual Circulation[5]' as the new national development strategy in 2020, future industrial deployment is likely to favour knowledge-concentrated industries over labour-

[5] A new growth strategy that aims to gradually transform domestic production and consumption to the mainstay of GDP growth, while maintaining the country's current position in international trade.

intensive ones. Therefore, future foreign investment is more likely to dilute in traditional manufacturing and transit to innovation and high-tech sectors, leading to an overall decrease.

5.2 Divergence between regional innovation capacities

(3) Regional policies have promoted a more balanced development distribution.

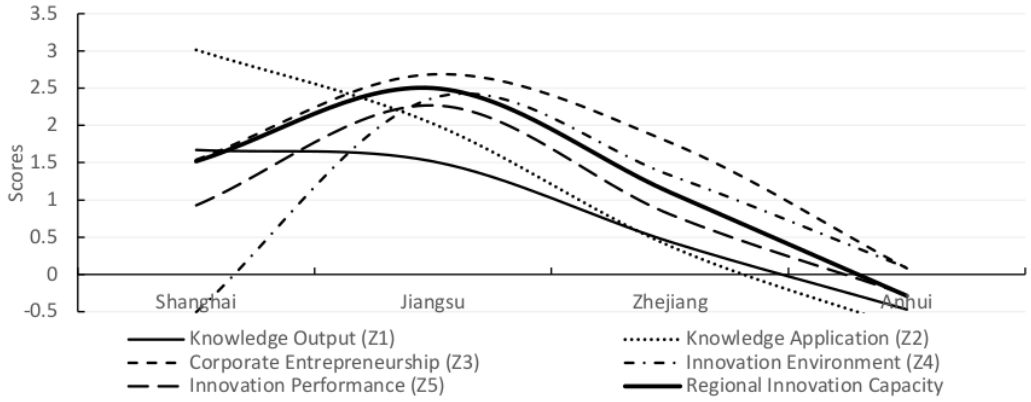

Chart 3: Relationship between Regional Innovation Capacity and Rule layers of each region in 2011

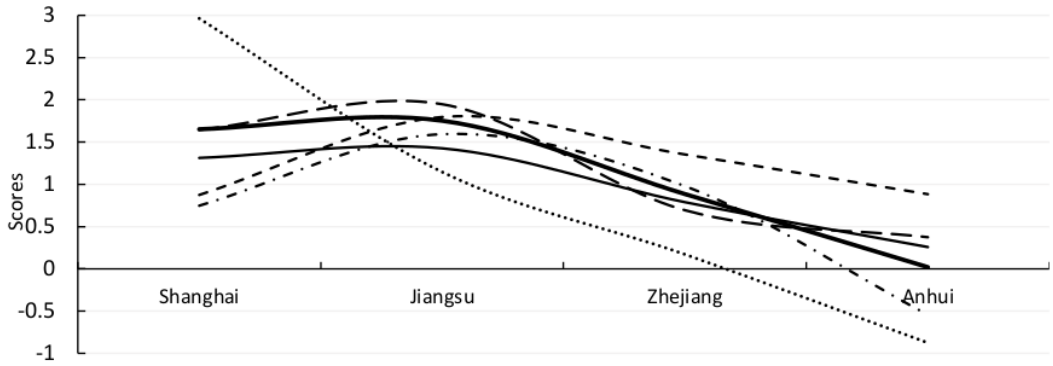

Chart 4: Relationship between Regional Innovation Capacity and Rule layers of each region in 2020

Charts 3 and 4 illustrate divergence of regional innovation capacity by comparing the relationship of RIC and rule layers in 2011 and 2020. Comparing overall trend of the curves, the curves in 2020 are evidently flatter than those in 2011, reflecting a more balanced development and distribution of regional innovation capacity. The consistency between the overall RIC and each rule layer indicator

is smoother as well, directly reflected by the similar slope and closing gaps between the lines. This indicates the effectiveness of the evaluation model constructed above to a certain extent.

Looking at each rule layer indicator respectively, the slope of Knowledge Output Z_1 is notably more identical to that of the RIC in 2020 than in 2011. The significant rise of local government investment on R&D largely accounts for the change. Although still following the overall trend, Corporate Entrepreneurship Z_3 now has a lower level of fitness. This is explained by the graphics in the above section that the fluctuations of index layer indicators in Z_3 result in the and decline of its correlation. Innovation Performance Z_5 generally have good fit throughout the decade. Its position has moved from below the RIC curve in 2011 to generally above it in 2020, indicating a larger weight in explaining RIC. The notable change of Innovation Environment Z_4 is the salient increase of Shanghai in 2020. This has largely to do with the designation of Shanghai's role as the domestic financial centre in the 2011 and 2016 Plan. Lastly, for Knowledge Application Z_2, unlike other indicators, it now has a larger divergence and lower consistency. Apart from Shanghai, other regions all suffer decline or stagnation. The policy intention to move technology clusters to Shanghai has strong impact on this. To remedy the exacerbating divergence, the *2019 YRD Integration Planning Outline* set out the goal to facilitate major research infrastructure and literature and data transfer through the establishment of sharing platforms.

