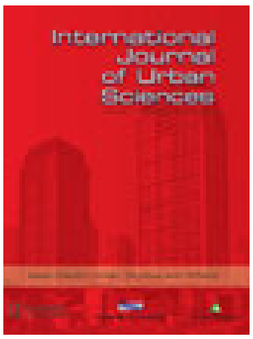

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Creating a state strategic innovation space: the development of the Zhangjiang Science City in Shanghai

Kan Zhu, Fangzhu Zhang and Fulong Wu

Bartlett School of Planning, University College London, London, UK

ABSTRACT

The development of science parks has been studied extensively. Understanding these innovation spaces requires us to investigate the development context beyond local knowledge dynamics. This paper examines the Zhangjiang Science City in Shanghai, the first science city endorsed by the central government in China. We find three salient features. First, the Zhangjiang Science City represents China's latest state innovation strategy to build Shanghai into a National Comprehensive Innovation Centre. Second, the science city is no longer a mono-functional park. It is integrated into Shanghai's overall urban development. Third, the state's role is visible, and state actors are involved in implementing this innovation strategy. This study reveals that the science city is a state strategic innovation space.

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science park; innovation space; the Zhangjiang Science City; China; urban development

Highlights

- This paper introduces the first centrally endorsed science city in China, namely the Zhangjiang Science City in Shanghai.
- The Zhangjiang Science City is a project to implement China's latest national innovation strategies through urban development.
- The multi-scalar state has been visible in the development of the Zhangjiang Science City with state actors operating in different tasks.
- This paper contributes to understanding the transformation of Chinese science parks against China's contemporary development context.

1. Introduction

Science parks, in the various forms of technology parks, technopoles, or science cities, have been studied extensively as an innovation space to achieve knowledge-based development and economic prosperity (Lecluyse, Knockaert, & Spithoven, 2019; Nahm, 2000;

CONTACT Kan Zhu kan.zhu.18@ucl.ac.uk Bartlett School of Planning, University College London 14 Upper Woburn Place, London WC1H 0NN, UK

Shearmur, 2012). The diversification of science parks has been noted in different contexts, including North America (Link & Scott, 2017), Europe (Benneworth & Ratinho, 2014), and Asia (Edgington, 2008; Zou & Zhao, 2018). Generational changes in science parks have been observed, and studies on these spaces have moved beyond knowledge diffusion and park management (OECD, 2011).

Current global geopolitical situations have altered institutional and economic backgrounds at the macro level, leading to the promulgation of innovation strategies like European Smart Specialization (Balland, Boschma, Crespo, & Rigby, 2018) and Made in China 2025 (Yeung, 2019). On the ground, the development of contemporary innovation spaces usually requires embeddedness in the wider urban transformations (Miao, Phelps, Lu, & Wang, 2019; Yigitcanlar, Adu-McVie, & Erol, 2020). By providing functional and institutional conditions, the city is inextricably linked with innovation activities (Florida, Adler, & Mellander, 2017; Shearmur, 2012).

For China, since the Medium- and Long-term Science and Technology Development Plan in 2006, the national innovation strategies have demanded a re-assertion of state power (Yang, 2014; Zhou, Sun, Wei, & Lin, 2011). The ongoing US-China trade war further triggered the considerations of China's technological competitiveness (Zhang & Lan, 2022). In 2021, the State Council renewed the principle of 'indigenous innovation' as 'seeking autonomy and self-strengthening of science and technology' (*keji zili ziqiang*) under the strategy of 'innovation-driven development'. Generally, China's concurrent innovation capacity is fostered by the dual efforts of the state and the market. The Chinese states act as the institutional enabler and the market regulator in a firm-centred innovation model.

Besides the overarching role of the Chinese central state, the implementation of national innovation strategies needs to be investigated in local innovation spaces (Miao et al., 2019; Zou & Zhao, 2018). Originating from China's science and technology programmes (Liu, Simon, Sun, & Cao, 2011), the Chinese high-tech zones and science parks demonstrate more 'cultivated' features under state intervention (Miao & Hall, 2014). The science parks are the regional innovation systems in China (Zhang, 2015). Their dynamics are hybrid and can hardly be simplified as the localities hosting state-sponsored R&D programmes (Zhang & Wu, 2012) or the rescaled space under globalization (Ngo, Yin, & Tang, 2017). Situating these science parks in China's ongoing urban processes, the spatialization of innovation strategies into local innovation spaces equips 'both devolution and deregulation of state power and recentralisation and recollection of state authority' (Li, 2015, p. 81). In other words, contemporary innovation spaces in China should be studied under changing innovation strategies and in relation to the national and local conditions required to realize such strategies.

To advance the innovation capacity of Chinese science parks, state intervention and policy instruments have provided resources beyond knowledge-centred elements (Zhang & Wu, 2019). From state strategies to policy tools, 'innovation' is inextricably interlinked with general development strategies (Shearmur, 2012). With state endeavours, the Chinese science parks combine spatial and economic strategies as part of urban development (Zhang & Wu, 2012; Zou & Zhao, 2018). Therefore, China's emerging innovation spaces ought to be studied through the lens of urban governance, which provides an opportunity to examine the role of the state on the ground (Wu & Zhang, 2022).

This paper focuses on the Zhangjiang Science City in Shanghai, the very first Chinese science city project endorsed by the central government. Under the national innovation strategy to build the National Comprehensive Innovation Centre in Shanghai, the Zhangjiang Science City has been proposed as a state strategic space to host national ambitions for key innovations. This science city project was initiated in 2016 and officially launched in 2017, located in the former Zhangjiang High-Tech Park. After examining the planning and implementation of the Zhangjiang Science City, we find that this Chinese innovation space is a project to implement national innovation strategies through urban development. During its development, the multi-scalar state has been visible, and state actors operating in different tasks have participated in its development. This paper engages with two bodies of literature. First, it contributes to the non-firm and extra-local understanding of 'spaces of innovation' (Bunnell & Coe, 2001) by providing the explanatory insights lacking in many studies of science parks (Lecluyse et al., 2019). Second, this paper puts the Zhangjiang Science City in China's development context and investigates the transformation of science parks under state entrepreneurialism in China (Wu, 2020).

In this paper, science parks are defined according to OECD (2011)'s proposition of 'the third generation of science parks' with specific site-based strategies, technology transfer policies, and inward investment support through a technopole approach (p. 200). This definition fits the Zhangjiang Science City as an under-studied Chinese innovation space.

The paper is organized as follows. The next section reviews the literature on science parks as diversified innovation spaces and then contextualizes the development of science parks in China where the role of the multi-scalar state should be emphasized. The third section justifies the choice of methodology. The fourth section introduces China's new innovation strategies to understand the science city project from the perspective of its national vision. The fifth section presents the development of the Zhangjiang Science City as a mega urban project that combines the realization of state innovation strategies and urban development. The sixth section investigates the operations of the multi-scalar state and state-created actors, and the final section offers the discussion and conclusion.

