SHRINKING CITIES, GHOST CITIES AND HIGH-DEBT CITIES IN RAPIDLY URBANIZED CHINA: THE ASYMMERTIC STATE RESCALING

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This study is driven by the emerging phenomena in China's urbanization: shrinking cities, rapid land urbanization of "ghost cities", and high-debt cities. How do cities shrink in rapidly urbanized China? Why are local governments in China actively engaging in land development even if the population is shrinking to generate "ghost cities/towns"? Why do cities keep borrowing and accumulating high debts? The market-demand based theories can hardly explain these unique urban phenomena. Therefore, this study focuses on the "supply-side" stories, which is the core piece in China's "state-led" urbanization. I draw theories from state rescaling and develop it by examining its asymmetric features in policy domains and territorial dimensions in China's context.

The first paper uses a new technique, Dynamic Time Warping clustering, to identify cities into different growing and shrinking typologies based on their urban population and economy trends from 2006 to 2015. Considering the asymmetric rescaling in terms of state spatial selectivity, the multinomial logistic regression shows different shrinking mechanisms between the south and the north. Shrinking cities in the south are losing their population due to their proximity to the state-selected high-level cities and the pulling effects. They sustain economic growth with more local debt and state funds for fixed assets investment. This may result in potential "ghost" phenomenon in these high-debt cities. In the north, shrinking cities are mining and resource-based and lack of competitiveness to attract investment by state and market. Some of these left-behind

cities have to rely on their own by cheaply leasing land to finance urbanization. This also could generate the oversupplying issue of “ghost” cities. State fund for urban maintenance on facilities and service is found to be very critical to divert population into shrinking regions.

The second paper focused on the land transactions of all city governments from 2006 to 2015 to explore why they are so passionate about land leasing, especially in the shrinking regions. Under China’s asymmetric rescaling in policy dimensions, the paper first examines the institutional incentives from fiscal, political and economic aspects to drive local land transactions. The Geographical Temporal Weighted Regression disaggregates these incentives and shows they are particularly strong to drive land urbanization in the less developed northern and western inland regions. This is harmful to these cities since their populations are shrinking or slowly growing, and the land is leased at a lower price. Thus, the “ghost” phenomenon is expected, and land and public resources are used in an inefficient way. State funds need to be spatially designed and allocated carefully. The state fund for urban maintenance can reduce the incentives of such fiscalization of land use while state fund for fixed assets investment is found to promote more land competition.

The third paper dives into the high local debt in China’s urbanization and examines the spatially variegated stories of China’s debt with a self-developed Geographical Weighted Panel Regression for all cities from 2006 to 2015. By exploring the institutional incentives of China’s asymmetric rescaling, this paper finds different reasons for local bond issuance besides just development by borrowing. These include fiscal management by borrowing, debt-repayment by borrowing, capitalization of land resources by borrowing, inter-city competition by borrowing, state fund-promoted borrowing. Cities in the inland regions of the north and the west are likely to playing the “hunger game” to issue bonds to ameliorate their budgetary fiscal stress, pay the existing debt and capitalize more land resources. This hunger games with debt feeding debt can be

reduced by more state fund, especially for the maintenance purpose. Cities in the more developed coastal region are playing a “competition game” to use local issuance as a policy tool to compete with peers by showing more development effort for future state fund in investment.

These findings provide a multilevel institutional perspective to explain local planning and development trajectories. These “supply-side” stories can better explain the phenomenon of shrinking cities, ghost cities, and high-debt cities. This dissertation advances a theory of asymmetric state rescaling. It first highlights the uneven spatial selectivity of the state in terms of its rescaling of powers and resources and links it with diverse development outcomes. It next emphasizes the institutional incentives embedded in the asymmetric rescaling process across different policy fields, and how they shape local policy and planning making. Thirds, it shows the important roles of state policy to reduce the incentives and spatial disparities. The state needs to combine funds and transfers with spatially targeted regulation and scrutiny in land transactions and debt issuance, as well as regional and spatial plans that clearly layout functions of cities and promote collaboration between cities.

BIOGRAPHICAL SKETCH

Yuanshuo Xu received his bachelor's degree in Land Resource Management from China University of Mining and Technology in 2011 and his master's degree in Regional Planning from the Department of City and Regional Planning, Cornell University in 2013. Before coming to Cornell, he interned at China's local governments on land use planning in Anhui Province and Jiangsu Province. He also worked as a GIS analyst in the Program of Applied Demographics at Cornell in 2013. He started her Ph.D. program at the Department of City and Regional Planning at Cornell University in 2014. From August 2018 to May 2019, he worked as a visiting lecture to teach Introduction to GIS and Quantitative Methods for Planning and Public Policy in the Department of City and Regional Planning at Cornell University.

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CHAPTER 1

INTRODUCTION

Diversity of Urban Trajectories

China has experienced a rapid urbanization process and the country's urbanization rate reached more than 50 percent in 2011. Previous attempts to understand China's urbanization often applied western theories, such as growth machine, urban regime, or entrepreneurial city to focus on the growth-oriented strategy for large cities and growing regions (e.g., Logan and Molotch, 1987; Lin, 2007; Ma and Wu, 2005; Zhang, 2008; Han, 2010; Ping, 2011). While they provided a useful analytical framework from the "market-led" standpoint (e.g., Liu and Jiang, 2005; Jiang et al., 2012) with the emphasis on the demand of migration, foreign investment, and local economic growth, it can only tell part of the story (He et al., 2015).

In fact, not every city is growing; there is a diversity of trajectories in China's urbanization. On one hand, issues including shrinking cities, resource-depleted or old-industrial declining cities have drawn scholars' attention recently (e.g., Long and Wu, 2016; He et al., 2017; Yang and Dunford 2017; Mykhnenko and Li, 2018). Research effort including geographical analysis, case studies, and general surveys on these shrinking localities reveals the other side of the coin for urbanization. It also raises the concerns of the recent slowing-down population and economic growth rates across the Chinese nation. However, these studies are just emerging and exploratory. Theories on China's shrinking cities still need to be developed with both integrated frameworks and more nuanced geographical understandings (Peck and Zhang, 2013). On the other hand, considering the slowing-down or shrinking phenomena, the oversupply and overbuild issues have been found in cities (He et al., 2015). In general, land urbanization in these cities has outpaced population and economic growth to result in the underutilization of infrastructure, and the

inefficient use of land and public resources. This emerging urban phenomenon is termed pseudo-urbanization, phantom urbanization, administrative urbanization, half-urbanization etc. (Liu, et al., 2014; Yuan, 2008; ARDHMC 2010-2011; Sorace and Hurst, 2016). Ghost cities (e.g., Woodworth and Wallace, 2017) are examples of the extreme manifestations of these urbanization problems, showing the detachment from planning for real market or growing demand.

To explain these divergent urban trajectories, this dissertation focuses on the "supply-side" story since China's urbanization is primarily state-led at different scales. Along with the urban transformation, China is also undergoing a state rescaling process in fiscal, political, and economic fields, which has fundamentally shaped local planning and urban policy making. Specifically, these political and economic transformations include fiscal decentralization, political centralization, economic-based cadre evaluation system, the prohibition of local borrowing, the large economic power of local land use, inter-city competition, and spatial divergent intergovernmental transfers etc. They together have created fiscal, political, and economic incentives in shaping local planning for urbanization.

This multilevel institutional perspective can well explain why there is an issue of oversupply or overbuilding; why there is a parallel pattern of shrinkage and growth; why urbanization in China is land-based and debt-financed; how fiscalization and financialization of land use have been formed and operate within China's multilevel governance system. Therefore, this dissertation examines the key institutional transformations under China's state rescaling, local policy responses in fiscalization and financialization of land use, and the consequent divergent urbanization trends and phenomena, for all municipalities from 2006 to 2015. It aims to provide a multilevel institutional framework to understand local planning.

Purposes of Study

There are three objectives in this study.

Objective 1: Spatiotemporally measure the divergent urbanization trajectories of cities in China and explore how state rescaling has shaped these urban paths. This examines the relationships between dimensions of population and economy in China's urbanization to answer how state spatial selectivity has shaped local and regional responses and development results of growth and shrinkage.

Objective 2: Describe how state rescaling has generated fiscal, political and economic incentives to drive local governments to pursue land urbanization. This examines the relationships between dimensions of population and space in China's urbanization to answer why local governments have been actively engaged in land sales and oversupply or overbuild, to create ghost cities and towns.

Objective 3: Describe how state rescaling has generated fiscal, political and economic incentives in local borrowing to drive rising local debts. This examines the relationships between dimensions of economy and space in China's urbanization, to answer how local governments have used the land to support and finance their urban economic development, and whether such land-based debt-financed urban finance model is rational, efficient, accountable and sustainable.

In general, this study aims to build a multilevel institutional framework from the "supply-side" of government behaviors to explain and respond to the divergent urbanization trajectories, especially for the shrinking and declining localities, ghost cities with oversupply and overbuilding, as well as the places with high debt in financing urbanization.

Overview of Dissertation Chapters

Chapter 2 draws the theories from planning, geography and public administration to engage in the investigation on the relationships between state rescaling and urban transformation. It aims to answer what institutional factors under rescaling really drive the development behaviors of local governments and shape their planning and policy decisions. The objective is to derive a theory that can explain the emerging urban phenomenon in China's rapid urbanization, such as shrinking, ghost (over-supply), and high debt (over-borrow). Figure 1 shows the study context of all prefecture-level cities and economic regions in China. The most economically developed regions are coastal regions, especially the Eastern Coast and the Southern Coast. The relatively developed regions include the Middle Yangtze River and the Northern Coast. Inland regions, such as the Northeast, Middle Yellow River, the Northwest and the Southwest, are less developed.