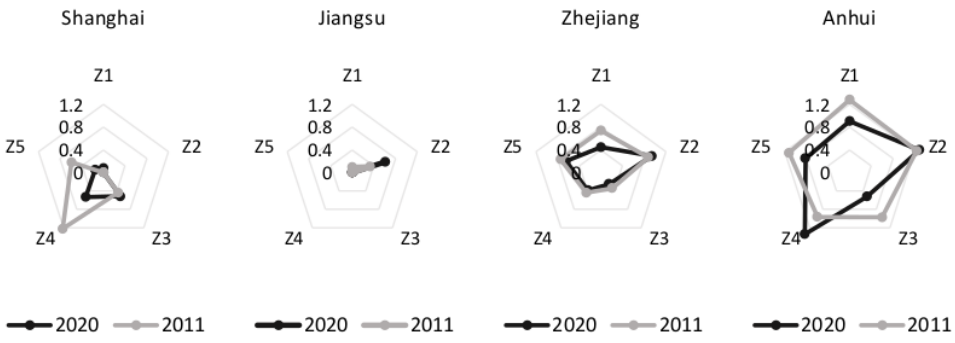

Chart 5: Difference between the highest score and the rule layer score of regions (absolute value)

Chart 5 shows the divergence between regions by comparing the absolute difference between the highest and lost score of each indicator. Looking at Chart 3, 4 and 5 together, Shanghai

predominates Z_2 in both years. The 2016 Plan aims to consolidate this lead by appointing Shanghai as the centre to construct the YRD innovation network. However, the Plan also points out the urgency to improve the original innovation ability to fully utilise its outstanding knowledge application ability; the 2019 Plan advances this goal by positioning YRD as the national source of knowledge creation. In addition, the Innovation Environment Z_4 has significantly improved in Shanghai, largely due to the increasing importance of international trade. In 2013, the Chinese state council approved the establishment of Shanghai Pilot Free Trade Zone (FTZ) to promote the development of export and offshore business in Shanghai. The 2016 and 2019 Plan set Shanghai FTZ as the strategy to further facilitate the free flow of trade, capital and logistics; to improve the financial and regulatory systems; and to lead the future globalisation in YRDUA.

Although Jiangsu still ranks the top in most indicators, its gap with other regions is closing rapidly. The reasons behind this varies. From the political perspective, policy restrictions on population may have an impact. The 2010 Plan addresses an even distribution among core cities and their neighbourhood small and medium-sized cities encourages concentration of population towards growth areas. The 2016 Plan even further restricts the development in saturated areas by dividing land into three types – renewal, growth and restriction[6]. As most innovation activities in Jiangsu province concentrate in the science parks in growth areas, such a policy might have severely hindered its development of innovation. From a practical perspective, Xu and Xie (2021) found that although Jiangsu has been ahead of the YRDUA in terms of R&D investment, its R&D intensity and efficiency is relatively low. They also concluded that the reluctance of cities to share the innovation spill overs and the poor integration of technology and industries impose local blockades and worsen innovation environment. In addition, although Jiangsu is leading in manufacturing, the distribution of enterprise is relatively scattered. The lack of strong industrial clusters also accounts for the lack of knowledge transfer, and hence the sinking innovation performance.

For Zhejiang and Anhui, their gaps with the leading regions narrow in most aspects. These findings, despite at the regional level, generally accord with the 'Great Divergence Puzzle'. The 'Great Divergence', albeit mostly cited at the international level, explains the rise and fall of regions from

[6] A similar approach in virtue of the 2020 Planning White Paper in England.

five dimensions – technology, culture, geography, politics and economic institutions. Among the differences for Zhejiang and Anhui, Z_1, Z_3, and Z_5 have the most salient changes. Technology trickle-down from Shanghai and Jiangsu accelerate the initial accumulation of innovation, more government and corporate R&D investment, together with a political intention to balance regional development, jointly boost the innovation performance. However, as culture and geography are competitive endowments, a more well-established innovation environment in Shanghai further attracts business to settle down. Therefore, Z_4 inclines to decline in Anhui and Zhejiang.

(4) Overall regional innovation performance is diminishing.

It is also found in the preliminary results and the above section that although the divergence between regions is smaller, the scores of rule layers and the overall RIC is diminishing in the past decades. Zhejiang maintains the same innovation capacity with slight decline. Shanghai's five rule layer indicators have reshuffled largely due to the policy direction that positions it as the urban core of YRDUA. Lastly, for Anhui, its overall capacity improves as the main recipient of knowledge trickle-down and relocation of industries from other regions. This section explores the reasons from three perspectives: the relative importance of index layers, the industrial structure and impact of policies.

Firstly, as the goal of this dissertation is to analyse the policy impact on regional innovation capacity, the research design does not follow a time series approach. As such, the relative weight of the five rule layer indicators differs in 2011 and 2020. This approach may be more effective in deriving the overall RIC score as the evolution of innovation capacity is not a static process; however, it does cause minor inconsistency of scores for comparison.

The adjustment of industrial structure and deployment of new technologies also largely accounts for the decline of innovation capacity. As existing service, manufacturing and traditional industries grow mature, policies have changed the strategy for them from 'develop' to 'streamline'. From the changes, there has been significant improvement in the development of new innovative industries in YRD, and the drop of Z_{52} below the key determinant level does not necessarily indicate less importance, but an upgraded measurement of RIC. Table below summarises the major changes.

2010 Policy			2016 Policy	
Strategy	Sectors		Strategy	Sectors
Prioritise the development of modern services	Production-oriented. Livelihood-oriented		**Reinforce innovation** in key areas of the leading industries	Electronic information. Equipment manufacturing; Steel. Petrochemicals. Motor vehicles. Textile. Modern finance. Modern logistics. E-commerce. Cultural tourism
Strengthen advanced manufacturing	Electronic information. Equipment manufacturing. Steel. Petrochemicals;	→		
Consolidate traditional industries	Agriculture. Textile. Tourism			
Accelerate the development of emerging industries	Biomedical. New materials. New energy. Civil Aerospace	→	**Cultivate** emerging industries through innovation industrial chains	New information technology. Biomedical. High-end equipment manufacturing. New materials. Satellite. Photovoltaics

Table 6: Summary of changes of industrial structure

Tu and Li (2017) concluded that the YRDUA has experienced an overhaul of industrial structure since 2008, moving to an innovation-oriented knowledge economy structure. They suggest some features of the structure from a regional innovation perspective: (1) concentration on technology-intensive

industries; (2) integration and synergy between modern manufacturing and service industries; (3) Shifted emphasis from quantity to quality of innovation; (4) promotion of a more balanced and compartmentalised development pattern. Interestingly, their opinions coincide with the direction of policy adjustment, and therefore jointly explains the changes of RIC scores.