2. Literature review

2.1. The development of science parks

In the Western economies where science parks originated (Castells & Hall, 1994), these spaces have witnessed continuous efforts to foster knowledge collaboration. Generally, science parks constitute a significant part of the national innovation system (Albahari, Catalano, & Landoni, 2013). By fostering knowledge diffusion and improving park management, science parks contribute to the spontaneous synergy among university-industry-state actors (Lecluyse et al., 2019). The twenty-first century has seen generational changes in science parks. The aims of these localities have evolved from spatial proximity and property development to 'soft' infrastructures for networking and high-tech branding (OECD, 2011). The development of science parks towards innovation spaces emphasizes urbanization economies besides agglomeration externalities. Some exurban science parks have transformed into knowledge precincts

(Benneworth & Ratinho, 2014) or innovation districts (Yigitcanlar et al., 2020). Additionally, modern innovation spaces are not limited to their precedent park formats and can even be virtual without physical agglomerations (Albahari et al., 2013). However, these studies focus on the mechanisms of knowledge generation and interpret science parks from a knowledge-based view. They offer inadequate explanations of park development in the national development context.

To address the 'why' questions of park formation and evolution, there has been continuous research interest in East Asian science parks (Lecluyse et al., 2019). Under the developmental state, East Asian science parks represent proactive planning to create economic development rather than reactive planning in Western economies (Sonn & Choi, 2022). Therefore, East Asian science parks are often categorized as more 'planned' innovation spaces, or 'innovation by design' (Castells & Hall, 1994, p. 39). Analogous to the Western science parks as localities that foster knowledge collaboration, East Asian science parks have been examined in terms of technological transfer, research commercialization, and synergy promotion (Edgington, 2008; Miao & Hall, 2014). Besides these knowledge-centred angles, East Asian science parks are often utilized as policy tools for economic catch-up, but on a much larger scale (OECD, 2011). These science parks are more 'cultivated' than 'spontaneous' due to the visible participation of state actors and state-organized resources. For instance, the post-developmental thesis highlights the technocratic rationale in planning Taiwanese science parks for strategic coupling (Hsu, 2011; Yeung, 2009).

Two distinctive features have been concluded from the development of East Asian science parks. First, many science parks are seen as policy tools under state strategies. The externalities between firms are generated from state-organized resources to facilitate industrial agglomerations (Sonn & Choi, 2022). The proactive participation of the state has originated from political and economic considerations in these science parks. In Taiwan, decades of science park construction and technopolis programmes have been enacted against changing geopolitical backdrops, shifting from international development ambitions towards domestic electoral calculations under populism (Hsu, 2017). In South Korea, the Daedeok Science and Technology Park has undergone national and regional conflicts, which complicates the park's governance structure (Kim, Lee, & Hwang, 2014). In China, the proliferation of high-tech development zones progressed alongside the processes of decentralization, marketization, and globalization (Prodi, Nicolli, & Frattini, 2017; Wei, Lu, & Chen, 2009). In other words, the development of East Asian science parks should be understood comprehensively, not only for knowledge production but also for the economic, political, and social aspects of state strategies. The functions of these localities exceed hosting government-sponsored R&D programmes or arranging innovation resources (Zhang & Wu, 2012).

Second, the operation of East Asian science parks is related to urban development. Occasionally referred to as 'siliconisation' projects, the science parks serve both the spatial fix of global (re)industrialization (Zhou et al., 2011) and the speculation for land value extraction (Liu, Yue, Fan, Peng, & Zhang, 2016). These science parks possess inextricable connections to the social and spatial changes brought by urban development. Such issues range from redistributing land value appreciation (Hsu, 2017) to balancing land use between industrial, residential, and environmental functions (Zou & Zhao, 2018). The development of such innovation spaces is embedded in the

wider urban development strategies and thus structurally confined by the conditions provided by the latter, such as land availability (Huang & Fernández-Maldonado, 2016), cross-level administration (Cheng, van Oort, Geertman, & Hooimeijer, 2014), human capital (Heilmann, Shih, & Hofem, 2013), and infrastructural financing (Zhang, 2015). Compared with Western studies, in which urbanization is usually seen as the external or tacit conditions that encourage innovation activities (Florida et al., 2017), these cultivated science parks are institutionally designed as urban development tasks. With the processes of strategic coupling, decoupling, and recoupling (Yang, 2014; Yeung, 2009), East Asian science parks have gradually shifted from industrial agglomerations and production sites toward mega urban projects (Hsu, 2017; Zou & Zhao, 2018). They enjoy the locational advantages of (sub)urban areas and the resources of urban policies (Li & Wang, 2019). The city is seen as the arena of innovation where the development of science parks has a relationship of mutual reinforcement with urban transformation (Zhang & Wu, 2019).

Empirically, a worldwide trend of the transformation of science parks requires a context-specific understanding of these innovation spaces (Yigitcanlar et al., 2020). A representative example of diversified science parks is the science city projects. The Tsukuba Science City in Japan was initiated under the national programmes for university collaborations and the commercialization of campus research (Castells & Hall, 1994). The science city in Taiwan, meanwhile, is argued as a harmonization scheme to smooth the social concerns arising from the former land-centred science park development (Hsu, 2017). Compared with Western science cities (Perry, 2007), these East Asian science cities usually have more explicit spatial boundaries. Their development involves state politics of the urban land nexus (Huang & Fernández-Maldonado, 2016). Such innovation spaces originate from state planning instead of university entrepreneurs or private ventures (Hsu, 2017; OECD, 2011).

2.2. The role of the multi-scalar state in China's innovation strategies

To develop science parks, functional specialization is required for actors at different scales (Castells & Hall, 1994). Studies on innovation systems have shown that the decentralization of innovation tasks from national to regional levels promotes local knowledge circulation through institutional and organizational support (Miao & Hall, 2014; Zhang, 2015). But the translation of national innovation strategies into local innovation spaces needs to overcome central-local conflicts and delegate innovation resources (Perry, 2007). Meanwhile, local policies interpret the national indications into practical implementations during the multi-scalar governance of innovation (Sonn & Kang, 2016). These cross-scalar views emphasize the non-firm and extra-local connections during the development of innovation spaces. Hence, the role of the multi-scalar state requires careful investigation.

In China, multi-scalar governance constitutes the political-economic backdrop to innovation strategies, as well as for the development of science parks (Zhang & Wu, 2019). Supported by proactive state interventions, Chinese science parks are beyond knowledge-centred Marshallian-Jacobian externalities (He & Zhu, 2018). The increasingly specialized roles of state actors at different levels (Shen, Luo, & Wu, 2020) provide more nuanced insights into the political-economic features of these innovation

spaces. The 'soft' policy instruments and 'hard' spatial development require careful examination (OECD, 2011). From state strategies to local projects, Zhang and Lan (2022) suggest that consideration be given to balancing re-asserted central authority and local implementations.

2.2.1. The central state: strengthening national innovation strategies

The role of the central state in China's innovation strategies has been expanding since the 2006 Medium – and Long-term Science and Technology Development Plan (Zhang & Wu, 2012). To elevate China's position in global production networks, the principle of 'indigenous innovation' gave birth to the 'Strategic Emerging Industries' (Yang, 2014), further developed by the techno-nationalism strategies of 'Made in China 2025' (Yeung, 2019). The recent US-China trade war led to the expansion of state power in controlling strategic industries, represented by the 'New Whole State System' (Zhang & Lan, 2022). The Chinese central state's role is highlighted in market creation and industrial regulations (Yeung, 2019). Through institutional facilitation, the central state contributes to new path creation.