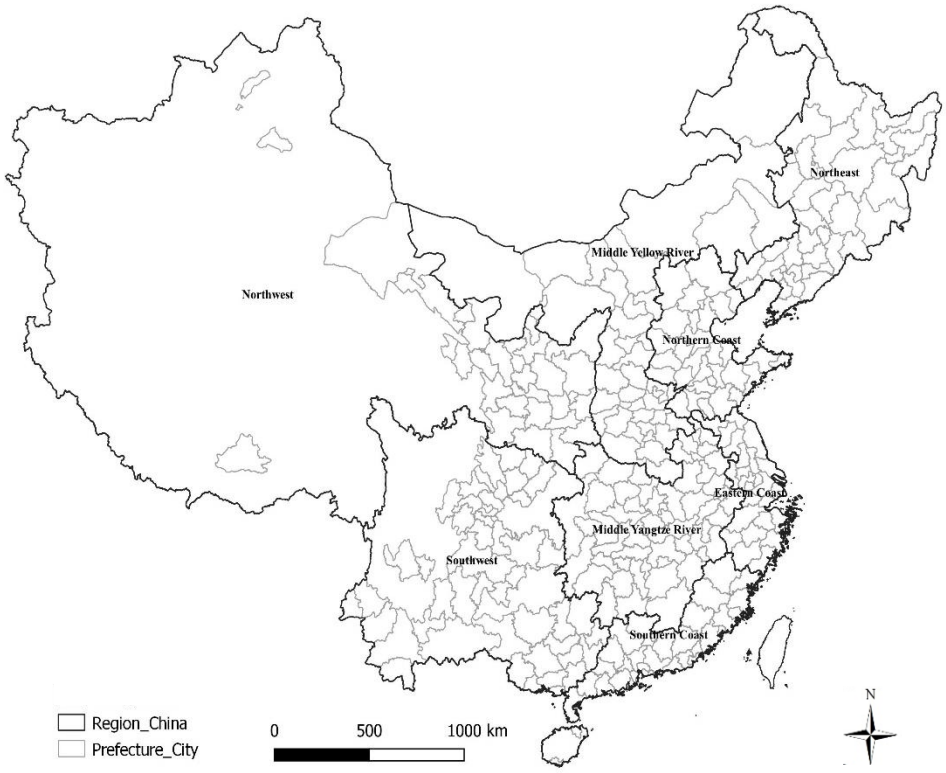


Figure 1 Study Context: Prefecture-Level Cities and Economic Regions in China

With the innovative use of the Dynamic Time Warping (DTW) time-series clustering technique, Chapter 3 delineates cities of both growth and shrinkage for the past decade and explores possible factors of state rescaling, neighboring pulls and economic restructuring.

It finds shrinking cities with growing economies in southern China, especially for the eastern coast, southern coast and Middle Yangtze River region. They tend to be neighbors of the state-selected high-level cities, such as provincial capitals, and suffer from the gravitational pulls of their population. State does not generally favor them, so most cities in this typology are likely to have a higher local debt to sustain their economic growth with debt-financed investment.

For the shrinking cities with recent slowing-down or declining economies, they are concentrated in northern China, especially in central-north China, the Middle Yellow River region, the northeast and the northwest. Cities in this category are featured with higher shares in the mining sector or primary sector of agriculture, forestry, livestock, and fishing. They also have lower natural population growth rate and are less favored by developers and the land market. In addition, the stagnant or declining economy in these resource-based northern shrinking cities can also be attributed to another important function of state spatial selectivity - the state also designated fewer special zones, such as economic zones, high-tech zones etc. in these regions. In contrast to the competitive neighboring effects or gravitational pulls in more developed southeastern regions, cities in northern China tend to shrink and decline in clusters.

Chapter 4 and 5 further explore China's land-based debt-financed urban model as the major local response to state rescaling. It discusses the key institutional transformations of fiscal decentralization, political centralization, prohibitions of local borrowing, economy-based cadre promotion, inter-city competition, large economic power in local land use, and spatially divergent functions of allocation of state funds. These multilevel structural dynamics have generated a

variety of fiscal, economic and political incentives and formed local strategies in fiscalization and financialization of land use to “kill many birds with one stone”, such as for revenue generation, urban finance, economic growth and competitions etc.

Chapter 4 examines the fiscalization of land use mainly to reveal the fiscal incentives of local land transactions. Other institutional factors on local land transactions are also modeled with Geographical and Temporal Weighted Regression (GTWR). This technique can decompose the statistical relationship across space and time, and generally finds land transactions of cities in less developed northern and western regions are likely to be driven by institutional incentives.

For example, the fiscal incentives to close the local budget gap under decentralization are found as one of the most significant institutional factors to drive local land development. Under GTWR, the disaggregated modeling results show fiscal incentives are strong in the less developed inland regions of western and northern China. Inter-city competition also stimulates municipal governments to lease more land and rely more on land revenues, which are strong in the northwest and the central-north of Middle Yellow River region, and in the northeast after 2010. The competition for state investment funds is found to significantly drive local land transactions in all the western and northern regions. Thus, state funds in these regions need to pay attention to the possible spillover effects to stimulate competition through land urbanization for the future urban investment fund. The state fund for urban maintenance is found to reduce the fiscal incentives and thus ameliorate the rapid land urbanization. However, in the southwest, the Middle Yellow River region and parts of the northern coast, this maintenance fund from the state functions as a complementary source of urban finance to drive more land urbanization practices rather than ameliorate the fiscalization of land use.

Chapter 5 focuses on the financialization aspect of land use in Chinese cities as responses to the different fiscal, economic and political incentives under rescaling. It starts with the elaboration of the formation of a quasi-government financing entity - local government financial platforms (LGFPs), their proliferation along with rising local bond issuance and debt which are supported by land assets. It further explores different motivations behind the prevalent local debt-financed investment and urban model in China.

Specifically, our model shows the budgetary fiscal gap, existing loans, land premiums, neighboring issuances, and state funds all drive more local issuance for different reasons rather than for development only. This chapter unveils the diversity of reasons in local borrowing. For example, cities may issue bonds for the purposes of fiscal management to close the budgetary gap; cities may also borrow for the existing debt repayment; inter-city competition for more state funds of investment may also drive cities to issue more bonds to show their development effort; and cities can choose this debt-finance approach to financialize local land resource and further to capitalize land-premium.

In addition, the Geographical Weighted Panel Regression (GWPR) algorithm is developed in Chapter 5 to explore the spatial variation of these driving forces and draw conclusions with regional-specific stories of local borrowing. Generally, the mechanism of the local debt-financed urban model is spatially diverse, such that borrowing in the less developed regions, e.g. the North, the West and the Central region, tend to be driven by fiscal and debt-servicing concerns while cities in more developed coastal regions are found to issue bonds for competition purposes.

Through Chapter 3 to Chapter 5, a vicious cycle has been discovered for cities in less developed inland regions (northern and western China). Their land transactions and bond issuance tend to be driven by institutional factors, such as fiscal incentives, inter-city competition, and debt-

repayment while their population and economy are growing slowly and even shrinking, and they are less favored by market and state comparing to the developed southeastern coastal region. This indicates that the land-based and debt-financed urban model may not be compatible with real local demand and may not be able to generate reasonable fiscal and economic returns. Thus, cites will have to continuously develop more land to close the fiscal gap, repay previous debt and destructively compete with peers and for state funds. Thus, "ghost cities" might be formed due to the rapid land urbanization that outpaces the growth of population and economy.

Chapter 6 discusses the contributions of this study to both theory and methodology. First, it enriches the theory of state rescaling by showing the possible complexity of asymmetric rescaling across fiscal, political and economic policy domains. It also empirically tests how this asymmetric rescaling can generate various institutional incentives to shape local planning and policy making, such as fiscalization and financialization of land use. Second, by linking asymmetric rescaling and the consequent incentives to development outcomes, this study also shows the disproportionate impacts of state rescaling across regions. This further contributes to the shrinking city studies in developing contexts with the lens of state spatial selectivity in rescaling. Third, this dissertation shows multiple spatiotemporal analytical approaches, such as time-series clustering for pattern of trends, Geographical and Temporal Weighted Regression (GTWR) to capture diversity of state rescaling and its impacts across space and time, and Geographical Weighted Panel Regression (GWPR) to combine both the nonparametric technique and traditional econometric models to derive context-specific explanations for panel data.

The core contribution of this dissertation is that it provides a multilevel institutional framework to examine local planning and urban policy making, and it offers innovative methods to empirically model and analyze this issue.

References

ARDHMC. (2011). Annual Report of the Development of the Housing Market in China 2010-2011 Greenbook Edition. Shanghai: Shehui Kexu Wenxian Chubanshe.

Han, S. S. (2010). Urban expansion in contemporary China: What can we learn from a small town? *Land Use Policy*, 27: 780–787.

He, S., Lee, J., Zhou, T. & Wu, D. (2017). Shrinking cities and resource-based economy: The economic restructuring in China's mining cities. *Cities*, 60: 75–83.

He, C., Zhou, Y. & Huang, Z. (2015). Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geography*, 37 (3): 436–457.

Lin, G. C. S. (2007). Reproducing spaces of Chinese urbanization: New city-based and land centered urban transformation. *Urban Studies*, 44 (9): 1827–1855.

Liu, S. & Jiang, X. (2005). Financial risks of land financing by local governments. *China Land Science*, 19 (5): 3–9.

Liu, T. & Lin, G. (2014). New geography of land commodification in Chinese cities: Uneven landscape of urban land development under market reforms and globalization. *Applied Geography*, 51: 118–130.

Logan, J. R. & Molotch, H. L. (1987). *Urban Fortunes: The Political Economy of Place*. Berkeley, CA: University of California Press.

Long, Y. & Wu, K. (2016). Shrinking cities in rapidly urbanizing China. *Environment and Planning A*, 48 (2): 220–222.

Ma, L. J. C. & Wu, F. (2005). Restructuring the Chinese city: Diverse processes and reconstituted spaces. In L. J. C. Ma and F. Wu, editors, *Restructuring the Chinese City: Changing Society, Economy, and Space*. London, UK: Routledge, 1–20.

Mykhnenko, V. & Li, H. (2018). Urban shrinkage with Chinese characteristics. *The Geographical Journal published by John Wiley & Sons Ltd on behalf of Royal Geographical Society (with the Institute of British Geographers)*, 184 (4):8, 398-412, DOI: 10.1111/geoj.12266

Peck, J. & Zhang, J. (2013). A variety of capitalism with Chinese characteristics? *Journal of Economic Geography*, 13: 357–396.

Sorace, C. & Hurst, W. (2016). China's phantom urbanization and the pathology of ghost cities. *Journal of Contemporary Asia*, 46 (2): 304–322.

Woodworth, M. D. & Wallace, J. (2017). See ghosts: parsing China's "ghost city" controversy. *Urban Geography*, 38 (8): 1270–1281.

Wu, W. (2010). Urban infrastructure financing and economic performance in China. *Urban Geography*,31: 648–667.

Yang, Z. & Dunford, M. (2018) City shrinkage in China: scalar processes of urban and hukou population losses. *Regional Studies*, 52:8, 1111-1121, DOI:10.1080/00343404.2017.1335865

Yuan, S. (2008). Land Problems Due to Impetuous Urbanization. *Reform and Policy-Making Internal reference 16*.