There are also growing policy tendencies to reinforce the regional complementarity and synergy in terms of the industrial structure. The YRD development plan has been supporting the growth of existing local leading industries and their side-lines since 2010. The Plans encourages the expansion of biomedical, international trade and finance in Shanghai, Logistics and software and information science in Jiangsu, cultural tourism and e-commerce in Zhejiang, and modern agriculture and equipment manufacturing in Anhui. The 2016 and 2019 Plan further promote the integration and cooperation of emerging innovation industries among regions, establishing a YRD innovation industrial chain through the division of industrial structure. However, there is yet no policies specifying the cost and benefit allocation among regions, obstructing the integration of industries and collaboration of regions.

Strong policy intervention may drawback growth potential of innovation capacity while balancing the regional divergence, hence overall diminishing the score of RIC. Before answering why policies may have deleterious effects on innovation, it should be noted that although most Chinese enterprises (excluding national-owned ones) instead compete under the market economy, the state maintains absolute power in defining the regulatory framework for all regions. Firstly, national planning policies have a strong effect on the human resource and capital allocation on industries. The changes of industrial structure therefore may dilute the productivity and competitiveness of existing innovation industries when most resources are removed to the new ones. Secondly, as mentioned in the literature review, Wu (2003) pointed out that the lack of market information and market mechanisms make policy-oriented interventions inefficient to assemble initial industrial clusters at smaller scales. While proactively encouraging the coordinated development of regions, the unmatched supply and demand of some industrial production also leads to the waste of resource. Thirdly, the lack of protection of property rights generates no motivation by individuals to conduct entrepreneurial activities. The 2016 Plan has been rigorously advertising knowledge

sharing platforms, however, the omission of the method to channel intellectual knowledge sharing refrain further agglomeration of innovative activities, therefore downgrading the capacity of a region.

Referring to Patankul and Pinto's (2014) propositions for innovation, the evolution of YRD development plans from 2010 to 2019 coincides with the three policy conditions. Besides creating the basis for innovation through the establishment of science parks, infrastructure, university towns and sharing platforms, policies also begin seeking to stimulate innovation through market mechanisms and safeguard the innovation environment. Instead of appointing new clusters, the 2019 Plan encourages the spontaneous creation of new agglomerations of innovation through interactions of various market participants. For state-owned enterprises, the Plan promotes the reform to a public-private mixed ownership to allow further cooperation with third parties. For private enterprises, the Plan encourages cross-regional mergers and acquisitions and allows their participation in some national activities such as the construction of major infrastructure. Most importantly, it pointed out the importance to combine market-mechanism and policy intervention, optimise and upgrade existing industries through not only regional policies but also the knowledge transfer within agglomerations.

5.3 Implications for future policy formulation

(5) Future policies should address regional synergy by promoting comparative advantage.

To facilitate the construction of an industrial chain for major innovation industries, the 2016 Plan further identifies 5 Metropolitan Circles (MC)[7] – the Nanjing MC as the financial business services cluster and Su-Xi-Chang MC as the advanced manufacturing and modern service cluster in Jiangsu; the Hangzhou MC as the international E-commerce experimental zone and Ningbo MC as the international port and logistic base in Zhejiang; and the Hefei MC in Anhui taking on industrial transfer and trickle-down from other regions. According to the locational choice of urban agglomeration, policies have minimum effect in kick-starting industrial clusters but are conducive to

[7] Apart from Shanghai MC as the urban core specialising in biomedical, international trade and finance.

the self-reinforcement of agglomeration. As the leading industries for these five MCs occurs 'naturally' to an extent, existing large enterprises act as the anchor point to attract further SMEs for expansion. Through the specialisation of industrial structure and division of labour, regions take advantage of relative availability of resources and maximisation efficiency.

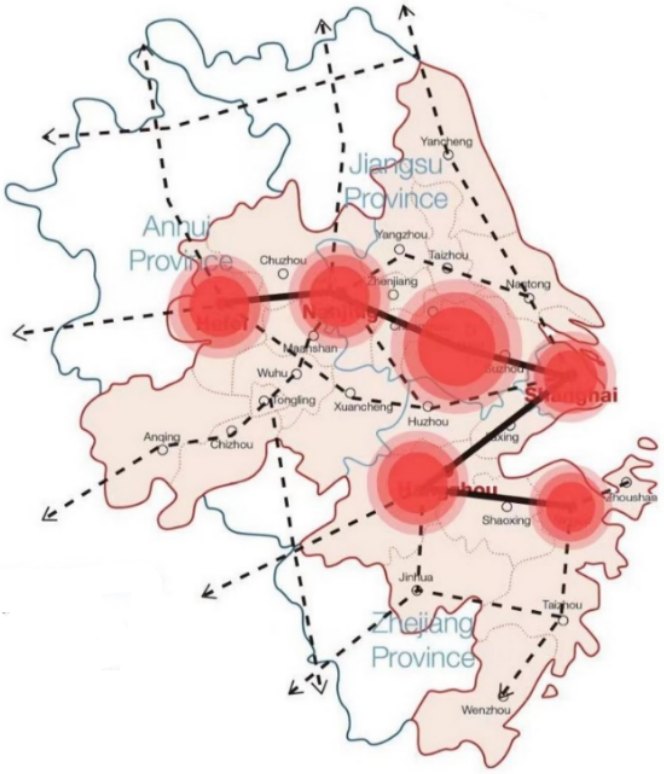

Figure 6: Spatial distribution of the metropolitan circles (Source: Adapted from 2010 YRD agglomeration plan)

The role of policy here is to strengthen the bond between MCs and facilitate their collaboration, accelerating the evolution of agglomeration from stage 2 to 3. However, the specification of industries only facilitates the knowledge application process of the regional innovation capacity. The lack of interaction between industries means despite strong policy intension, the level of synergy between regions may still be low, as proposed by Paul Krugman (2009) that industrial localisation

within China may have little impact on the pattern of 'trade' (information exchange in this instance). Therefore, while actively upgrading and integrating the industrial structure, future YRDUA policies should also pay attention to other dimensions of innovation framework to boost the information and activity transmission between regions.