Meanwhile, to promote indigenous innovation capacity, participants from the central state are diversified. Although the Ministry of Science and Technology still plays a guiding role in the national innovation system (Heilmann et al., 2013), ongoing strategies of 'innovation-driven development' (Zhang & Lan, 2022) and 'new urbanisation' (Zou & Zhao, 2018) have incorporated other departments from the central state. To expand indicative science and technology policies to financial and spatial operations, cross-ministry cooperation within the central state has been established (Liu et al., 2011).

However, central interference can also generate conflicting results with local policies in industrial upgrades (He & Zhu, 2018). Influenced by the tax-sharing reform and innovation programmes in the early 1990s, local development tasks have shared the burdens of financing and spatial planning to realize national innovation strategies (Heilmann et al., 2013). Meanwhile, there is a divergence between central indications for long-term innovation capacity and quick gains pursued by local growth (Wei et al., 2009). So, since the early 2010s, the central state has regained its power in authorizing high-tech zones, science parks, and other strategic spaces (Ngo et al., 2017). The role of the central state has witnessed a re-assertion in certifying innovation spaces and guiding national innovation strategies.

2.2.2. The local state: finding operational solutions in urban development

During China's massive urbanization, national innovation strategies have been disassembled into local spaces (Prodi et al., 2017). The regional varieties in China have generated differentiated industrial bases throughout the country, ranging from subcontracting to indigenous-driven types (Yeung, 2009). As a result, Chinese science parks represent a comprehensive concept that includes industrial parks (Wei et al., 2009), technological parks (Cheng et al., 2014), export bases (He & Zhu, 2018), and university spin-offs (Zhang & Lan, 2022). Generally, Chinese science parks constitute a significant part of local development (Zhang & Wu, 2012). Meanwhile, park management is entangled with the hierarchical administrations in Chinese cities (Cheng et al., 2014).

Chinese science parks are a spatial approach that incorporates both industrial and urbanization strategies (Zou & Zhao, 2018). Compared with regional innovation

systems, science parks serve as a more concrete planning concept (Miao & Hall, 2014). Planned by proactive local states, science parks are positioned as urban development tasks in China. During China's massive urban expansion, science parks yield spillover effects based on cheap industrial land. Revenues from industrial production and adjacent residential and serviced land 'offset' the low land-leasing fees of science parks (Yang & Wang, 2008). In other words, the development of Chinese science parks demonstrates a dual-directional capital switching between industrial production and land-based development (Liu et al., 2016). Further, local states adopt proactive measures to create competitive advantages in inter-city competition. Regional resources are allocated to develop local science parks. For instance, the Shanghai municipal government moved its international flights from the metropolitan centre to Pudong, improving Zhangjiang High-Tech Park's spatial connectivity (Zhang & Wu, 2012). To sum up, Chinese science parks are important spatial projects for urban development. They demonstrate a more visible role of the local state compared with Taiwan's central state-anchored science parks (Huang & Fernández-Maldonado, 2016). However, there is a lack of long-term sustainability in developing Chinese science parks because speculative land development could generate lock-in effects that hinder high-tech advancement (Zhang, 2015).

The operation of Chinese science parks is related to urban governance which determines the institutional environment. Thinking of Chinese science parks as mega urban projects further requires us to understand the ongoing changes in China's urban governance. Along with the urban transformation in China, local states have both provided and altered the tools that could be deployed for science park development. The state creates its agencies for different development tasks. Coping with the need to both strengthen state authority and flexibly apply market tools, Chinese states act in an entrepreneurial manner (Wu, 2020). The local state bridges national innovation strategy and project implementation through institutional and organizational innovation. In Shenzhen, state-owned venture capital firms are crucial in the strategic recoupling process of the liquid crystal display industry (Yang, 2014). They work in conjunction with China's strategic ambitions to upgrade labour-intensive industries. This demonstrates the linkage between the national strategies to foster China's innovation capacity on the one hand and the local governance innovation for feasible implementation on the other. In this vein, the development of Chinese innovation spaces incorporates emerging agents in China's urban governance (Wu, 2020). These actors include management committees as within-the-state organizations (Shen et al., 2020) and state-controlled development corporations as market instruments (Feng, Wu, & Zhang, 2021). Government-guided investment funds and local government financing vehicles provide 'patient money' for innovation (Zhang & Lan, 2022).

In summary, the development of contemporary Chinese science parks should be studied against the expanding state guidance for technology upgrading. Meanwhile, China's innovation strategies have become increasingly incorporated into the development of Chinese cities. The operation of science parks is required to solve the mismatch between national innovation strategies and local resources. Therefore, these innovation spaces demand state participation and are state spaces. It is worth studying how Chinese science parks could transform under changing national innovation strategies and how they are developed as urban development tasks. Operationally, the actual

participation of state actors in China's emerging innovation spaces requires further investigation.

3. Methodology

The evolution of science parks and their contextual interpretations justify our choice of methodology. Qualitative methods can tackle the heterogeneous nature of science parks and provide context-sensitive answers to 'how' and 'why' questions regarding park development (Lecluyse et al., 2019). In this paper, the empirical data have been collected through three channels. First, official documents including statistics yearbooks, planning files, and annual reports were sorted from government sources. These documents show how the Zhangjiang Science City was planned and evaluated from various perspectives. Second, promotional materials for the Zhangjiang Science City were gathered. However, the ongoing rescaling of high-tech zones among Chinese cities could bring challenges related to the continuity of official data (Li, 2015), hence supplementary sources, tweets, and articles from three WeChat accounts were also analysed. Written in an easy-to-understand style, these semi-governmental but market-oriented documents are helpful to understand the actual practices in innovation spaces. Third, a total of 27 semi-structured interviews were conducted with planners, managers, officers, and scholars in Shanghai between June 2020 and March 2021. Most interviewees were directly involved in the development of the Zhangjiang Science City, either in its planning or implementation, and they were familiar with the local context of Shanghai. The interviews typically last for 45 minutes to 2 hours.