Zhang, L. (2008). Conceptualizing China's urbanization under reforms. *Habitat International*, 32 (4): 452–470.

CHAPTER 2

ASYMMETRIC STATE RESCALING

To study the "state-led" urbanization in China, this chapter reviews the theories from the "supply-side" that focus on the explanation of state behaviors at different scales. It first discusses the state rescaling theory (Brenner, 2004) that has been widely used to explain the uneven urban and regional development from the lens of government restructuring. Based on this framework, I further describe various state rescaling practices in China across different policy domains and regions. These asymmetric features result in different fiscal, political, economic, financial incentives in shaping local planning and policies, and further drive inter-city competition. These problems of institutional incentives and negative externalities of state spatial selectivity are barely addressed by state rescaling theory. In addition, the emerging urban phenomena of oversupply, overbuild and overborrow can also hardly be explained by state rescaling framework. Therefore, I draw theories from second generation of fiscal federalism (Oates, 2005; Weingast, 2009) and the asymmetric decentralization (Tarlton, 1965; Congleton, 2006) to derive an asymmetric state rescaling framework. It advances the traditional state rescaling framework by revealing the new problems embedded in this asymmetric process, including unintentional institutional incentives and spillovers of state policy on local planning and competition, as well as the spatiotemporal diversity of local responses. The following section will review the relevant literature of state rescaling, introduce the institutional context of China and then derive the new asymmetric rescaling framework for the further analysis.

1. State Rescaling Theory

1.1 Theoretical Perspectives

State rescaling is the theory that explains how the nation state has been experiencing changes in its allocation of authorities and responsibilities across territorial and spatial scales (Brenner, 2004; Jones, 2001). This transformation of the nation state is a response to challenges of regulatory institutions in the context of globalization in the post-Fordism era. In this sense, state rescaling can be understood as a reactive process to the political and economic challenges in capitalist transitions. Under the state rescaling process, the state adjusts to the crisis of capital accumulation and makes a strategic response to the changing production regimes in globalization to increase its global economic competitiveness. In general, the state uses rescaling to improve the state's capacity to resolve crisis, manage regulatory problems, and establish new spaces for capital development and political and economic governance (Brenner, 2009).

Regulation Perspective (Functional Response): The regulationist approach incorporates the role of social regulation into the concepts of capitalist (re)production and emphasizes the coupling of a specific accumulation system (pattern of production and consumption) and its mode of regulation, such as Fordism-Keynesianism (Jessop, 1990). With the dismantling of Fordist production regime in globalization, state rescaling shifts from Keynesian welfarism to Schumpeterian workfarism (Jessop, 1993; Brenner, 2009; Peck and Tickell, 1994). To overcome the crisis and restore the capitalist growth, a new structural coupling system that integrates capital accumulation/production and regulatory institutions must be created. However, considering the constant destructive innovation of capitalism, the regulatory sphere must be periodically renewed to match the changing requirements of capital accumulation. State rescaling is part of this process of regulatory renewal (Brenner, 2004).

Globalization Perspective (Strategic Response): Under globalization, domestic economies become more open with the proliferating flows of money, information, commodities and human capital. These external forces make obsolete the notion of integrated and independent national state from Fordism-Keynesian capitalist system (Swyngedouw, 2004; Jessop, 1993). In order to compete in the global market, the nation state becomes more entrepreneurial, ceding its powers to global forces while strategically transferring more authority and responsibility down to localities that have more flexible and competitive markets (Cox, 2002 and 2009). State rescaling is a strategic response of state to reposition its functions from a single predominant center to multiple scales and territories (Brenner, 2004). This state strategy will create more competitive spaces for capital production and accumulation and thus increase global competitiveness.

1.2 State Spatial Selectivity

Brenner's works (2004 and 2009) on "new state spaces" emphasized the changes of the state territorial structures and spatial logic of selectivity in rescaling mechanisms. Spatial Keynesianism describes the compensatory regional policies of the state after WWII in creating investments to serve as economic stabilizers in poor and declined areas. In this period, "the old state spaces" were places of local welfare and places in need.

However, from the early 1970s on, a "new state space" has gradually replaced the old ones. The effectiveness of "old state spaces" in creating employment and investments in poor areas dropped dramatically under globalization. Flexible production modes require locality-specific assets to compete. This highlights the importance of growing places and their need for state support through increased regulatory powers and infrastructural investments to complement local special assets. Rather than search for places in need, the nation state now favors growing places with support. The objective of the state now is to create and facilitate the "new state spaces" to develop.

In this sense, localities not only face the pressure of territorial competition due to the retreat of "spatial Keynesianism", but also the exacerbated inequalities from state spatial selectivity which privileges the most "promising" places for global competition. In this sense, state rescaling is intrinsically spatially and temporally uneven; some places obtain more preferential policies and power while others get less. With the change of the spatial logic from state policy, we expect a divergent instead of a convergent regional landscape of local development.

2. State Rescaling Process in China

State rescaling provides a powerful theoretical framework to explore the links between government restructuring, especially through "state spatial selectivity" (Brenner, 2004) on urban and regional transformations. However, it is not clear if the literature can travel to the developing context or explain the emerging "urban phenomena" and divergent urban paths in China. This section will examine the state rescaling process in China first and discuss several variations that give more insights to complete and develop this theory. These include the complexity in policy dimensions of rescaling, the possible asymmetric rescaling process, the institutional incentives, the spillover effects of state selectivity and spatial heterogeneity of rescaling and its impacts.

2.1 Fiscal Decentralization (Fiscal Dimension)

Fiscal reform in China has fundamentally changed central-local fiscal relations (Wong, 2000). Before the reform, the central state collected all local revenues and reallocated money to each local government. In the 1980s, the fiscal contracting system was established that allows provincial governments to keep surplus after they sent the required revenues to the central government (Knight and Shi, 1999). Although local development interest with fiscal effort had been significantly aroused, the revenue share of the central government had decreased. To increase the fiscal control of the central government, thus, in 1994, a tax-sharing system was introduced to

request local governments to proportionally share their local taxes rather than a fixed remittance (Chung, 1994). Since 1994, the share of the central government has been increased by keeping more "lucrative sources of revenue", such as "value-added tax, resource tax, stamp duty tax, business tax for finance and insurance, corporate and personal income tax" (He et al., 2015) at the central level (Tsui, 2011, Wu, 2010; Liu and Lin, 2014). Thus, this tax sharing system has largely increased the central share in revenue (Lin and Yi, 2011; Liu and Lin, 2014; Tsui, 2011; Wu, 2010).

At the same time, local governments have been decentralized with more urban development responsibilities while the revenues are more centralized. Thus, the vertical imbalance between local revenue and expenditure has been growing over time. Moreover, local governments also don't have the authority to adjust local tax rates to meet the changing urbanization demand. About 85% of total public expenditure responsibilities are now decentralized to local governments while only 55% of total government revenues can be used by at the local level (World Bank, 2014). Thus, the increased fiscal pressures push local governments to seek extra financial resources by either requesting more central transfers or generating extra-budgetary revenue sources from the market.

2.2 Local Government Financial Platforms (Financial Dimension)

Nevertheless, the 'Budget Law' (Article 28) of China prohibits local governments from market borrowing through municipal bonds. Therefore, Local Government Financing Platforms or local financing vehicle companies (hereafter referred to as 'LGFP') were created by local governments to function as their "credit card" to borrow from the bank and the bond market. Public assets have been injected into LGFPs to meet capital requirements for bank loans and smooth the issuances in equity and bond markets (Tsui, 2011; Lu and Sun 2013; World Bank, 2009). LGFPs thus have undertaken the financing responsibilities for local governments in urbanization.

In late 2008, to protect the domestic economy from the external shocks of recession, the central state issued a fiscal stimulus with 4 trillion RMB, but only paid for this package with 1.18 trillion and left the rest as debt to local governments. Facing such urban finance challenges, LGFPs significantly helped local governments approach credit and capital from the bond market for investment, and this brought about a local debt explosion in 2009. In addition, the People's Bank of China, China's Central Bank and the Regulatory Commission also supported local governments to explore different urban investment and finance sources, especially via the establishment of LGFPs and bond issuance in 2009. Thus, LGFPs have thrived as an urban finance innovation since 2009 with more and more local governments establishing new LGFPs. The mushrooming number of LGFPs is accompanied with rapidly increasing local debt, which has imposed burdens and risks to local governments, as this debt is often directly or indirectly guaranteed by local governments. These local debts also usually lack transparency, accountability, and may increase the risks of the financial system and undermine the macroeconomic stability of China (Tsui, 2011).

2.3 Dualist Land Management System (Economic Dimension)

If fiscal decentralization and financial limitations gave birth to the debt-financed urban model, the unique land management system in China has enabled and enhanced such practices through the support of land revenues and assets (Pan et al., 2017). According to the *Chinese Land Management Law*, China has a dualist land management system where the ownership of rural land belongs to the village collectives while urban land is owned by the state. Only the use rights of urban land can be traded in the market by local governments for a certain amount of time. Thus, local governments often requisition rural land, compensate farmers with a non-market price (mostly lower than market prices). Then, they sell rights to use the land to developers at higher market prices through tendering, auction and listing for land premiums. Land is used as a

competition tool. As local governments are the sole land supplier, they can reap monopoly rents to compete in capital accumulation through land development practices (Lin, 2009; Lin and Yi, 2011). Land revenues have become the major local off-budgetary source to finance infrastructure development and urbanization (Lin and Zhang, 2014; Lin et al., 2014; Tao et al., 2010).

More importantly, land revenues have enabled local governments to pursue debt-financed investment. Land and its use rights are the most important assets to be transferred as collateral to LGFPs. Additionally, land revenue can provide the revenue source and subsidies to LGFPs for their operating and debt-servicing (Feng, 2013). Therefore, the sale of land use rights becomes the major source of debt repayment (Feng, 2013; Pan et al., 2017). The debt-repayment capacity of local government highly depends on the land premiums, which are unstable and unsustainable, considering the limited supply of land and its sensitivity to the general economy.

2.4 Political Centralization (Political Dimension)

Political centralization is another institutional setting in China that facilitates and encourages local debt-financed investment and urbanization. In China, there are multiple administrative levels including the central government, provincial government, deputy-provincial government, prefecture government, county government and town government. Although the political powers have been decentralized since the reform in the 1980s, the hierarchical nature remains, such that upper-level governments still control the key personnel appointments and resource allocations in their subordinate units (He et al., 2015).