Based on the notion of maximising comparative advantage[8], this dissertation stratifies the five layers of RIC into three procedures: 1) knowledge output Z_1 and knowledge application Z_2 as the generator of innovation; 2) Corporate Entrepreneurship Z_3 and innovation environment Z_4 as the processor of innovation; and 3) innovation performance Z_5 as the distributor of innovation. It is noticed previously that all regions suffer from the declining performance of innovation due to regional balance. By further assigning the stages of innovation activities to regions, it is supposed that the comparative advantages of each region will improve the efficiency and amplify the trickle-down effect, therefore boosting the overall RIC level while achieving regional balance.

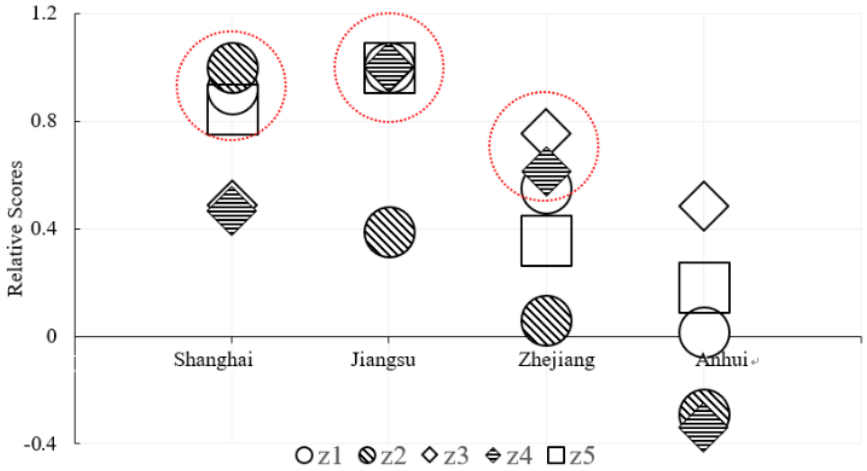

Chart 6: Relative rule layer scores in 2020

Chart 6 shows the rule layer scores of the five regions. Based on the notion above, it is suggested that Jiangsu and Zhejiang should specialise in the processing of innovation based on their current

[8] Comparative advantage does not denote the highest level of production among all regions, but the relative stronger skill of a region. The rationale is that no region can provide all goods and services due to resource limitation. Therefore, all regions benefit from the specialisation in their own comparative advantage and trade with others.

industrial division. Currently, Jiangsu's innovation activities mainly focus on biomedical, information technology and high-end manufacturing, while Zhejiang's on modern logistics and E-commerce. Together with their traditional competency in petrochemicals, steel and equipment manufacturing, their comparative advantages will cover most of the innovation industries. Shanghai should specialise as the innovation generator due to its increasing dominance in knowledge application. In addition, due to its unique role in finance and international trade, Shanghai is also supposed to partially take on as the distributor of innovation, especially pertaining to modern services related output. Although Jiangsu is also strong in the generation of innovation, its performance has significantly declined in the past decade. As Paul Krugman (2009) contended the increasing scale of returns as the comparative advantage, it is recommended Jiangsu should complement Shanghai as the generator but mainly concentrate on processing innovation. As Anhui is still relatively weak in all aspects, it should mainly act as the recipient of knowledge spill-over by taking over the transfer of surplus industries and reinforcing existing traditional industries.

The ideal specialisation and collaboration of the regional innovation pattern in then as follows. Firstly, Shanghai acts as the generator of innovation and shoulders most of the research, original knowledge creation and transformation work. Then, Jiangsu and Zhejiang, based on their industrial specialisation, mainly act as the processor to apply intellectual ideas into products and services. Lastly, innovation output returns to Shanghai and is distributed domestically and internationally. Such a division will complement the industrial division and increase the interaction between regions. Anhui as the main beneficiary, is supposed to complement the industrial structure of other regions when it grows its own competitive industries in the future. Through the specialisation of the procedure of innovation, all regions are supposed to avoid competition and benefit from increasing returns, developing co-ordinately while achieving the goal of industrial integration.

(6) Future policies should establish a structure of multi-level governance to utilise market mechanisms and reinforce planning statutory status.

Despite the growing importance of the YRDUA, there is no multi-level governance and devolution in the agglomeration. Table 7 summaries the governance structure in YRDUA. Currently, all YRD development plans are structured and issued at the national level OECD (2012) pointed out the

importance to highlight the region's voices. They argued that to enhance policy continuity and mobilises regional development, the role of institutions is indispensable in facilitating the negotiation among key actors. However, the missing structure indicates no decentralisation of power at the agglomeration level, meaning there is no legal institution directly regulating and monitoring the enforcement of plans.

Institutions	State council	YRDUA	Provincial dept of natural resources	City planning bureaus	Local planning committee
Plans	YRD development plans	?	Territorial spatial plans	Concept Plans and strategies	Local masterplans

Table 7: Governance structure in YRDUA

Decentralisation of power to the YRDUA is crucial to foster an open and embracive market environment for innovation. Firstly, multi-level governance allows more market participants through privatisation and public-private ownership. Market-oriented innovation activities not only promote healthy competitions among enterprises, but also is conducive a diversified collaboration of research and application between industry and academia (Ren et al, 2021; Xu, Xie and Rao, 2020; Wu, 2018). Though agglomeration plans have been attempting to promote an overall trade-friendly environment within YRD. Empirical evidence suggests that Shanghai is currently the only city successful in doing so; not to mention this is largely due to Shanghai government has relatively more autonomy compared to others. Secondly, the current collaboration between regions is coordinated by the intangible duty to corporate, however, no institution at the agglomeration level means that states may not possess sufficient information to reallocation resources when conflicts of interest arise. As local governments usually possess more tacit knowledge than the state government, the centralisation of power and establishment of an institution at the YRD level may better tap underutilised regional potential and redirect regional competition in a beneficial way through a context-specific approach. In addition, such an institution would better encourage cross-region cooperation, facilitating the establishment of knowledge sharing platforms and reconciling

the location of subsidiary companies to help knowledge transmission.