4. National innovation strategies to develop Comprehensive Innovation Centres in China

National innovation strategies to develop Chinese science cities originated in the late 12th Five-Year Plan cycle. During an inspection in Shanghai in May 2014, President Xi Jinping emphasized that 'Shanghai should step into the frontier of pushing forward indigenous innovation. That is, Shanghai should take the leading role in carrying out innovation-driven development strategies. Shanghai needs to build an innovation centre with global influences' (Shanghai municipal government, 2014). The State Council then established a leading group to investigate how to realize, in practical terms, such an ambition. In 2016, the strategy for building the National Comprehensive Innovation Centres (*guo jia zong he ke chuang zhong xin*) was officially launched. It attempted to link 'innovation-driven development' strategies to high-quality urbanization in China (State Council, 2016). In January 2017, the National Development and Reform Commission promulgated the 13th Five-Year Plan of National Strategic Science Infrastructures. This plan clearly assigned national innovation strategies to the city level. The mission was:

> To construct the National Comprehensive Innovation Centres in the nominated cities with decent infrastructures and agglomerated facilities. To become vital nodes in global innovation networks, frame the platform foundation of the national innovation system, and promote spillover effects for regional innovation-driven development … Overall, to serve the national strategic interests in major scientific and technological tasks, promote

> breakthroughs in original innovation and basic research, and conquer the challenges in core and key technologies. Above all, to strengthen China's voice power in international science and technology competition. (National Development and Reform Commission, 2017)

Guided by these principles, Shanghai, Hefei, Beijing, and Shenzhen were designated to perform the National Comprehensive Innovation Centre strategy (Table 1). As the first pilot city, Shanghai was selected for its relatively mature environment for market-oriented development, represented by the Pudong New District (Zhang, 2015). Shanghai's status as a world city also encourages innovation. As the second designated city, Hefei was chosen for its strength in basic research and outstanding research infrastructures thanks to the historical connection with the Chinese Academy of Science. Altogether, Shanghai and Hefei shape the regional pivots of the innovation-driven development of the Yangtze River Delta. As for Beijing, the capital was designated as the National Comprehensive Innovation Centre for its eminent higher educational institutions and national-leading R&D expenditures. Last, owing to its great capacity for in-house product innovation, Shenzhen joined the list of National Innovation Comprehensive Centres with the establishment of the Guangdong-Hong Kong-Macao Greater Bay Area.

Down to implementation, these science city projects, also referred to as 'science centres' or 'innovation hubs' (*ke xue zhong xin*), were planned with an emphasis on the generation of original innovation (National Development and Reform Commission, 2017). With the entitlement of the National Comprehensive Innovation Centre came the crucial infrastructures for innovation.[1] For instance, the Large Research Infrastructures and the State Key Laboratories are managed by the Chinese Academy of Sciences and the Ministry of Education, respectively. These two departments, under the coordination of the State Council, allocate the future facilities in the nominated four cities (Interview with an official, August 2020). Such institutes provide fundamental research for knowledge generation and foster science and technology development. These infrastructural foundations support the further agglomeration of higher education institutes to conduct sector-leading research in science cities. Likewise, by offering discounted charges for basic research activities, the Large Research Infrastructures exert

Table 1. China's National Comprehensive Innovation Centres and the affiliated science city projects.

City	Entitlement date	Local innovation spaces	Area (initially planned)	Strategic emerging industries
Shanghai	Feb 2016	The Zhangjiang Science City	94 km^2	Integrated circuit Biotech Artificial intelligence
Hefei	Jan 2017	The Binhu Science City	102 km^2	Quantum information science New energy Artificial intelligence
Beijing	May 2017	The Huairou Science City	101 km^2	New material Energy conservation and environmental protection industry Biotech
Shenzhen	March 2020	The Guangming Science City	99 km^2	Information industry Biotech New material

Source: Summarized by the authors according to the planning documents of each science city project in Shanghai, Hefei, Beijing, and Shenzhen.

specialization externalities for private firms in addition to state science and technology programmes.

Besides knowledge generation, the development of the National Comprehensive Innovation Centre is supported by state strategies in other domains. For example, in June 2019, the Sci-Tech Innovation Board was officially established on the Shanghai Stock Exchange to support the development of Shanghai into an international financial centre. This national financial strategy assisted the development of local innovation spaces by providing venture capital and financial services. It further attracted human capital and entrepreneurship, promoting Jacobian externalities for innovation.

However, with the re-assertion of central authority also came regulatory restrictions on developing the science city projects. In 2014, the State Council launched a series of policies for the high-quality transformation of high-tech zones and parks. Document No. 54 reflected the indicative guidance to promote innovation-driven development. It contained 19 principle-based clauses to upgrade these spaces in industrial, financial, and environmental aspects. Related to this central initiative were other regulations at the implementational level. Document No. 62 targeted the 'unregulated' and 'informal' taxation rebates in development zones. Even before the 2008 certification of high-tech firms in China, there were numerous taxation subsidies to encourage firms with innovation activities. But these incentives led to vicious inter-city competition for industrial production whilst the effects of promoting innovation remained questionable. Document No. 62 was supposed to provide a solution to this 'race-to-the-bottom' situation. Document No. 43, with a more indirect influence, aimed to control local debt. The land collateral model for the local state to finance the development of science parks (Zhang, 2015) should be scrutinized because such operations generate implicit debts (Interview with an official, August 2020). These regulations can be seen as the renewed 'carrot-and-stick' strategy from the central state to exert control over the development of science parks.

Generally, the entitlement of the National Comprehensive Innovation Centre has granted significant strength to the four cities in terms of inter-city competition in the long run. The four selected cities now have centrally certificated privilege in allocating strategic innovation facilities, like Large Research Infrastructures. It is evident that the Chinese science city projects reflect state strategies to foster technological upgrading, and such an entitlement is supported by innovation resources delivered by central endorsement. For local leaders, this also brings a great opportunity to fulfil the central state's political task in local innovation spaces, namely the science cities. Interestingly, the central-local relation can hardly be described as a top-down command under the strategies to build the National Comprehensive Innovation Centres because central ambitions do not have a fixed answer in implementation. The challenges, notably in industrial upgrades and spatial planning, seek solutions from local operations.

5. Integrating state strategies and urban development in the Zhangjiang Science City

The Zhangjiang Science City is a development project in Shanghai's Pudong New District. Two entitlements have laid the foundations for the Zhangjiang area, the first is the National High-Tech Zone. Following the opening-up of the Pudong New District in 1992, the Shanghai Zhangjiang Development Zone was established with designated

tasks to develop high-tech industries. In 1999, the 'Focusing on Zhangjiang' policy granted municipal-level resources to the Zhangjiang Development Zone, especially to the Zhangjiang High-Tech Park. Until 2011, a 'parks within the park' structure was matured with an expanded scope of 79.7 km^2 in the Zhangjiang High-Tech Park. Several sub-parks, including Shanghai Pudong Software Park, Zhangjiang Pharmaceutical Valley, and Zhangjiang Integrated Circuit Industrial Port, are now located in this core area. The second entitlement is the Zhangjiang National Demonstration Zone of Indigenous Innovations (the Zhangjiang Demonstration Zone hereafter). In 2011, the Zhangjiang Demonstration Zone, as an administrative concept, assisted the former Zhangjiang High-Tech Zone in expanding to 296 km^2. With the integration with Shanghai Pilot Free Trade Zone, the Zhangjiang Demonstration Zone came with an enormous area of 531 km^2 and a 'one zone, twenty-two parks' layout in 2014 (Figure 1).

In 2017, the core Zhangjiang High-Tech Park was selected by the Shanghai municipal government to implement the National Comprehensive Innovation Centre.[2] The vision of this national innovation strategy differed from the former science park as a local cluster. Therefore, the entitlement of this space represents Shanghai as a fertile ground for innovation. Initially, the project to transform the core Zhangjiang High-Tech Park was titled 'the Zhangjiang Tech City' (*ke ji cheng*). However, the finalized version of the master plan in 2017 was modified as 'the Zhangjiang Science City' (*ke xue cheng*). The brand of the science city attempted to distinguish the vitality of this modern type of Chinese innovation space. Arguably valuing high-tech innovation over industrial production, the Zhangjiang Science City has been developed in accordance with national innovation strategies (Table 2).