This administrative hierarchy is accompanied by a unique economic based promotion system – the ‘cadre evaluation system’. The central government sets up growth benchmarks and passes these goals to different local governments. Local government officials will be evaluated and get promoted based on how well they boost economic growth, industrialization and

urbanization to meet the benchmarks during their short terms (5-year) in office (Guo, 2009). For example, infrastructure and economic growth, namely GDP growth numbers are two important indicators to evaluate the success of local officials (Tsui, 2011), so city officials often actively compete with peers by increasing local investment in infrastructure and boosting economic growth. Such a political system facilitates and encourages more local competition via the land-based and debt-financed activities.

3. Gaps of State Rescaling

To integrate state rescaling theory with the processes in China, I draw from frameworks of Second Generation Theory of Fiscal Federalism and Asymmetric Decentralization to derive my own theory on asymmetric features of state rescaling with respect to different policy fields and various territorial logics and impacts. This section will discuss the gap areas of current state rescaling studies, including possible institutional incentives and impacts, spillover effects of state spatial selectivity and spatiotemporal diversity of state rescaling. The understanding of these aspects can help explain the divergent urban paths and the emerging unique urban phenomena, such as shrinking cities, ghost cities, high-debt cities etc. in rapidly urbanized China.

3.1 Second Generation Theory of Fiscal Federalism

The First Generation Theory of Fiscal Federalism was discussed as a normative framework to lay out appropriate specific responsibility and the corresponding fiscal instrument for each level of government (Peterson, 1981 and 1995; Musgrave, 1959; Oates, 1972). Paul Peterson (1981) in his influential work, "*City Limits"*, illustrated the normative framework of first generation theory (FGTFF) on the assignment of functions to different levels of government. In general, the central government or higher-level government is in the traditional position to conduct redistributive policies by providing assistance to the poor and other groups in need. Subnational government is

argued to be a developmental state to manage development policies and provide efficient levels of public goods to promote growth and quality of local life. Public choice theory (Tiebout, 1956) also explains the developmental role of local government from the perspective of inter-jurisdictional competition in order to attract business, tax base and people. The trade-off between redistribution and development activities at the local level always gives priority to development. In general, the FGTFF model is designed as a functional allocation system of government authorities and responsibilities to promote local fiscal efficiency and development that matches local need and preference.

The Second Generation Theory of Fiscal Federalism (SGTFF) builds on FGTFF (Oates, 2005; Weingast, 2009). SGTFF focuses on the institutional incentives and impacts on the behavior of political agents (Oates, 2005). SGTFF assumes a divergence in local decision making between maximizing citizen welfare to political goals of local officials, while FGTFF is a normative framework that assumes public decisions are made to maximize social welfare. Rather than emphasizing the optimal institutional design for functional allocations in FGTFF, SGFFT develops a framework to analyze the alignment or misalignment of the incentives of political officials with citizens (Weingast, 2009) by extending the FGTFF to the context of institutional incentives of officials.

In other words, SGFFT describes a principal-agent model of the multilevel government system where the central state or higher government acts as a principal, and local governments are agents to respond to the principal instead of constituencies with the incorporation of their own objectives into the central goals. This principal-agent model basically delineates a setting of "administrative federalism" rather than "economic federalism" in the FGTFF (Inman, 2003; Inman and Rubinfeld, 1997). This "administrative federalism" is much like current China's public system.

It is important to pay attention to how different institutional arrangements/incentives affect the performance of local governments within a multi-scalar governance system.

3.2 Institutional Incentives in China's State Rescaling

China's political system fits the SGTFF with Chinese characteristics (Peck and Zhang, 2013). It emphasizes the primacy of political conformity and institutional incentives. Based on the previous sections, we see China's state rescaling has occurred in different policy dimensions with various extents, such as centralized and hierarchical political powers, centralized revenue authorities, decentralized fiscal responsibilities, centralized financial powers, and decentralized economic powers in land use. These institutional settings together have contributed to an asymmetric rescaling process across policy domains where the political power is mainly centralized while fiscal responsibilities and economic power to use land as a fiscal, financial and developmental tool have been decentralized. Together they have created different institutional incentives within state rescaling that fundamentally shape local policy making and development paths. This issue has not been addressed in previous rescaling literature, either theoretically or methodologically.

We expect different institutional incentives interwoven with the rescaling. For example, local governments have strong fiscal incentives to sell land use rights for extra-budgetary revenues, economic incentives to bring in investment and spur growth, and political incentives to compete with peers to "kill many birds with one stone". Besides, the principal-agent model also indicates possible policy imitations and "regional isomorphism" (Chien, 2008) that agents are likely to imitate other's successful experiences, such as fiscalization of land use and LGFPs. This may explain the prevailing land urbanization that has outpaced population and economic growth

demand in some places in China, e.g., the formation of "ghost cities" (Woodworth and Wallace, 2017; Sorace and Hurst, 2016) and "zone fever" (Cartier, 2010; Wei, 2015).

In addition, SGTFF also results in the problem of "soft budget constraint" (Kornai, 1986) and further preserve incentives of intergovernmental transfers. The agents or local governments have the incentive to spend beyond their capacities as they have "expectations" that they will be bailed out by the central government through more transfers. Specifically, local governments in China have financial incentives to use land as collateral to issue bonds and accumulate debt to invest in infrastructure and finance urbanization for economic growth objectives, and also to show highly visible symbols of political accomplishments (e.g. mega projects) to the central state for political purposes.

3.3 Sequential Asymmetric Decentralization

Asymmetric decentralization, derived from asymmetric federalism, can help complement the framework from a sequential perspective of rescaling and better understand the spatiotemporal logic of China's state policy. Brought by Charles Tarlton (1965), asymmetric decentralization was built as a theory to describe a variation of decentralization. The difference between symmetric and asymmetric decentralization lies in the different regulatory and fiscal powers at the same level of government (Congleton, 2006). In other words, asymmetry is characterized by the extent to which functions, powers, authorities or responsibilities are not common features for all governments at a certain level (Tarlton, 1965). Supporters of asymmetric decentralization argue that localities are diverse in capacities and not all of them can handle the decentralized functions and responsibilities. Asymmetric decentralization is more customized-designed to the institutional setting and more effective than symmetric decentralization (Katorobo, 2007).

Nasution (2016) further proposed a concept of "Sequential Asymmetric Decentralization" that considers the diversity and capabilities of all the regions. To improve the decentralization in Indonesia, Nasution (2016) argued for an asymmetric decentralization design in the beginning, and a "ranking system" which is periodically (every five years) checked and all the regions are evaluated by the central government to revise the design and implementation of decentralization.

3.4 Spillover Effects of State Rescaling

Given the spatial unevenness and sequential nature of state rescaling, one issue that has not been addressed is the spillover effects of state spatial selectivity since the process is often territorial and sequential asymmetric. Based on the discussion of institutional incentives and the principal-agent model in the previous section, localities are expected to react to the rescaled powers, functions and resources from neighboring localities if the state rescaling is geographically uneven within a sequential asymmetric decentralization context.

For example, if the neighboring cities are more favored by state, and get more complementary transfers and funds for development, this may send the signal to the targeted locality to increase their own efforts via more bond issuances and land sales, to compete with neighbors for further state funds. In contrast, cities may choose to decrease their effort if they observe state funds assisting their neighbors and substituting for local effort. In this study, I use the spatial lag terms to capture such spillover effects through the reaction function of local responses to its neighbors.

3.5 Spatiotemporal Diversity of State Rescaling

By combining asymmetric territorial and sequential decentralization with state rescaling theory, we can expect a diversity of impacts on local responses. Based on the studies in the western

context, several reasons are listed here. First, not all localities have sufficient fiscal, administrative and economic capacities to respond to rescaling opportunities and responsibilities (Lobao and Adua, 2011; Lessmann, 2012; Rodriguez-Pose and Ezcurra, 2010; Rodriguez-Pose and Gill, 2004). Local context matters and affects development consequences. In other words, similar planning policies or state rescaling strategies may succeed in some places but fail in others. Differences in local context have further complicated the strategic choices of the state and the impacts rescaling (Lobao and Adua 2011; Xu and Warner, 2015 and 2016). Second, the nature of state policy, to be either redistributive or developmental across regions, may also affect local paths (Xu and Warner, 2016). For example, the developmental rescaling policies based on the "new state spaces" theory (Brenner, 2004) may exacerbate the spatial disparity by creating a virtuous cycle for localities with competitive local assets and vicious cycles for places with limited capacity and higher need (Warner and Pratt, 2005).

3.6 Territorial and Sequential Logic of Rescaling in China

The sequential and spatial perspective of rescaling resonates with the national strategy of "development stage" theory in China. It justifies the notion that that uneven regional development is an inevitable stage during development, and inequality will rise at first and decline at more advanced stages of development. China was at an early stage of development so uneven development is an inevitable manifestation of an objective law rather than a problem. Scholars also predicted the diffusion of economic growth when the nation becomes more developed according to experience in US and Japan (Yu and Chen, 1985).

Therefore, more territorial-specific and favored development policies have been pursued. Decades ago, the 6th and 7th National Five-Year Plans of China formally divided the nation into three belts based on the economic functions: the eastern (coastal) region with a focus on export-

oriented industrialization and trade; central region emphasizing energy development and agriculture; western region to develop husbandry and energy exploitation. The state also designated a series of open zones to facilitate the export-oriented development in coastal regions. The most famous one is the Special Economic Zones (SEZs) of Shenzhen, which profoundly and rapidly changed Shenzhen from a fishing village to one of the largest cities in China in less than 20 years. Other state zone designation examples include Free Trade Zones, Open Economic Zones, Special Development Economic Zones, High Technology and Industrial Development Zones etc., which are more likely distributed in the southeastern coastal regions.

According to sequential asymmetric decentralization, the state periodically evaluates its territorial strategies in rescaling of powers, resources and functions and shifts its attention from privileging production efficiency and competitiveness, to the recent efforts to reduce disparities between coastal and inland regions, eastern and western regions, big cities and small cities, urban and rural area etc. A series of territorial central planning policies and targeted transfers have been pursued by the state to provide development assistance to the less developed inland regions, such as “Great Development of the West”, “Revitalization Northeastern Region”, “Rise of the Central” etc. In this point, state rescaling in China is territorially mixed with both competitiveness promotion and regional inequality reduction across region and time.