The goal of YRDUA plans is to curb the undue competition and coordinate growth through specialisation and synergy; however, they are unlikely to be successful with a fragmented governance as the lack of statutory status and implementation mechanisms means policies will only be considered as guidance but not duty (Wang and Wu, 2021). The lack of policy implementation mechanisms is particularly severe in terms of green economy and energy matters. In the past, China is mostly criticised for prioritising economic development over environmental protection. The rapid urbanisation and development of manufacturing have encroached agricultural land and public green spaces. The YRD developmental plans have been continuously reinforcing environmental issues since 2010, and China's *Fourteenth Five-Year Plan for National Economic and Social Development* even highlights the inadequate resource and environmental capacity and prioritises 'ecology first, green development' as the core strategy for YRDUA. However, as it was mentioned in the preliminary result section, the negative correlation between sustainable development and innovation performance makes regions no incentive to obey them if they have no legal status.

Chapter 6: Conclusion and Limitation

This dissertation studies the implications of agglomeration-related planning policies on regional innovation capacity in Yangtze-River Delta Urban Agglomeration. For authoritativeness and data availability, the dissertation selects the evaluation framework of innovation capacity proposed in *China Regional Innovation Capability Report* and data in 2011 and 2020 for comparison.

The dissertation sets out four objectives: (1) To explore the effectiveness of the evaluation framework of regional innovation capacity over time. (2) To explain the divergence of innovation capacity among regions over time. (3) To explore how planning policies explain the change of innovation capacity. (4) To provide implications for future policy formulation on regional innovation capacity. The first two objectives are achieved through quantitative data analysis in SPSS, and the latter two are achieved through interpretation of data and related policies.

The preliminary results indicate that the evaluation framework is effective in measuring the changes of regional innovation capacity (RIC) over time. The scores of regions indicate that despite the unchanged overall ranking of regions, the gaps between them are significantly narrower, meaning a more balanced development pattern. In addition, the gaps between the five rule layer indicators are also narrowing though some regions have experienced larger fluctuations. Through further data and policy interpretation, it is found that:

(1) Key determinants of RIC are now more policy oriented.

From the macro level, the five rule layer indicators remain robust in explaining RIC, despite the drop of Z_3 and the rise of Z_1, Z_4 and Z_5 in terms of relative importance. From the micro level, the key determinants of the index layer have reshuffled, and the changes have significantly reflected YRD planning strategies in the past decade.

(2) More variables now jointly contribute to RIC as the result of policy intervention.

Compared with 2010, there is now one more indicator that is useful in explaining RIC. However, the composition of the useful factors has also changed dramatically due to shifted policy preference. It is found that although policies have successfully facilitated the incubation of knowledge into innovation products, they are still ineffective in encouraging original R&D activities and knowledge

output. The importance of foreign investment Z_{23} is expected to continue to decrease due to the change of financing mechanism for planning. For the unchanged factors, Sustainable development (Z_{55}) is still not significant because of its negative correlation with RIC. Infrastructure for innovation (Z_{41}) is predicted to be more important as its new calculation method incorporates technology incubation platforms.

(3) Regional policies have promoted a more balanced development distribution.

Comparing the scores of regions in the time nodes, apart from the narrowing gap of RIC among regions, the consistency between the overall RIC and each rule layer indicator is smoother as well. The divergence among regions is largely explained by the changes found in (1) and (2). Although Jiangsu remains the top region of YRDUA in 2020, its gap with other regions is closing rapidly. Shanghai is expected to take over Jiangsu and ranks the first in the upcoming years due to the policies positioning it as the urban core. For Zhejiang and Anhui, their gaps with the leading regions narrow in most aspects as well.

(4) Overall regional innovation performance is diminishing.

Whilst regions are now following a more balanced development pattern, it is found that policies have been diminishing the overall performance of RIC in YRDUA. The phenomenon is explained from three aspects. Firstly, the relative weight of the five rule layer indicators differs in 2011 and 2020 as the consequence of the data processing method. Secondly, the adjustment of industrial structure and deployment of new technologies largely accounts for the decline. Lastly, strong policy intervention may hinder the free transactions among existing participants and the entrance of new ones into the market, hence snagging the growth potential of innovation capacity while balancing the regional divergence.

(5) Future policies should address regional synergy by promoting comparative advantage.

It is first recommended that while promoting the collaboration of the leading industries of each region, future policies should also specify the stages that each region is responsible for in the process of innovation output. Based on quantitative analysis, this dissertation suggests that Shanghai acts as the generator of innovation, and Jiangsu and Zhejiang mainly act as the processor of knowledge into products according to their leading industries. Anhui, at this stage, should

continue to absorb the innovation trickle-down from other regions and aims to grow its own competitive industries.

(6) Future policies should establish a structure of multi-level governance to utilise market mechanisms and reinforce planning statutory status.

In the end, it is suggested that a separate institution should be established at the agglomeration level, directly managing the monitoring the enforcement of plans. In addition, more power should be devolved as the result of multi-level governance. The decentralisation of power is conducive to properly solving the problem of low original knowledge output and implementing the goal of sustainable development.