Regarding industrial development, the former Zhangjiang High-Tech Park was known for the agglomeration of integrated circuit, biotech, and automobile industries. A 'dragonhead' strategy has been adopted for high-tech clusters. Agglomerated in the Integrated Circuit Industrial Port, Shanghai's integrated circuit industry is symbolized by Semiconductor Manufacturing International Corporation (SMIC). Originating from the vision to localize the 'hollowed-out' semiconductor industry from Taiwan in the early 2000s, SMIC led a systematic strategic coupling process and has been generating

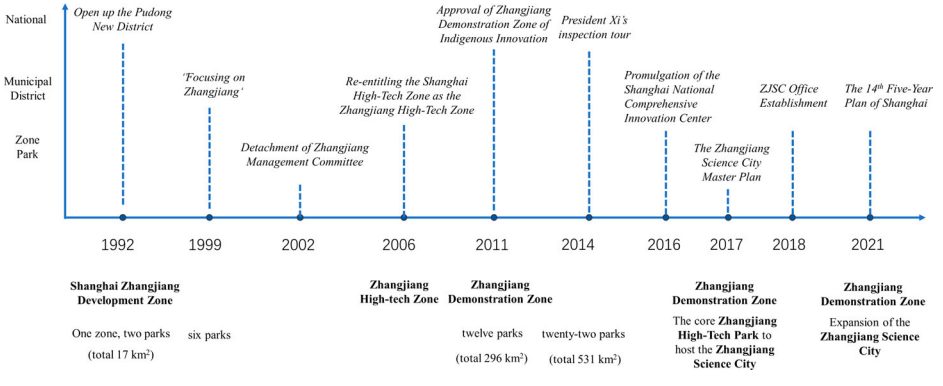

Figure 1. The multi-scalar strategies and entitlements during the development of the Zhangjiang area.

Table 2. The development of the Zhangjiang Science City with state strategic directions.

Measurement index	Data in 2019	Annual growth rate from 2016 to 2019 (%)	Ratio to the total in the Zhangjiang Demonstration Zone, 2019 (%)
Certified high-tech firms	1375	85.8	19.8
Number of national-level enterprise technology centres	14	40.0	26.4
Patents granted annually	4605	32.5	31.3
Total employees (10 thousand personnel)	40	11.1	16.8
Number of national-level incubators	11	10.0	25.6
Number of foreign-invested R&D institutes	161	9.5	50.6
Tax revenue (100 million yuan)	337	5.0	11.0
Industrial output (100 million yuan)	3022	2.5	18.2

Source: Summarized by the authors based on the development reports of the Zhangjiang Demonstration Zone, various years.

spillover effects since then. A similar path applies to biotech in the Zhangjiang Pharmaceutical Valley. In 1994, Roche located its international headquarters in Zhangjiang. Over decades, the experience of contracted research organizations has generated a mix of local buzz and global pipelines. As for the automobile industry, this sector now incorporates new energy vehicles, this having been Shanghai's strategic emerging industry since 2017. The Shanghai municipal government negotiated with Tesla's Gigafactory to locate in Lingang, an area southeast of Zhangjiang. Under the urban development strategies of Shanghai, the Zhangjiang Science City collaborated with Lingang. This further contributed to the partnership between SAIC Motor, Alibaba, and Zhangjiang High-Tech Park Development Co., Ltd to co-establish IM Motors, an indigenous new energy vehicle group, in 2020.

The changing national innovation strategies urge sectors in the Zhangjiang Science City to surpass incremental innovation. Knowledge workers in Zhangjiang have inherited tacit knowledge from foreign sectoral giants. The incumbent firms with innovation capacity require assistance in the 'post-take-off' phase of innovation, for example, from specialization to diversification (Interview with a manager, August 2020). Entrepreneurs expect better integration of the production chain as well as access to venture capital. Therefore, the industrial development in the Zhangjiang Science City is supposed to seek a lock-out from the former science park trajectory. Localizing sectoral platforms and functional facilities, such as Shanghai Motor Vehicle Inspection and Certification Centre, is highlighted in modernizing this science city as an innovation space. Further, local planners emphasize the development of people-centred facilities and urban amenities to attract the creative class.

For research platforms channelled by the central government, site-selection and construction are project-specific and hybrid in labour division. For instance, Shanghai Synchrotron Radiation Facility was located with a total investment of 1.2 billion yuan, equally shared by the central government, the Shanghai municipal government, and the Chinese Academy of Sciences. After successful construction, it has been managed by the Zhangjiang Management Centre of Large Research Infrastructures, a department under the Development and Management Office of the Zhangjiang Science City. In other words, such strategic research infrastructures are centrally authorized and then locally coordinated in the Zhangjiang Science City.

Besides high-tech upgrading, the development of the Zhangjiang Science City faces challenges in urban development, such as land availability and development quota control. Rather than a start-from-scratch high-tech enclave, the Zhangjiang Science City is an upgrading project based on the former science park. The two previous strategies, namely 'Focusing on Zhangjiang' and the establishment of the Zhangjiang Demonstration Zone, have brought two rounds of urban expansion. Before the promulgation of the Zhangjiang Science City, over 70 per cent of available land was already developed (Interview with a planner, June 2020). Moreover, the relatively market-oriented land reserve system in Shanghai protects the exchange value of existing plots, thus pushing up land costs. In 2018, the average industrial land price per square meter in Shanghai was above 2,500 yuan, twice the price in Nanjing which was the second in the Yangtze River Delta. Fierce inter-city competition near Shanghai forced the local state to change the land-based development model. As a result, the Pudong New District Government began to experiment with new policies in the Zhangjiang Science City. To encourage innovation activities with limited land availability, firms that reach the required number of granted patents can apply for an increase in the plot ratio. Therefore, the Zhangjiang Science City presents the shift from quick gains in urban expansion to functional upgrading. Land use quotas are coordinated to foster innovation capacity as the entering threshold of firms is elevated in Shanghai:

> In Zhangjiang, the industrial land price should be understood differently. Normally, Chinese cities utilise the strategy of 'feeding land with industries', that is, to offset the low land leasing fees from industrial revenues. But here, we are also required to 'feed land with land'. We should maintain the land value and we cannot use land lavishly. We are pressured to guarantee that the real high-tech industries are located on those land plots. (Interview with an official from the ZJSC Office, June 2020)

On the ground, the development of the Zhangjiang Science City demands district and city level support, such as land preparation and urban amenities. Notably, the model of land development in the Zhangjiang Science City has changed. During previous development of the Zhangjiang High-tech Park, park developers were encouraged to carry a self-financing approach. State-owned land capital was collateralized for bank loans. After accomplishing basic infrastructures, the cost could be recovered from property development. After Document No. 43 in 2014 on local debt and Decree No. 4 in 2016 to regulate the land reserve system, the tasks of land development remained with park developers whilst income was collected by the district government for coordinated redistribution. To develop projects in the Zhangjiang Science City, advance planning should be approved before detailed construction and industrial project allocation. The district government regained the power in coordinated planning. 'Now we hand in our guns' (Interview with a local developer, August 2020). The former debt-financing approach is now examined and approved by the district land reserve centre. This strengthened the coherence between high-tech development and urban planning.