3.7 Methodology Gap

To capture such spatiotemporal diversity of state rescaling and its impacts on local responses and trajectories of development, we need more locally customized modeling techniques to reflect such variations across space and time. In contrast to the standard econometric global model, the Geographic Weighted Regression (GWR) model focuses on subsampling and weighting the data and enables the investigation of spatial variations in local relationships (e.g.,

Brunsdon et al., 1996 and 1998; Fotheringham et al., 2002). GWR allows for differential effects across space instead of uniform influence over all locations (Fotheringham et al., 2002).

To obtain local estimates for the target location, the GWR model will first calculate the optimal number of locations (adaptive bandwidth) that are going to be subsampled for local estimation through either cross-validation method (CV) or Akaike information criterion (AIC) method. The optimal bandwidth is calculated to find the most "closed" data points group and capture the spatial heterogeneity between groups. Then, the data or locations within the customized bandwidth or adaptive subsample will be properly weighted in each local regression for the target location. In general, GWR is often considered a nonparametric method that fits local regressions to each specific location in the data, with more weights on observations that are closer to the target. Therefore, for each location, there is a customized bandwidth and weighted subsample for local regression, as well as a set of local estimates.

GWR is a technique developed for cross-sectional data only where the weights and influence decline with distance (Fotheringham et al., 2002). In this project, I extended the GWR approach to include time into the weighting scheme by assuming that data points close in both space and time can have a greater influence on the target location (Huang et al., 2010; Fotheringham et al., 2015) to capture the spatiotemporal variation of how the institutional factors affect local planning and policy making.

I also developed a new modeling solution to account for spatial non-stationarity of panel data that combines both the adaptive bandwidth selection, subsampling and weighting from GWR and the fixed effects estimations strategies for panel data. This Geographic Weighted Panel Regression (GWPR) is different from GTWR. In this model, once a bandwidth is chosen, observations of each subsampled location for all the time will receive the same weight, to

reproduce the global fixed effects model at local level. In other words, the weight is time-invariant and only affected by the data structure and locations of cities while the time effect is controlled by the fixed effects model. Thus, we control the panel structure with local fixed effects models after subsampling and weighting. Our model has a very good balance of nonparametric method and econometric techniques, in which both spatial heterogeneity of statistical relationships and the very nature of data from the repeated observations for each location are considered, with geographic weighted local fixed effects models.

4. Asymmetric State Rescaling Framework

My theoretical framework on the asymmetric state rescaling process focuses on aspects that are missing in previous literature both theoretically and methodologically (See Figure 2).

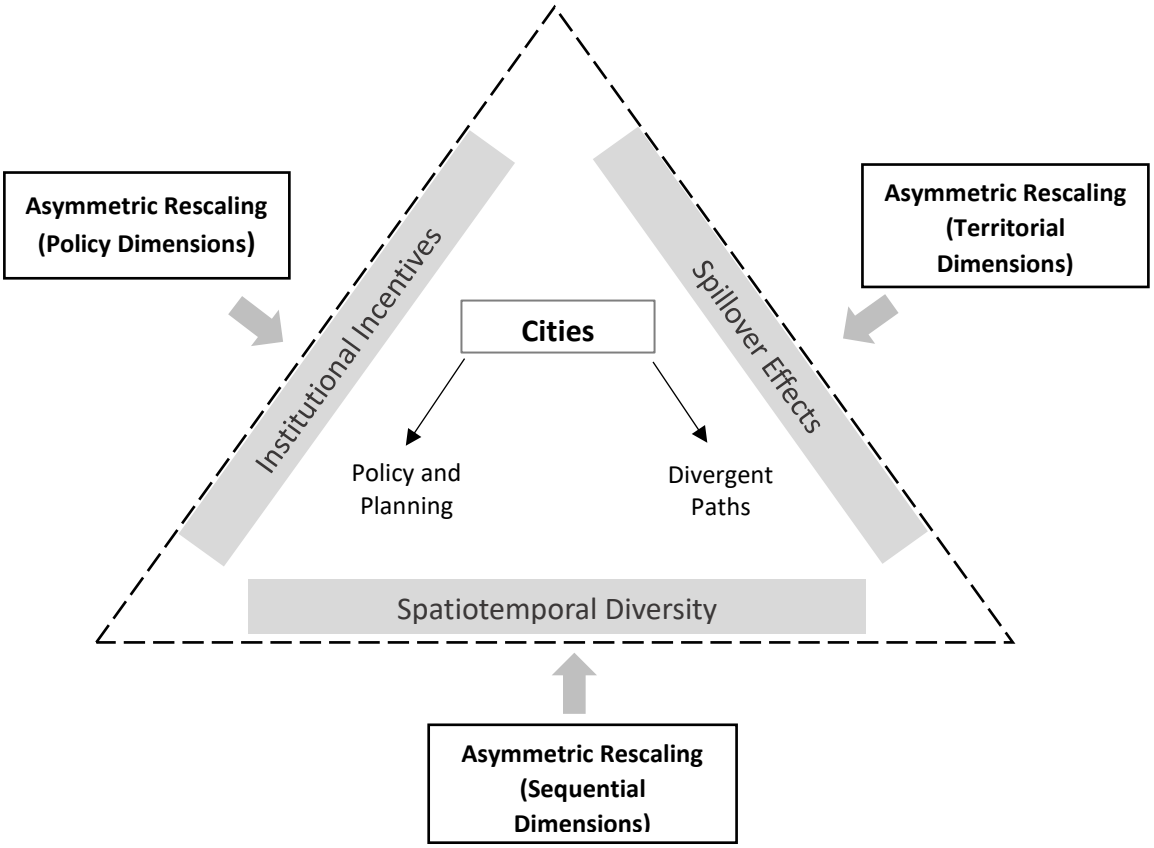


Figure 2 Asymmetric State Rescaling Framework

First, the complexity notions of rescaling and its variability in degrees across different policy dimensions have created fiscal, financial, political and economic incentives to shape local planning and policy making. These incentives, which result from asymmetric rescaling across policy dimensions, further affect local development trajectories. Second, the direct impact of state rescaling is often territorially and sequentially asymmetric. The spatiotemporally divergent process is likely to generate spillover or indirect effects to shape local paths by engaging localities to react to neighbors and their status under rescaling. Last, the diversity across space and time of state rescaling and its impacts on local policy and development results is the focus of this project. It contributes methodology with more locally-weighted and customized modeling strategies to capture the spatiotemporal diversity. My framework focuses on the asymmetric feature of state rescaling in policy fields, territories and sequences. This completes the rescaling theory and provides a multilevel framework to link institutional factors with local planning and policy making to understand transformations of cities and regions.

References

ARDHMC. (2011). Annual Report of the Development of the Housing Market in China 2010-2011 Greenbook Edition. Shanghai: Shehui Kexu Wenxian Chubanshe.

Brenner, N. (2009). Open questions on state rescaling. *Cambridge Journal of Regions, Economy and Society*, 2(1): 123–139.

Brenner, N. (2004) New State Spaces: Urban Governance and the Rescaling of Statehood. Oxford: Oxford University Press.

Brunsdon, C., Fotheringham, A. S. & Charlton, M. (1998). Spatial nonstationarity and autoregressive models. *Environment & Planning A*, 30 (6): 957–973.

Brunsdon, C., Fotheringham, A. S. & Charlton, M. (1996). Geographically weighted regression: a method for exploring spatial nonstationarity. *Geographical Analysis*, 28 (4): 281–298.

Cartier, C. (2010). 'Zone Fever', the arable land debate, and real estate speculation: China's evolving land use regime and its geographical contradictions. *The Journal of Contemporary China*, 10 (28): 445-469.

Chien S-S. (2008). The isomorphism of local development policy: A case study of the formation and transformation of national development zones in post-Mao Jiangsu, China. *Urban Studies*, 45(2): 273–294.

Chung, J. H. (1994). Beijing confronting the provinces: The 1994 tax-sharing reform and its implications for central-provincial relations in China. *China Information*, 9(2–3): 1–23.

Congleton, Roger D. (2006). *Asymmetric Federalism and the Political Economy of Decentralization*. Virginia: George Mason University.

Cox, K. R. (2002). 'Globalization', the 'Regulation Approach', and the Politics of Scale. *Geographies of Power: Placing Scae.* (eds by Herod, A. & Wright, M. W.). Oxford: Blackwell, pp 85-114.

Cox, K. R. (2009). 'Rescaling the state' in question. *Cambridge Journal of Regions, Economy and Society*, 2 (1): 107–121.

Feng, X. (2013). Local government debt and municipal bonds in China: Problems and a framework of rules. *The Copenhagen Journal of Asian Studies*, 31: 23–53.

Fotheringham, A. S., Brunsdon, C. & Charlton, M. E. (2002). Geographically Weighted Regression: The Analysis of Spatially Varying Relationships. Chichester: Wiley.

Fotheringham, S., Crespo, R. and Yao, J. (2015). Geographical and Temporal Weighted Regression (GTWR). *Geographical Analysis*, 47: 431-452.

Guo, G. (2009). China's local political budget cycles. *American Journal of Political Science*, 53: 621–632.

Han, S. S. (2010). Urban expansion in contemporary China: What can we learn from a small town? *Land Use Policy*, 27: 780–787.

He, S., Lee, J., Zhou, T. & Wu, D. (2017). Shrinking cities and resource-based economy: The economic restructuring in China's mining cities. *Cities*, 60: 75–83.

He, C., Zhou, Y. & Huang, Z. (2015). Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geography*, 37 (3): 436–457.

Huang, B., Wu, B. & Barry, M. (2010). Geographically and temporally weighted regression for modeling spatio-temporal variation in house prices. *International Journal of Geographical Information Science*, 24 (3): 383-401.

Inman, R. P. (2003). Transfers and bailouts: Enforcing local fiscal discipline with lessons from U.S. Federalism, In J. Rodden et al.(eds.), *Fiscal Decentralization and the Challenge of Hard Budget Constraints*. Cambridge, MA: MIT Press, pp. 35–83.

Inman, R. P. & Rubinfeld, D. L. (1997). Rethinking Federalism. *Journal of Economic Perspectives,* 11, 43–64.

Jessop, B. (1993). Towards a Schumpeterian Workfare State? Preliminary Remarks on Post Fordist Political Economy," Studies in Political Economy, 40: 7-39.

Jones, M. (2001). The rise of the regional state in economic governance: "Partnerships for Prosperity" or new scales of state power? *Environment and Planning A,* 33: 1185–212.