Limitations and Recommendations

This dissertation possesses three main limitations. Firstly, for simplicity, this dissertation only selects two time periods for comparison. This may potentially lead to inaccurate interpretation of data trends as it only focuses the results but neglects the process of evolution of RIC. Secondly, due to data availability, the dissertation uses secondary data from the *China Regional Innovation Capability Report,* and as the consequence, this dissertation is unable to capture the change of the evaluation framework overtime (and may slightly causes bias of results). Should future studies collect original data, they are also able to adjust the evaluation framework to fit the local context better. Thirdly, the method of analysis is relatively simple. Due to the small sample size, this dissertation only conducts the Principal Component Analysis for three regions and one municipality. Although results indicate overall good level of significance, future studies could potentially apply this evaluation method at the national level to get larger sample size (and examine the stage 3 to stage 4 transition of agglomeration).

Apart from addressing the limitations, linkage between data results and policy interpretation is still not very strong for this dissertation. Future studies could potentially apply GIS to explore more profound policies implications of the spatial-temporal change of industrial structure distribution. Future studies can also explore to what degree agglomeration policies facilitate innovation trickle-down and balance regional development, therefore providing more constructive recommendations to improve the overall innovation competitiveness of YRDUA.

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Appendix A: SPSS Results

2020: Rule Layer Results

$$\begin{cases} Z_1 = 70.694F_1 \\ Z_2 = 71.333F_2 \\ Z_3 = 82.600F_{31} \\ Z_4 = 73.486F_4 \\ Z_5 = 53.764F_{51} + 22.210F_{52} \end{cases}$$

Component Matrix

Component Matrix[a]

	Component 1
Z11	.936
Z12	.851
Z13	.721

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1
Z23	.893
Z22	.871
Z21	.765

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1
Z33	.923
Z34	.919
Z31	.907
Z32	.886

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1
Z45	.880
Z43	.863
Z42	.857
Z44	.849
Z41	.836

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1	2
Z51	.889	.170
Z52	.832	-.284
Z54	.815	-.163
Z53	.730	.174
Z55	.094	.972

Extraction Method: Principal Component Analysis.
a. 2 components extracted.

2011: Rule Layers

$$Z_1 = 79.971F_1$$
$$Z_2 = 70.902F_2$$
$$Z_3 = 72.961F_3$$
$$Z_4 = 64.090F_{41}$$
$$Z_5 = 51.714F_{51} + 24.929F_{52}$$

Component Matrix

Component Matrix[a]

	Component 1
Z11	.957
Z12	.886
Z13	.780

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1
Z23	.923
Z22	.831
Z21	.765

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1
Z32	.945
Z31	.922
Z34	.839
Z33	.686

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1
Z41	.881
Z43	.840
Z45	.792
Z42	.779
Z44	.698

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Component Matrix[a]

	Component 1	2
Z52	.953	.013
Z51	.896	-.044
Z53	.893	.171
Z55	.082	.827
Z54	.265	-.729

Extraction Method: Principal Component Analysis.
a. 2 components extracted.

2020: Regional Innovation Capacity (RIC)

$$RIC_{2020} = 81.499G_1$$

Component Matrix[a]	
	Component 1
REGR factor score 1 for analysis 3	.943
z5	.914
REGR factor score 1 for analysis 1	.905
REGR factor score 1 for analysis 2	.877
REGR factor score 1 for analysis 1	.873
Extraction Method: Principal Component Analysis. a. 1 components extracted.	

2011: Regional Innovation Capacity (RIC)

$$RIC_{2020} = 76.331G_1$$

Component Matrix[a]	
	Component 1
REGR factor score 1 for analysis 3	.933
Zscore(z5)	.870
REGR factor score 1 for analysis 4	.869
REGR factor score 1 for analysis 2	.867
REGR factor score 1 for analysis 1	.825
Extraction Method: Principal Component Analysis. a. 1 components extracted.	

Appendix B: Variables for the evaluation framework

Rule Layer	Index Layer	Variables
Knowledge Output (Z1)	Local government R&D investment (Z11)	No. of R&D staffs Average no. of R&D staffs per 10,000 people Growth rate of R&D staffs Government investment in R&D Government investment in R&D as percentage of GDP Growth rate of government investment in R&D
	Patent and copyright (Z12)	No. of patent applications received for inventions (excluding enterprises) No. of patents received per 10,000 R&D staff Growth rate of patent applications received for inventions (excluding No. of patent applications produced per 100 million RMB of internal R&D expenditure No. of patents granted No. of patents granted per 10,000 R&D staff Growth rate of patents granted No. of patents granted per 100 million RMB of internal R&D expenditure
	Research paper publication (Z13)	No. of domestic publications Average no. of domestic publications per 100,000 R&D staffs Growth rate of domestic publications International publications Average no. of international publications per 100,000 R&D staffs Growth rate of international publications
Knowledge Input (Z2)	Scientific research collaboration between scholars (Z21)	No. of scientific and technical publications by authors from different firms in the same province No. of scientific and technical publications by authors from different firms in the same province per 100,000 R&D staffs Growth rate of publications by authors from different firms in the same No. of collaborative scientific publications by authors from different provinces No. of collaborative scientific publications by authors from different provinces per 100,000 R&D staffs Growth rate of publications by authors from different provinces No. of collaborative scientific publications by authors from different countries No. of collaborative scientific publications by authors from different countries per 100,000 R&D staffs Growth rate of publications by authors from different countries R&D expenditure of universities and institutes that is funded by enterprises Percentage of R&D expenditure of universities and institutes that is funded by enterprises Growth rate of R&D expenditure of universities and institutes that is funded by enterprises
	Technology transfer between firms(Z22)	Total volume of technology market transactions Average volume of technology market transactions per enterprise Growth rate of volume of technology market transactions Domestic expenditure on technology for industrial enterprises above scale Average expenditure on the purchase of domestic technology for industrial enterprises above scale Growth rate of expenditure on the purchase of domestic technology for industrial enterprises above scale Expenditure on the introduction of technology by industrial enterprises above scale Average expenditure on the introduction of technology by industrial enterprises above scale Growth rate of expenditure on the introduction of technology by industrial enterprises above scale
	Foreign Investment (Z23)	Percentage of foreign capital in the registered capital for foreign-invested enterprises Percentage of foreign capital in the registered capital for foreign-invested enterprises per capita