The Zhangjiang Science City is a project that incorporates state innovation strategies into urban development. First, the Zhangjiang Science City has an official status to foster key innovations under the entitlement of the National Comprehensive Innovation Centre. Platform functions and public facilities are underlined for science and technology development. Therefore, this state strategic innovation space is distinctive from a mono-

functional cluster. It is beyond a planning tool to generate agglomeration effects and industrial growth, which has been usually seen in Chinese science parks (Sonn & Choi, 2022; Wei et al., 2009). Secondly, in the Zhangjiang Science City, park management and project implementation are integrated into Shanghai's urban development strategy. Urbanization economies are emphasized in the Zhangjiang Science City. Meanwhile, the local development context of Shanghai raises challenges to delivering high-tech upgrading in the Zhangjiang Science City. Therefore, institutional innovations and governance efforts are required for the grounded implementation of this innovation space.

6. Local state actors and operations

6.1. The development and management office: integrating vertical and horizontal administration

After the formal promulgation of the Zhangjiang Science City, the Shanghai municipal government rescaled the former Zhangjiang Management Committee in 2018. To inject extra-local resources to develop the Zhangjiang Science City, the Development and Management Office of the Zhangjiang Science City (the ZJSC Office hereafter) was established. As a re-organized management committee, the ZJSC Office incorporated a municipal-level office, a district-managed department of the Zhangjiang Demonstration Zone, and the Zhangjiang Bureau of China (Shanghai) Pilot Free Trade Zone Administration.

The ZJSC Office now performs local governance of the Zhangjiang Science City and operates in a way that includes both vertical and horizontal administrations (*tiao kuai jie he*). This re-organized structure is more efficient. For instance, when locating biotech firms one needs to consider issues including land development quotas, R&D laboratories, vapouring and sewage treatment, and customs and ethics control. Within the same body of the ZJSC Office, there is no need to seek cross-department communications at the district level. However, conflicts also emerge within the ZJSC Office. In relocating some supplement biotech production bases, the District Planning and Natural Resources Bureau and the District Science and Economic Commission had different opinions. This led to the contradiction in industrial and spatial plans within the ZJSC Office. Some biotech firms actually complained about the distance from the laboratories to the production sites (Interview with a manager, June 2020).

To upgrade the Zhangjiang Demonstration Zone, the Zhangjiang Special Fund was established from the municipal-level fiscal budget. Five billion yuan were spent from 2017 to 2020 with expenditure on shared facilities, intellectual property rights, marketization training, networking events, and social services for high-skilled talents (Zhangjiang Demonstration Zone, 2021). The Zhangjiang Special Fund takes a variety of forms such as discounted loans, government purchasing, and equity investment, making it flexible to incentivise innovation through financial means. To foster local motivation, the Zhangjiang Special Fund requires a 1:1 matching ratio between municipal budgets and self-financing from the district government. For the ZJSC Office, this fund takes the form of public expenditures under 'the Twenty Policies of Zhangjiang'. In the Zhangjiang Science City, the ZJSC Office assists in intellectual property services, hukou offers for high-skilled talents, entrepreneurship training, environmental rebates,

etc. Further, the ZJSC Office has launched a 'lifecycle management' policy for tenant firms, providing targeted services during different stages of innovation.

The Shanghai municipal government delegated the right to approve high-tech firms to the ZJSC Office. Likewise, firms in the Zhangjiang Science City can utilize geographical proximity and fast tracks to accelerate patent application processes. Assisted by the Shanghai Intellectual Property Court, the normal cycle of patent applications has been shortened from two years to three months. The Zhangjiang Science City stands out in patents per 10,000 people, with over 600 in 2020, twelve times the Shanghai average (Zhangjiang Demonstration Zone, 2021).

Generally, the ZJSC Office believes in a 'big market, small government' model to foster high-tech innovations (Interview with an official, July 2020). The ZJSC Office connects different actors both vertically and horizontally in innovation development. It implements municipal and district level coordination that assigns specialized sectors to individual sub-parks. Also, the ZJSC Office reports the policy feedback from incumbent firms to the respective district departments.

Finally, the ZJSC Office is the legal entity that signs formal contracts with private firms. However, municipal or district leaders usually negotiate with international sectoral giants. The ZJSC Office provides planning support and realizes state strategies in suitable land plots. According to a local officer, 'the municipal leaders draw the big boxes, then we fill in with smaller ones' (August 2020). However, the ZJSC Office cannot catch up with all the market dynamics in the Zhangjiang Science City. Its status as a government agency lacks flexibility. Therefore, the ZJSC Office often relies on Zhangjiang Group to draft an initial intentional agreement with the target firms before formalizing the land lease contract.

6.2. The state-owned enterprise: conducting park management and performing state strategies

Since 2003, Zhangjiang Group has carried out development tasks in the Zhangjiang Area. As the current developer of the Zhangjiang Science City, Zhangjiang Group is a huge state-owned enterprise (SOE) directly affiliated with the Pudong State-owned Assets Supervision and Administration Commission (SASAC). The evaluation of Zhangjiang Group includes both its operations as a functional-type SOE and its market performance. Its role is comprehensive and mixed depending on the specific tasks at hand in the Zhangjiang Science City.

The massive Zhangjiang Group also contains a variety of subsidiaries. In 2020, there were 112 subsidiaries, including 29 second-tier subsidiaries, classified into two categories: functional subsidiaries and place-based subsidiaries. The functional subsidiaries specialize in different businesses related to the development of the Zhangjiang Science City, such as property management and high-tech investment. The administrative separation between the government and SOE leaves Zhangjiang Group free to act. Ever before the planning of the Zhangjiang Science City, many functional subsidiaries of Zhangjiang Group acted as market players. After the promulgation of the Zhangjiang Science City, the functional subsidiaries received further opportunities to provide specialized services for high-tech development. These subsidiaries deployed diverse market tools, including direct equity investment into sector-leading firms, providing land-share agreements for

start-ups, and using the fund of funds to cooperate with institutional investors (Zhangjiang Group, 2021). A representative market operation is the incubating services for start-up firms which are managed by Zhangjiang Huicheng Company, a second-tier subsidiary of Zhangjiang Group. In the Zhangjiang Science City, over 160 market ventures and 23 banking institutions have been introduced to provide financial services for innovation. Interestingly, the functional subsidiaries can 'free-ride' as follow-up investors:

> On the one hand, the state-led investment fund could leverage market ventures because it provides the endorsement from the state. On the other hand, however 'functional' our subsidiaries are, they need to go through the level-by-level procedures within the SASAC system. A clever solution is to learn from the market ventures. For instance, we have Alibaba here, we have Microsoft and Johnson here, and these giants have both technologies and financial capital. (Interview with a manager from Zhangjiang Group, July 2020)

The place-based subsidiaries, meanwhile, follow the coordinated planning of spatial and industrial development in the Zhangjiang Science City. These place-based subsidiaries serve as the local project implementors in collaboration with the ZJSC Office. With the expansion of the Zhangjiang Science City, the eight place-based subsidiaries cannot directly recruit industrial firms without the approval of the Pudong New District Government. On the one hand, periphery areas in the Zhangjiang Demonstration Zone manage to receive high-tech firms that they were unable to attract before, as the brand of the Zhangjiang Science City raises their attractiveness. On the other hand, the place-based subsidiaries become less self-motivated because they can no longer share land-derived income. Furthermore, the connection between the place-based subsidiaries and local township governments is weakened because these subsidiaries are evaluated based on their accomplishment of state tasks. As a result, the local township governments find themselves in a passive position in solving social management issues caused by industrial development projects (Interview with an official, August 2020).