Katorobo, James. (2007). Decentralization and Local Autonomy for Participatory Democracy, in Public Administration and Democratic Governance, Governments serving Citizens: Economic & Social Affairs, United Nations, Januari, 2007.

Knight, J. & Shi, L. (1999). Fiscal decentralization: Incentives, redistribution and reform in China. *Oxford Development Studies*, 27(1): 5–32.

Kornai, J. (1986). The soft budget constraint. *Kyklos*, 39: 3–30.

Lessmann C. 2012. "Regional inequality and decentralization: An empirical analysis". *Environment and Planning A,* 44 (6) 1363-1388.

Lobao L M, Adua L. 2011. "State rescaling and local governments' Austerity Policies Across the USA, 2001-2008". *Cambridge Journal of Regions, Economy and Society*, 4 (3) 419-435.

Lin, G. C. S. (2009). Scaling-up regional development in globalizing China: Local capital accumulation, land-centered politics, and reproduction of space. *Regional Studies*, 43 (3): 429–447.

Lin, G. C. S. (2007). Reproducing spaces of Chinese urbanization: New city-based and land centered urban transformation. *Urban Studies*, 44 (9): 1827–1855.

Lin, G. C. S. & Yi, F. (2011). Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geography*, 32 (1): 50–79.

Liu, Y., Li, Z. & Jin, J. (2014). Pseudo-urbanization or real urbanization? Urban China's mergence of administrative regions and its effects: A case study of Zhongshan City, Guangdong Province. *The China Review*, 14 (1): 37–59.

Liu, T. & Lin, G. (2014). New geography of land commodification in Chinese cities: Uneven landscape of urban land development under market reforms and globalization. *Applied Geography*, 51: 118–130.

Lin, G. C. & Zhang, A. Y. (2014). Emerging spaces of neoliberal urbanism in China: Land commodification, municipal finance and local economic growth in prefecture-level cities. *Urban Studies*, 52 (15): 2774–2798.

Logan, J. R. & Molotch, H. L. (1987). *Urban Fortunes: The Political Economy of Place*. Berkeley, CA: University of California Press.

Long, Y. & Wu, K. (2016). Shrinking cities in rapidly urbanizing China. *Environment and Planning A*, 48 (2): 220–222.

Lu, Y. & Sun, T. (2013). Local government financing platforms in China: A fortune or misfortune? IMF Working Paper, No. 13/243. http://ssrn.com/abstract=2375564

Ma, L. J. C. & Wu, F. (2005). Restructuring the Chinese city: Diverse processes and reconstituted spaces. In L. J. C. Ma and F. Wu, editors, *Restructuring the Chinese City: Changing Society, Economy, and Space*. London, UK: Routledge, 1–20.

Musgrave, R. A. (1959). *The Theory of Public Finance: A Study in Public Economy*. McGraw-Hill, New York.

Mykhnenko, V. & Li, H. (2018). Urban shrinkage with Chinese characteristics. *The Geographical Journal published by John Wiley & Sons Ltd on behalf of Royal Geographical Society (with the Institute of British Geographers),* 184 (4):8, 398-412, DOI: 10.1111/geoj.12266

Nasution, K. I. (2016). The challenge of Decentralization in Indonesia: Symmetrical and Asymmetrical Debate. *International Journal of Social Science and Humanity*, 6 (9): 691–691.

Oates, W. E. (2005). Toward a second-generation theory of fiscal federalism. *International Tax and Public Finance, 12* (4), 349-373.

Oates, W. E. (1972). *Fiscal Federalism.* NY: Harcourt Brace Jovanovich.

Pan, F., Zhang, F., Zhu, S. & Wojcik, D. (2017). Developing by borrowing? Inter-jurisdictional competition, land finance and local debt accumulation. *Urban Studies*, 54 (4): 897-916.

Peck, J. & Tickell, A. (1994) Searching for a new institutional fix: The after-Fordist crisis and the global-local disorder, in post-Fordism: A Reader (ed Amin A.), Blackwell Publishers Ltd, Oxford, UK.

Peck, J. & Zhang, J. (2013). A variety of capitalism with Chinese characteristics? *Journal of Economic Geography*, 13: 357–396.

Peterson, P. E. (1995). *The Price of Federalism*. Washington D.C.: Brookings Institution Press.

Peterson, P. E. (1981). *City Limits*. Chicago, IL: University of Chicago Press.

Ping, Y. C. (2011). Explaining land use change in a Guangdong county: The supply side of the story. *The China Quarterly*, 207 (1): 626–648.

Rodríguez-Pose A, Ezcurra R. 2010. "Does decentralization matter for regional disparities? A cross-country analysis". *Journal of Economic Geography*, 10 (5): 619-644.

Rodríguez-Pose A, Gill N. 2004. "Is there a global link between regional disparities and devolution?". *Environment & Planning A*, 36 (12) 2097-2118

Sorace, C. & Hurst, W. (2016). China's phantom urbanization and the pathology of ghost cities. *Journal of Contemporary Asia*, 46 (2): 304–322.

Swyngedouw, E. (2004). Globalization or 'glocalization'? Networks, territories and rescaling. *Cambridge Review of International Affairs*, 17 (1): 25–48.

Tao, R., Su, F., Liu M. & Cao, G. (2010). Land leasing and local public finance in China's regional development: Evidence from prefecture-level cities. *Urban Studies,* 47: 2217–2236.

Tiebout, C. M. (1956). A Pure Theory of Local Expenditures. *Journal of Political Economy, 64* (5), 416-424.

Tsui, K. Y. (2011). China's infrastructure investment boom and local debt crisis. *Eurasian Geography and Economics*, 52: 686–711.

Wei, Y. D. (2015). Zone fever, project fever: Development policy, economic transition and urban expansion in China. *Geographical Review,* 105 (2):156–177.

Weingast, B. R. (2009). Second generation fiscal federalism: The implications of fiscal incentives. *Journal of Urban Economics*, 65: 279 - 293.

Woodworth, M. D. & Wallace, J. (2017). See ghosts: parsing China's "ghost city" controversy. *Urban Geography*, 38 (8): 1270–1281.

World Bank (2014). Urban China: Toward efficient, inclusive, and sustainable urbanization. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/18865

World Bank (2009) The Urban Development Investment Corporations in Chongqing China. Technical Assistance Report. http://documents.worldbank.org/curated/en/2010/01/12648119/urban-development-investmentcorporations-udics-chongqing-china

Wu, W. (2010). Urban infrastructure financing and economic performance in China. *Urban Geography*,31: 648–667.

Xu, Y, Warner, M E. 2015. "Understanding Employment Growth in the Recession: The Geographic Diversity of State Rescaling", *Cambridge Journal of Regions, Economy and Society*, 8 (2), 359-377. doi:10.1093/cjres/rsv001

Xu, Y, Warner, M E. 2016. "Does Devolution Crowd out Development? A Spatial Analysis of US Local Government Fiscal Effort", *Environment and Planning A*, 48 (5), 871-890. DOI: 10.1177/0308518X1562244

Yu, J. & Chen, A. (1985). Shi lun dongxibu di chayi he kaifa xibu yin caiqu di teshu zhengce [Discussion of the gap between the east and the west and special policies for developing the west] *Zhongguo gongye jingji xuebao* [Journal of Chinese Industrial Economy], 4: 76-89.

Yang, Z. & Dunford, M. (2018) City shrinkage in China: scalar processes of urban and hukou population losses. *Regional Studies*, 52:8, 1111-1121, DOI:10.1080/00343404.2017.1335865

Yuan, S. (2008). Land Problems Due to Impetuous Urbanization. *Reform and Policy-Making Internal reference 16*.

Zhang, L. (2008). Conceptualizing China's urbanization under reforms. *Habitat International*, 32 (4): 452–470.

CHAPTER 3

URBAN GROWTH AND SHRINKAGE IN CHINA: A TIME-SERIES CLUSTERING

Abstract

The shrinking city is one of the most critical challenges in urban planning. However, the issue of urban shrinkage has not been explored much in the developing world, especially in rapidly urbanizing China. The "developing" character tends to divert the research focus to the growing and megacities, masking the parallel uneven development and the problem of shrinkage in other cities. In fact, the massive state-led urbanization in China has created different development trajectories for cities.

To fill the gap of shrinking cities in developing contexts, this paper contributes to the study of urban shrinkage in China both methodologically and theoretically. Instead of choosing two time points and calculating urban changes, this paper utilizes an innovative technique, Dynamic Time Warping (DTW) algorithms, to conduct time-series clustering analysis on urban growth and shrinkage. It groups all 290 prefecture cities in China into different urban trajectories from 2006 to 2015, such as continuous growth, recent growth, stabilized shrinking, recent decline etc. The typologies are further created based on the trend of time-series clustering of urban population and economy dimensions.

The paper further explores the factors that may affect urban shrinkage in China using a multinomial logistic regression. The impacts of state spatial selectivity, local responses to state rescaling, core-periphery neighboring effects and economic restructuring are examined across different urban trajectory typologies. In general, cities in northern China, especially in the Middle Yellow River region and the Northeast, suffer from population loss and economic decline due to

not being privileged by the state for development, higher local economic share in resource-based sectors, lower natural growth rate, less competitiveness and attractiveness to the market and developers. In contrast, shrinking cities in south-central China, especially in the southeastern coast and Middle Yangtze River, can be attributed to their proximity to state-selected high-level large cities that have a gravitational pull of people and economic activities. Since these middle and smaller cities are not favored by the state policies, they are likely to rely on debts to sustain local economic growth.

Key Words: Shrinking Cities; China; Time-Series Clustering; State Rescaling

Introduction

The Shrinking city is one of the most critical challenges in urban planning. The "shrinkage identity" includes the loss of population, the decline of the economy and rise of social issues (Reckien and Martinez-Fernandez, 2011). These "identities" have been studied from numerous cities of developed countries in Europe, North America, Japan, Russia (e.g. Oswalt, 2006; Oswalt and Rienitz, 2006; Hill et al., 2012; Reckien and Martinez-Fernandez, 2011; Wiechmann and Pallagst, 2012; Schilling and Mallach, 2012; Turok and Mykhnenko, 2007; Beauregard, 2009).