		Growth rate of percentage of foreign capital in the registered capital for foreign-invested enterprises
Corporate Innovation (Z3)	Corporate R&D investment (Z31)	No. of R&D staffs in enterprises above scale Percentage of R&D staffs among all employees in enterprises above scale Growth rate of R&D staffs in enterprises above scale Total internal expenditure on R&D of enterprises above scale Percentage of total internal expenditure on R&D to sales revenue of enterprises above scale Growth rate of total internal expenditure on R&D of enterprises above scale No. of enterprises above with R&D institutions Percentage of enterprises with R&D institutions to the total no. of enterprises above scale Growth rate of enterprises above with R&D institutions
	Technology update expenditure (Z33)	External R&D expenditure by enterprises above scale Average external R&D expenditure per enterprises above scale Growth rate of external R&D expenditure by enterprises above scale Expenditure on technological improvement of enterprises above scale Average expenditure on technological improvement per enterprises above Growth rate of expenditure on technological improvement of enterprises above scale
	New product sales revenue (Z34)	Sales revenue of new products by enterprises above scale Percentage of new product sales revenue to total sales revenue of enterprises above scale Growth rate of sales revenue of new products by enterprises above scale
Innovation Environment (Z4)	Innovation infrastructure (Z41)	No. of mobile phone users Popularisation rate of mobile phone Growth rate of mobile phone users No. of internet users Popularisation rate of internet Growth rate of internet users
	International and domestic trade (Z42)	Total volume of import and export Percentage of import and export to GDP Growth rate of total volume of import and export Household consumption level Growth rate of household consumption level
	Labour force quality (Z43)	Total expenditure on education Percentage of expenditure on education to GDP Growth rate of expenditure on GDP No. of people aged 6 or above with tertiary or undergraduate qualifications Percentage of people aged 6 or above with tertiary or undergraduate qualifications Growth rate of people aged 6 or above with tertiary or undergraduate qualifications
	Financial loans (Z44)	Amount of loans obtained from financial institutions out of the amount of internal expenditure on R&D by enterprises above scale Average amount of loans obtained from financial institutions out of the amount of internal expenditure on R&D by enterprises above scale Growth rate of loans obtained from financial institutions out of the amount of internal expenditure on R&D by enterprises above scale
	Entrepreneurial level (Z45)	No. of High-tech enterprises Percentage of high-tech enterprises of total enterprises above scale Growth rate of high-tech enterprises
	GDP performance (Z51)	Regional GDP GDP per capita GDP growth rate
	Industrial structure (Z52)	Tertiary sector value added Percentage of tertiary sector value added to the total GDP Growth rate of tertiary sector value added High-tech industry output value

Innovation Performance (Z5)		Percentage of High-tech industry output value to the total GDP Growth rate of High-tech industry output value
	International competency of industries(Z53)	High-tech products export value Percentage of High-tech products export value to the total GDP Growth rate of High-tech products export value
	Employment rate (Z54)	registered urban unemployment rate Growth rate of registered urban employment rate Employment in high-tech industries Percentage of employment in high-tech industries to the total employment Growth rate of employment in high-tech industries
	Sustainable development (Z55)	Energy consumption per 10,000 RMB of GDP Growth rate of energy consumption per 10,000 RMB of GDP Total electricity consumption Electricity consumption per 10,000 RMB of GDP Growth rate of electricity consumption per 10,000 RMB of GDP Total industrial effluent discharged Industrial effluent discharged per 10,000 RMB of GDP Growth rate of industrial effluent discharged per 10,000 RMB of GDP Total industrial emissions Industrial emissions d per 10,000 RMB of GDP Growth rate of industrial emissions per 10,000 RMB of GDP

As a limitation, only the variables constant in both years are included.

Risk Assessment Form

RISK ASSESSMENT FORM

FIELD / LOCATION WORK

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form

http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION **BARTLETT SCHOOL OF PLANNING/ MPLAN CITY PLANNING**
LOCATION(S) **LONDON**
PERSONS COVERED BY THE RISK ASSESSMENT **Chenhao Liu**

BRIEF DESCRIPTION OF FIELDWORK
None

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.
If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Low level Risk posed by COVID-19.

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	work abroad incorporates Foreign Office advice
	participants have been trained and given all necessary information
	only accredited centres are used for rural field work
	participants will wear appropriate clothing and footwear for the specified environment
	trained leaders accompany the trip
	refuge is available
	work in outside organisations is subject to their having satisfactory H&S procedures in place
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	None.

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
	firefighting equipment is carried on the trip and participants know how to use it

	contact numbers for emergency services are known to all participants
	participants have means of contacting emergency services
	participants have been trained and given all necessary information
	a plan for rescue has been formulated, all parties understand the procedure
	the plan for rescue /emergency has a reciprocal element
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EQUIPMENT	**Is equipment used?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for equipment is followed
	participants have been provided with any necessary equipment appropriate for the work
	all equipment has been inspected, before issue, by a competent person
	all users have been advised of correct use
	special equipment is only issued to persons trained in its use by a competent person
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	**Is lone working a possibility?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. alone or in isolation *lone interviews.*	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for lone/out of hours working for field work is followed
	lone or isolated working is not allowed
	location, route and expected time of return of lone workers is logged daily before work commences
	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
	all workers are fully familiar with emergency procedures
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

ILL HEALTH	**The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.**
e.g. accident, illness, *personal attack, special personal considerations or vulnerabilities.*	None.