6.3. The development corporation: mobilizing capital from the financial market

Related to the financial operations of Zhangjiang Group is the local financing vehicle, Zhangjiang High-Tech Park Development Co., Ltd (ZJHTC hereafter). The business of ZJHTC began with the injection of high-quality assets from Zhangjiang Group, notably the properties in the Integrated Circuit Industrial Port.[3] After being listed on the Shanghai Stock Exchange in 1999, ZJHTC, a subsidiary of Zhangjiang Group, started its profit-oriented operations as a player in the financial market. Due to massive urbanization in Shanghai and the 2008 Global Financial Crisis, ZJHTC heavily relied on property-related businesses to maintain profitability. With the promulgation of the Shanghai National Comprehensive Innovation Centre in 2016, the control of ZJHTC was transferred from Zhangjiang Group to the Pudong New District SASAC. This created a more specialized labour division between the functional-type SOE (Zhangjiang Group) and the financial actor (ZJHTC). In developing the Zhangjiang Science City, Zhangjiang Group operates as a functional-type SOE to mainly implement the spatial planning and economic development of the Zhangjiang Science City (Figure 2 (a)), and ZJHTC serves as a financing vehicle to mobilize capital from the financial

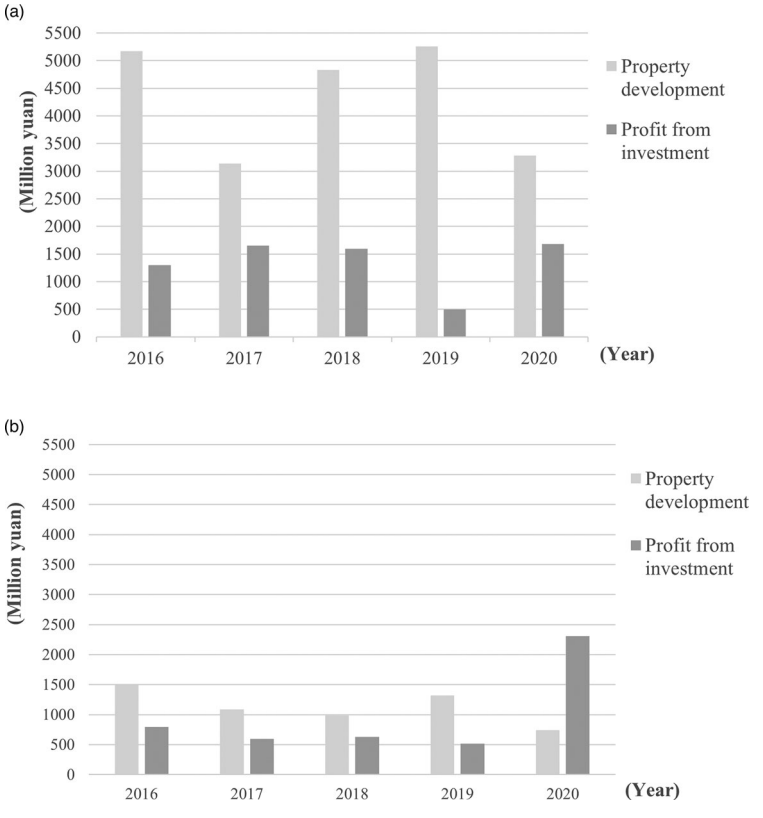

Figure 2. The revenues of Zhangjiang Group (a) and Zhangjiang High-Tech Park Development Co., Ltd (b). Source of Figure 2: Zhangjiang Group (2016–2020); Zhangjiang High-Tech Park Development Co., Ltd ([ZJHTC], 2016–2020).

market (Figure 2(b)). Meanwhile, Zhangjiang Group kept 50.75 per cent of ZJHTC's shareholding, so it benefits from the appreciation of ZJHTC's assets.

In 2017, ZJHTC proposed itself as a 'high-tech property manager', 'sector-focused investor', and 'innovation-related service provider' (ZJHTC, 2017). In addition to the state-owned land capital, Zhangjiang Group allocated its high-quality functional subsidiaries to ZJHTC. For instance, Zhangjiang Haocheng VC Co., Ltd. is now a wholly-owned subsidiary of ZJHTC. As a venture capital firm specializing in financing entrepreneurs in the Zhangjiang Science City, it contributed 101.4 per cent of ZJHTC's net profit in 2020 (ZJHTC, 2021).[4] Today, ZJHTC has two primary goals in the development of the Zhangjiang Science City. First, by the appreciation of financial assets through the shareholding relation, ZJHTC mobilizes capital for Zhangjiang Group to develop the Zhangjiang Science City. Second, ZJHTC provides the projects of state strategic industries for the financial market to invest in.

In summary, the Zhangjiang Science City is developed as an innovation space under state entrepreneurialism. In developing the Zhangjiang Science City, Zhangjiang Group implements development tasks whilst ZJHTC helps to finance Zhangjiang Group. Their shareholding relation also helps Zhangjiang Group to control financial risks.[5] They both

benefit from the development of the Zhangjiang Science City, but have specialized labour divisions to achieve state strategies through market means. Together with the ZJSC Office, these local state players have closely participated in the development of the Zhangjiang Science City. Their tasks include managerial coordination, functional project implementation, and market-oriented financial operations. In this process, the role of the state is visible, but state-market relations are variegated.

7. Discussion and conclusion

This paper investigates the emerging Chinese innovation space through the case study of the Zhangjiang Science City. Existing studies on science parks have largely concentrated on knowledge dynamics and managerial efforts to optimize such dynamics (Lecluyse et al., 2019; Link & Scott, 2017). This study provides a political-economic perspective to understand the development and transformation of science parks. The Zhangjiang Science City demonstrates China's strategic initiatives to foster the indigenous innovation capacity. In other words, the science city is a state strategic innovation space. In China, multi-scalar states enable the development of science parks, highlighting innovation strategies in addition to agglomeration and diversity externalities (Zhang & Wu, 2019). The ongoing development of the Zhangjiang Science City represents state guidance. In implementing the Zhangjiang Science City, strategic infrastructures are developed under the central government's endorsement. The resources are then mobilized for creating this innovation space through local state operations. This study enriches non-firm and extra-local understandings of innovation spaces.