Research on shrinking cities tends to fall into three categories: 1) describe and classify trajectories of shrinking cities (e.g., Beauregard, 2009; Wiechmann and Pallagst, 2012); 2) identify causal mechanisms (Reckien and Martinez-Fernandez, 2011; Wiechmann and Pallagst, 2012; Hill et al., 2012); and 3) explore planning responses (Schilling and Mallach, 2012; Hollander et al., 2009; Wiechmann and Bontje, 2015). These efforts not only increase the attention and importance of shrinking cities in academic and policy communities but also make urban shrinkage a useful framework for urban studies in planning, geography and governance.

However, the issue of urban shrinkage has not been explored much in the developing world, especially in rapidly urbanizing China. The "developing" character tends to divert the research focus to the growing and megacities, masking the paralleled uneven development and the problem of shrinkage in other cities. In fact, the massive state-led urbanization in China has created different development trajectories for cities. The phenomenon of shrinking cities in China has captured research attention in recent years.

On the population dimension, according to Long and Wu (2016), 180 of 653 cities experienced population losses from 2000 to 2010. At the same time, 19882 of 39007 townships, lost population as well. These shrinking places account for almost one-third of all localities in China. On the other hand, as the central fiscal stimulus in 2008 to protect the domestic economy from the Western financial crisis has been depleted, economic growth has slowed as well. The year 2012 is usually considered as the turning point for China's economy when its national GDP growth rate dropped below 8% to enter the "new normal" (Jin, 2015), compared to previous growth rates of 10%-15%.

However, unlike the extensive studies on urban and regional growth in China, the literature on shrinking cities in China is just emerging and exploratory. Studies are found in the form of general surveys to create different typologies for urban population change (Yang and Dunford, 2017; Mykhnenko and Li, 2018), case studies of resource depleted cities (He et al., 2017) and graphical analysis (Long and Wu, 2016). Based on western theories on urban growth and decline, some key factors on urban shrinkage in China are explored, including migration to cities, especially to the large cities, economic restructuring, resource-depletion and global economic changes, but theories on China's shrinking cities still need to be developed with more nuanced

geographical understanding considering the large regional differences of China (Peck and Zhang, 2013).

To fill the gap of shrinking cities in developing contexts, this paper contributes to the study of urban shrinkage in China both methodologically and theoretically. It utilizes an innovative technique, Dynamic Time Warping (DTW) time-series clustering to measure urban growth and shrinkage in China and groups cities into different urban trajectory typologies based on their urbanization processes. Then the paper explores factors that may affect urban shrinkage and growth in China's state-led urbanization. Based on the frameworks of state rescaling and new economic geography, the impacts of state spatial selectivity, local responses to rescaling, core-periphery neighboring effects and economic restructuring are examined across different urban trajectory typologies.

Classical Theory on Shrinking Cities in the Western Context

Life-cycle Theory

The initial effort of explanation for urban shrinkage lies in the life-cycle theories (Berry, 1977; van den Berg et al., 1982). Van den Berg et al. (1982) developed a four-successive-stage model for the metropolitan evolution that includes urbanization, suburbanization, de-urbanization and re-urbanization. This model views shrinkage as an inevitable process and an integral part of urban development. Its reasoning is based on a couple of neoclassical interpretations. First, based on the logic of the evolution of capitalism, featured by the process of "creative destruction" (Schumpeter, 1939), the production follows the "Kondratieff waves" to reduce the costs by relocating, innovation and introducing new technologies. Therefore, the lifecycles of industries of cities have determined their stages of urban development (Booth, 1987). Recent literature in urban studies also suggests the patterns of urban changes as a normal development stage rather than a

short-term interruption to respond to economic cycles (Hall and Hay, 1980; Martinez-Fernandez et al., 2012; Pallagst et al., 2013; Wiechmann and Bontje, 2015).

Suburbanization

Another strand of explanation of urban shrinkage focuses on the changing values of people to cities (Berry, 1977) that might lead to out-migration and is mainly captured by the literature of suburbanization in the U.S. context. The issues of overcrowding, poverty, crime, poor environment and decline in central cities may push people to move to the periphery to emphasize people's trade-offs between commuting costs and living environment. However, the poor and minorities tend to be stuck in the central cities. This "white flight" urban transition is characterized by economic and racial discrimination (Downs, 1997) that the "invasion" of the poor or minorities will cause the "white flight" to the outer suburbs (Lucy and Philips, 2000). Another perspective highlighted the increase of mobility supported by car ownership, and federally subsidized mortgages and massive highway construction, which contributed to the suburbanization in the U.S. especially in the 1950s and 60s (Jackson, 1985) to leave the central cities behind and decline with many large economic, social and fiscal problems (Downs, 1997).

Globalization and Spatial Fix

The third type of theoretical literature focuses on the restructuring of urban areas and capitalism within the context of globalization (Scott and Storper, 2003). In other words, the connection between urban stages and economic cycles is extended globally, and the urban trajectories now are affected by the cycles of economics that are scaled up to the global level. With the shift from Fordist industrialization to a post-Fordist regime of production, cities need to cope with the political and economic restructuring through their transformation (Bontje, 2004). Therefore, it would be more appropriate to understand urban growth and shrinkage as the "spatial

manifestation of globalization" for new regimes and economic order (Castells, 2000; Soja, 2000; Sassen, 2001). The restructuring of capitalism production also entails a spatial fix of capital with a "see-saw-movement of investment, disinvestment, and reinvestment" (Harvey, 1982 and 2006) to search for new spaces and areas to solve its accumulation crisis in the previous production (Harvey, 2000; Peck and Tickell, 1994). Thus, considering the unprecedented volatility and mobility of capital in globalization, some cities may be successful to compete for investment while others may fail, and experience shrinking and decline (Soja, 2000; Scott and Storper, 2003). Urban trajectories in this sense are constantly remade by new rounds of capital spatial fixes globally.

Deindustrialization and Territorial Divisions of Labor

One major type of capital shift is industrial restructuring (Storper, 1997; Scott, 1998; Soja, 2000) that massive transfers of capital from manufacturing in developed countries to other economic sectors and other parts of the developing world result in the deindustrialization process and the consequent urban shrinkage in the West (Soja, 2000). Examples include the shift from industrial sectors to service sectors, and the replacement of labor by technologies. Another example lies in a capital switch from the declining western industrial regions to the new urbanized area of China, due to the low cost of labor. China's regional policies also catered to this demand of globalization by promoting an export-oriented labor-intensive development mode, especially in coastal cities. The capital shift and new international division of labor (Scott, 1988) caused the shrinkage of former industrial cities in both Europe and North America (Birch and Mykhnenko, 2009).

Others: Demography, Climate Change

Demographic changes also play an important role in shaping urban change. The consequences of decreasing birth rates (Lesthaeghe, 1995) are argued to cause a long-term

decrease in the population growth rate. The slow growth of population, aging society, and decreasing working-age population are found in some European and North American cities (e.g. Turok and Mykhnenko, 2007). Other causes of urban shrinkage that may become more common in the future include ecological hazards, for example, floods or hurricanes (Lowe and Bates 2013), and post-socialist transformation (Oswalt, 2006).

Urban Shrinkage in China

The question is whether theories of urban shrinkage from western capitalist economies travel to the context of China. In fact, China's urban model is primarily state-led at different levels, which is influenced by China's political and economic transformations and institutional reforms. Therefore, this paper attempts to provide a lens from state rescaling and its impacts to explain urban shrinkage and growth in China. The explanations are derived from the state rescaling framework (Brenner, 2004 and 2009; Cox, 2009) as well as the emerging literature of shrinking cities in China Mykhnenko and Li, 2018; He et al., 2017; Yang and Dunford, 2017)). It generally argues the urban trajectory is a result of both state rescaling in the territory and its spillover effects via state-designated core-periphery dynamics, as well as major local policy responses in land use and finance.

State Spatial Selectivity

The first possible explanation of different urban trajectories relates to the territorial feature of the state rescaling process. Brenner (2004) pointed out the shifting spatial logic of state under globalization from the notion of "Spatial Keynesianism" to the privileging of places with global competitiveness. However, in China's context, such spatial logic of the state is territorially mixed with both competitiveness promotion in the 1980s and regional inequality reduction in the post-2000.

Decades ago, the 6th and 7th National Five-Year Plans of China formally divided the nation into three economic belts: the eastern (coastal) region with a focus on export-oriented industrialization and trade; central region emphasizing energy development and agriculture; and the western region to develop husbandry and energy exploitation. The state also designated a series of open zones to facilitate the export-oriented development in coastal regions. The most famous one is the Special Economic Zones (SEZs) of Shenzhen, which profoundly and rapidly changed Shenzhen from a fishing village to one of the largest cities in China in less than 20 years. Other state zone designation examples include Free Trade Zones, Open Economic Zones, Special Development Economic Zones, High Technology and Industrial Development Zones etc.

In addition, the state also pays much attention to the disparity of regional development between coastal and inland regions, eastern and western regions, big cities and small cities, urban and rural areas, etc. A series of territorial central planning policies have been pursued by the state to provide development assistance to the less developed inland regions, such as "Great Development of the West", "Revitalization of the Northeastern Region", "Rise of the Central" etc. However, these efforts don't translate into successful economic restructuring, industrial upgrading, or the foundation for new business and growth, despite their efforts to enhance the attractiveness of those resource-based industrial cities and less developed regions. Being selected by state and how state rescaling affects the urban growth and shrinkage in China require a more nuanced geographical understanding of state rescaling and state-led urbanization.

China's New Economic Geography

This study also considers the local spillover effects of state rescaling that may affect urban changes. To better describe the spillover effects of cities that are spatially selected by state, I draw the theories from new economic geography (Krugman, 1991). Its core-periphery model can help

illustrate the gravitational pulls of people and economic activities and explain the out-migration to the fast-growing coastal areas and state-privileged large cities (e.g., provincial capitals) from both the small or medium size cities and rural areas. This also echoes the perspective in Li Mykhnenko and Li (2018) on state-mediated core-periphery dynamics to explain urban shrinkage in China. In this sense, the core-periphery framework can capture the spatial interactions among cities that generate parallel growth and decline. We may also expect some cities may benefit from proximity to the state-selected high-level cities and enjoy the agglomeration of urban economies from regional development.

Local Responses in Land Use and Finance

In China's rescaling context, one important reform in fiscal decentralization in 1994 is the tax-sharing system (TSS), which created a large gap between local revenues and spending responsibilities (Wong, 2000; Chung, 1994; Tsui, 2011, Wu, 2010; Liu and Lin, 2014; Lin and Yi, 2011). About 85% of public expenditure responsibilities are now decentralized to local governments while only 55% of total government revenues are shared at the local level (World Bank, 2014). Thus, the increased fiscal pressures push local governments to seek extra resources by either requesting more central transfers or generating extra-budgetary revenue sources from the market.