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	an appropriate number of trained first-aiders and first aid kits are present on the field trip
	all participants have had the necessary inoculations/ carry appropriate prophylactics
	participants have been advised of the physical demands of the trip and are deemed to be physically suited
	participants have been adequate advice on harmful plants, animals and substances they may encounter
	participants who require medication have advised the leader of this and carry sufficient medication for their needs
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	**Will transport be required**	**NO**	**X**	**Move to next hazard**
		YES		**Use space below to identify and assess any risks**
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?			

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	only public transport will be used
	the vehicle will be hired from a reputable supplier
	transport must be properly maintained in compliance with relevant national regulations
	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
	drivers have been trained and hold the appropriate licence
	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
	sufficient spare parts carried to meet foreseeable emergencies
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	**Will people be dealing with public**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	all participants are trained in interviewing techniques
	interviews are contracted out to a third party
	advice and support from local groups has been sought
	participants do not wear clothes that might cause offence or attract unwanted attention
	interviews are conducted at neutral locations or where neither party could be at risk
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

WORKING ON OR NEAR WATER	**Will people work on or near water?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	lone working on or near water will not be allowed
	coastguard information is understood; all work takes place outside those times when tides could prove a threat
	all participants are competent swimmers
	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
	boat is operated by a competent person
	all boats are equipped with an alternative means of propulsion e.g. oars
	participants have received any appropriate inoculations
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	**Do MH activities take place?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for MH is followed
	the supervisor has attended a MH risk assessment course
	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities

	all persons performing MH tasks are adequately trained
	equipment components will be assembled on site
	any MH task outside the competence of staff will be done by contractors
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	**Will participants work with substances**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	the departmental written Arrangements for dealing with hazardous substances and waste are followed
	all participants are given information, training and protective equipment for hazardous substances they may encounter
	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
	waste is disposed of in a responsible manner
	suitable containers are provided for hazardous waste
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	**Have you identified any other hazards?**	**NO**	**If 'No' move to next section** **If 'Yes' use space below to identify and assess any risks**
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		
CONTROL MEASURES	**Give details of control measures in place to control the identified risks**		

Have you identified any risks that are not adequately controlled?	**NO**	**X**	**Move to Declaration**
	YES		**Use space below to identify the risk and what action was taken**

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research? No

If yes, please state your Project ID Number

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

DECLARATION	The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

x	I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk
X	I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR

Bessusi, Elena

FIELDWORK **5** May 2010

Ethical Clearance Form

Respondent: Chenhao Liu Submitted on: Wednesday, 8 June 2022, 9:00 PM

Ethical Clearance Pro Forma

It is important for you to include all relevant information about your research in this form, so that your supervisor can give you the best advice on how to proceed with your research.

You are advised to read though the relevant sections of UCL's Research Integrity guidance to learn more about your ethical obligations.

Please ensure to save a copy of your completed questionnaire BEFORE hitting 'submit' (you will not be able to access it later).

Submission Details

1 * Please select your programme of study.

MPlan City Planning : MPlan City Planning

2 * Please indicate the type of research work you are doing.

- [ ] Dissertation in Planning (MSc)
- [x] Dissertation in City Planning (MPlan)
- [ ] Major Research Project

3 * Please provide the current working title of your research.

Urban Agglomeration as Catalyst for Regional Innovation: A Study of Planning Policy Implications in Yangtze River Delta

4 * Please select your supervisor from the drop-down list.

Besussi, Elena : Besussi, Elena

Research Details

5 * Please indicate here which data collection methods you expect to use. Tick all that apply.

- [ ] Interviews
- [ ] Focus Groups
- [ ] Questionnaires (including oral questions)
- [ ] Action research
- [ ] Observation / participant observation
- [ ] Documentary analysis (including use of personal records)
- [ ] Audio-visual recordings (including photographs)
- [ ] Collection/use of sensor or locational data
- [ ] Controlled trial
- [ ] Intervention study (including changing environments)
- [ ] Systematic review
- [x] Secondary data analysis
- [ ] Advisory/consultation groups

6 * Please indicate where your research will take place.

Overseas only : Overseas only

7 * Does your project involve the recruitment of participants?

'Participants' means human participants and their data (including sensor/locational data and observational notes/images.)

○ Yes ◉ No

Appropriate Safeguard, Data Storage and Security

8 * Will your research involve the collection and/or use of personal data?

Personal data is data which relates to a living individual who can be identified from that data or from the data and other information that is either currently held, or will be held by the data controller (you, as the researcher).

This includes:

- Any expression of opinion about the individual and any intentions of the data controller or any other person toward the individual.
- Sensor, location or visual data which may reveal information that enables the identification of a face, address etc. (some postcodes cover only one property).
- Combinations of data which may reveal identifiable data, such as names, email/postal addresses, date of birth, ethnicity, descriptions of health diagnosis or conditions, computer IP address (of relating to a device with a single user).

○ Yes ◉ No

9 * Is your research using or collecting:

- special category data as defined by the General Data Protection Regulation*, and/or
- data which might be considered sensitive in some countries, cultures or contexts?

*Examples of special category data are data:

- which reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership;
- concerning health (the physical or mental health of a person, including the provision of health care services);
- concerning sex life or sexual orientation;
- genetic or biometric data processed to uniquely identify a natural person.

○ Yes ◉ No

10 * Do you confirm that all personal data will be stored and processed in compliance with the General Data Protection Regulation (GDPR 2018)?

○ Yes
○ No
◉ I will not be working with any personal data

11 * I confirm that:

☑ The information in this form is accurate to the best of my knowledge.
☑ I will continue to reflect on, and update these ethical considerations in consultation with my supervisor.

You MUST download a copy of your responses to submit with your proposal, and for your own reference.

To do this, use the print screen function of your web browser, and print to PDF in order to save.

BPLN0008 dissertation in city planning 20056244

GRADEMARK REPORT

FINAL GRADE

/100

GENERAL COMMENTS

Instructor

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