Reacting to the calls for more studies to understand the contexts that shape innovation spaces (Yigitcanlar et al., 2020), this study situates the Zhangjiang Science City in China's contemporary development background. The ongoing national strategies of 'innovation-driven development' (State Council, 2016) have generated the tasks of building the Shanghai National Comprehensive Innovation Centre and of the Zhangjiang Science City project. In contrast to UK science cities, which are criticized for the 'devolution of responsibilities without resources' (Perry, 2007, p. 1059), the Zhangjiang Science City under the strategic National Comprehensive Innovation Centre reveals more substantial central support in China's innovation development. The Chinese central state provides significant research infrastructures and relocates research platforms into the Zhangjiang Science City. Such designations have provided future competitive edges for Shanghai with centrally endorsed priority to receive innovation facilities, which advances Shanghai's industrial upgrades. This re-assertion of the central state moves beyond an enabling or intermediary role in innovation. Further, the Zhangjiang Science City is different from the former Chinese science parks. In China's urban development, science parks are usually utilized as an instrument to promote industrial production and generate quick gains from land sprawl (Wei et al., 2009; Yang & Wang, 2008). In the Zhangjiang Science City, however, the strong central endorsement and the project's official status emphasize its long-term support to foster science and technology development.

As innovation strategies have become more integrated into the development of Chinese cities (Miao et al., 2019; Zou & Zhao, 2018), studies on Chinese innovation spaces ought to investigate urban development alongside knowledge production. The Zhangjiang Science City is developed as a mega urban project that upgrades the

former science park with industrial foundations and sectoral agglomerations. Central government policies for the high-quality transformation of high-tech zones have generated path-breaking effects in developing Chinese innovation spaces. The regulations on local debt and taxation subsidies have influenced the development model of the Zhangjiang Science City. Meanwhile, land availability and fierce inter-city competition have influenced the implementation of the Zhangjiang Science City. Facing these challenges, agents from urban governance are utilized. The rescaled development and management office introduces extra-local resources to guide the development of the Zhangjiang Science City. The local state also deploys the local development corporation to implement this innovation space. In the meantime, coordination between high-tech development and urban planning is required to realize state innovation strategies.

State actors are involved in the development of the Zhangjiang Science City. From the national vision, the ambitious goals of this state strategic innovation space might be comparable to the previous technopolis programmes under the East Asian developmental state (Castells & Hall, 1994; Hsu, 2011). As a grounded development task, the Zhangjiang Science City has entered the entrepreneurial phase of science parks, which is similar to the Kyoto Research Park (Edgington, 2008). The Chinese local state creates agencies to act in the market and finds operational solutions to realize the goals of the National Comprehensive Innovation Centre. For state-owned resources and important issues, notably local debt and land development quotas, the upper-level state applies formal and conservative actions to avoid political risks. For state-guided but flexible operations in high-tech innovations, the ZJSC Office takes mixed and supportive measures assisted by Zhangjiang Group. Finally, regarding the state-created agency in the financial market, namely the local financing vehicle of ZJHTC, its financial operation is more market-oriented in implementing the development tasks of Zhangjiang Group. These state-created players specialize in different areas, but all act under the state strategy to develop the Zhangjiang Science City.

Although Shanghai may present a more 'planned' type of innovation development in China (Prodi et al., 2017), state-market relations are variegated in the development of the Zhangjiang Science City. The role of the state is not diminishing as it is involved in various tasks to develop the Zhangjiang Science City. The multi-scalar state and the state-created market agencies have implemented this state strategic innovation space through different operations. The Zhangjiang Science City is an innovation space under state entrepreneurialism (Wu, 2020). Its development demonstrates the relation between China's re-asserted state authority in innovation strategies and grounded implementation through local state operations and urban development.

Notes

1. Large Research Infrastructures (*da ke xue zhuang zhi*) are the key platforms to allocate high-tech land plots in planning each science city project. In 2021, there were 14 Large Research Infrastructures in Shanghai, including both completed and under-construction facilities. Eight out of them were in the current scope of the Zhangjiang Science City. Representative Large Research Infrastructures in Shanghai include Shanghai Supercomputer Centre, Shanghai Synchrotron Radiation Facility, National Centre for Protein Science Shanghai, etc. For other cities with the entitlement of National Comprehensive Innovation Centres,

information on their Large Research Infrastructure can be found at https://lssf.cas.cn/facilities.html.

2. The Zhangjiang Demonstration Zone has a 'one zone, 22 parks' layout. The science parks are geographically scattered in all of Shanghai's 16 districts whereas the core park named the Zhangjiang High-Tech Park were located in the Pudong New District. In 2017, the Zhangjiang Science City was planned with an area of 94 km^2 as an upgrade project of this core park. In 2021, the 14th Five-Year Plan of Shanghai expanded the scope of the Zhangjiang Science City to 220 km^2, which now covers the nearby vicinity areas of Beicai, Kangqiao, Zhoupu, Xinchang, Tangzhe, etc.
3. In 2008, Zhangjiang Group injected its high-quality assets into ZJHTC. Such an operation was justified as avoiding horizontal competition in an official statement:

> Zhangjiang Group, as ZJHTC's controlling shareholder, commits that ZJHTC shall have the prioritised right for the high-quality assets within the Zhangjiang High-Tech Park that have been incubated from Zhangjiang Group as well as from other subsidiaries controlled by Zhangjiang Group … In the future, when a subsidiary of Zhangjiang Group operates any business that may create substantial competition with ZJHTC, Zhangjiang Group shall induce the subsidiary to transfer the relevant assets to ZJHTC. Otherwise, Zhangjiang Group should help ZJHTC become the *de facto* controlling shareholder of that subsidiary through equity transfer or a unilateral capital increase.

   In 2018, a similar commitment was made by Zhangjiang Group again.
4. In 2020, Zhangjiang Haocheng VC Co., Ltd. contributed a net profit of 1.847 billion yuan to ZJHTC. Meanwhile, due to the impact of COVID-19, other subsidiaries of ZJHTC had negative earnings in total. Two major reasons were the penalty charge for overdue properties and the rent reduction policies in Shanghai. ZJHTC's net profit in 2020 was 1.822 billion yuan.
5. As noted in the annual report (2020), Zhangjiang Group needs to follow the regulations for *chengtou* (urban development and investment corporation) in China (see Feng et al., 2021) and control its debt ratio. In 2016 after the promulgation of the Shanghai National Comprehensive Centre, ZJHTC performed more market-oriented activities, especially operations on the financial markets. Meanwhile, Zhangjiang Group kept 50.75 per cent of ZJHTC's shareholding, so Zhangjiang Group controlled its financial risk in its consolidated balance sheets. Zhangjiang Group clarified itself with a stable debt ratio of around 70 per cent from 2016 to 2021. The relationship between Zhangjiang Group and ZJHTC after promulgating the Zhangjiang Science City has been described as 'the former father and son now become brothers' (*fu zi bian xiong di*).

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ORCID

Kan Zhu http://orcid.org/0000-0002-5475-468X
Fangzhu Zhang http://orcid.org/0000-0002-8975-5324
Fulong Wu http://orcid.org/0000-0003-4938-6066

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