The major extra-budgetary resource is from land (Lin and Zhang, 2014; Lin et al., 2014; Tao et al., 2010). According to the *Chinese Land Management Law*, China has a dualist land management system where the ownership of rural land belongs to the village collectives while urban land is owned by the state. Only the use rights of urban land can be traded in the market by local governments for a certain amount of time. This allows local government to sell the land use right to developers at higher market prices as local government is the sole urban land supplier and

it can reap monopoly rents from this process (Lin, 2009; Lin and Yi, 2011). More importantly, land and its revenues have been further used as collateral and a repayment source for local debt-financed investment (Pan et al., 2017; Feng, 2013). Besides fiscal and economic incentives, China's political centralization (He et al., 2015) further generates political incentives for localities to pursue fiscalization and financialization of urban land resources to compete with peers for investment, boost short-term economic growth (Tsui, 2011), generate extra revenues (Lichtenberg and Ding, 2009; Lin and Yi, 2011; Rithmire, 2013) and get promotions (Guo, 2009; Li and Zhou, 2005).

Meanwhile, issues of oversupply, overbuilding and overborrowing are found in China's cities with manifestations of "ghost cities (e.g. Woodworth and Wallace, 2017), "local development zone fever" (e.g. Cartier, 2010; Wei, 2015;) and rising local debts (e.g. Pan et al., 2017; Feng, 2013). These inefficient and unsustainable local development modes raise the concerns of potential urban shrinkage and the sustainability of urban growth.

Economic Restructuring

Last, this paper also takes into account the factors of resource-depletion and industrial restructuring. The resource sector has weak connections to other sectors and global economic upgrading (Martinez-Fernandez and Wu, 2007). Thus, resource depletion is considered as the key factor to result in shrinking cities in developing contexts (Oswalt, 2006). Not only for the developed countries have resource-based cities lost competitiveness and attractiveness (Martinez-Fernandez et al., 2012) but also in developing countries, resources-based cities are in the depletion stage that is associated with population losses (He, 2014).

In China, the State Council identified 262 cities (126 at prefecture-level) as resource-based cities and grouped them into four types of growth: mature, recession and recovery according to *the*

Plan of Sustainable Development for Resource-based Cities in China (2013-2020). For those resource-based heavy industrial cities, the Central State has forced economic restructuring through reindustrialization to high-technology manufacturing production with financial support and revitalization programs (NDRC, 2007 and 2015). However, the share of heavy industries has increased in these cities rather than dropped so they have not achieved economic diversification (Zhang, 2008; Li and Zhang, 2012). Mykhnenko and Li (2018) also pointed out such failure in economic restructuring, as well as the limited local effort to build a foundation for new economic sectors and improve the attractiveness of cities for living in these resource-based industrial cities. Therefore, the reindustrialization has not worked well for old-industrial cities in China (He, 2014). This leaves them with increasing socio-economic problems, such as population loss, unemployment, declining economy, municipal deficits and underutilized infrastructure.

Measuring Urban Shrinkage

Trajectories

Studies on shrinking cities usually choose two-time points to calculate the population change for a certain period to measure shrinkage (e.g., Long and Wu, 2016; Yang and Dunford 2017). Other studies extend this approach to two or more time periods by picking multiple time points for population change calculations. This will allow researchers to generate different urban trajectories regarding population changes in different time periods. For example, Mykhnenko and Li (2018) examined population changes from 1990 to 2000 and 2000 to 2010, to identify three different patterns of recent shrinkage, urban resurgence, and long-term shrinkage for all inner-city boroughs (urban districts) in China. Turok and Mykhnenko (2007) measured population changes for 310 European cities and discovered 25% of them lost population since 1980 and 40% suffer population shrinkage in the 1990s to generate 9 different population trajectories. Martinez-

Fernandez et al. (2015) applied a similar approach to generate 4 distinct trajectories of shrinkage, stabilized shrinkage, growth and relapsing-remitting.

Typologies

Other scholars further improve the measurements of urban change into both population and economic dimensions to capture the multiple aspects of shrinkage (Rink et al., 2011; Wiechmann, 2008). The two-dimensional matrix from Wiechmann and Pallagst (2012) has measured growth and shrinkage in both economic and demographic dimensions and generated a two by two typology to classify cities. Hartt (2018) combined the multi-faceted measurements of both population and economy with 6 different trajectories of continuous shrinkage, stabilized shrinkage, cyclic shrinkage cyclic growth, recovery and continuous growth, to create two-dimensional trajectory typologies for the 100 largest US cities from 1980 to 2010.

Time-series clustering

However, all the studies are still only calculating the population and economic changes based on subjectively selected time points such that the urban process and pattern within the selected time points are disguised. For example, a positive population change based on two-time points may entail a recent shrinkage or a recovery from earlier shrinkage. Therefore, to measure the typology of urbanization as a process, this paper utilizes the time-series clustering method to group cities based on their demographic and economic dimensions of the urban process. The two-dimensional trajectory typologies are created based on the urbanization patterns instead of the absolute changes between two-time points.

Research Questions

This paper first measures urban growth and shrinkage in China and groups cities into different trajectory typologies based on their urbanization process using the innovative approach of time-series clustering. Then a multinomial logistic regression model is conducted for the trajectory typologies to explore possible explanatory factors including state spatial selectivity, local responses to rescaling, neighbor effects and economic restructuring that may affect urban shrinkage in China's context.

Data and Study Unit

This analysis focuses on the prefecture-level cities (municipalities, N = 290). In China's government system, there are 6 levels of administrative entities. From top to bottom, they are the Central Government/State, Provincial Government, Prefecture Government, County Government, Town Government and Neighborhood Office. Prefecture-level cities are below provinces and above counties. They are one important part of China's local government apparatus since they are assigned important fiscal, economic and demographic development and management responsibility. Besides the significance in urbanization, prefecture cities also provide a good balance of fine-level of study unit and stable boundary for overtime analysis.

I use the urban registered population in China Urban Construction Yearbook instead of the total population for our measurements since the total population contains both urban and rural people. The government finance data are also retrieved from China Urban Construction Yearbook (2006-2015). The socioeconomic data of cities are from China City Yearbook[1] (2007 to 2016). The land-related data are obtained from China Land and Resources Statistical Yearbook (2006 to

[1] *The data in China City Yearbook is collected one-year later. For example, the Yearbook 2007 contains data in 2006.*

2015). The state designated special zones information is collected from the Ministry of Commerce of the People's Republic of China and geocoded by author.

Dynamic Time Warping (DTW) Time-Series Clustering

Traditional clustering algorithms are developed to handle the cross-sectional data, including partitioning, hierarchical, density-based, grid-based and model-based, based on how the data can be grouped (Liao 2005; Rani and Sikka, 2012; Aghabozorgi et al., 2015). With the recent development of dynamic clustering for time-series data, such as stock data, voice data, medical data etc., the challenge of high dimensionality related to time has been overcome in time-series clustering (Aggarwal and Reddy, 2013; Aghabozorgi et al., 2015).

The key part of clustering analysis is the distance measure to assess (dis)similarity. For the dynamic clustering, the most important elements include not only the (dis)similarity measure for distance, but also the function for prototype extraction (patterns), the clustering algorithms, and the evaluations (Aghabozorgi et al., 2015). Based on these metrics, dynamic clustering is further divided into shape-based, feature-based or model-based (Aggarwal and Reddy, 2013). The Dynamic Time Warping (DTW) distance is the most commonly used (dis)similarity measure in shape-based clustering (Aghabozorgi et al., 2015). It was initially developed in the data mining field to overcome the limits of traditional distance measure, such as Manhattan and Euclidean distances, which are sensitive to the outliers and phase shifts (Ratanamahatana and Keogh, 2004; Berndt and Clifford, 1994). Therefore, DTW provides a dynamic distance function for the optimum warping distance path, and then use the traditional clustering methods to group members.

In general, there are two big steps in DTW algorithms.

1. If there are two sample time series X and Y. Their lengths are n and m. The DTW distance between these two series can be computed in O(nm) time. The first step is to create a local cost matrix (LCM) in n*m dimensions for every pair of time-points in series. For each time point (i, j) in x and y, the LCM can be computed[2]:

$$LCM(i\,,j)\ == (\sum |X_i - Y_j|^p)^{\frac{1}{p}} \tag{1}$$

1. Then, the DTW algorithm finds the optimal path that minimizes the distance for alignment between X and Y. This step will be iteratively calculated for all LCM, starting from LCM (1, 1) and stopping at LCM (n, m). For each time-step, the DTW algorithm will find the direction with the least increase in cost/distance for alignment under certain constraints[3]. Figure 3 visualizes this process.

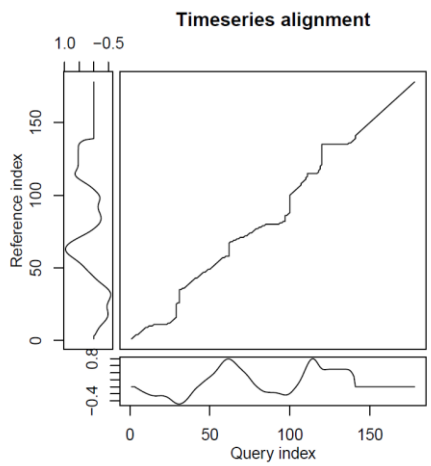


Figure 3 The optimal path identified using DTW to step through LCM

Source: Sarda-Espinosa (2017)

[2] *p equals to 2 in this study, which calculates the Euclidean distance for every pair of time points between two time series.*

[3] *The constraints here refer to the "window size" or window constraints to limit the area of the LCM that can be reached by DTW algorithm. Among many types of windows (Giorgino, 2009), this study uses the Sakoe-Chiba window to create the allowed region or window along the diagonal of the LCM (See the Appendix 3 for the visualization example). It is common to use a window size of 10% of the series' length. In this case of 10-year analysis, window size 1 is assigned for DTW algorithm.*

2. If we assume the optimal path contains points set $\emptyset = \{(1,1) \ldots (\mathrm{n}, \mathrm{m})\}$ the final distance can be calculated as below:

$$DTW_p(x, y) = \left(\sum \frac{m_\emptyset LCM(k)^p}{M_\emptyset}\right)^{\frac{1}{p}}, \ \forall \mathrm{k} \in \emptyset, \tag{2}$$

where $m_\emptyset$ is a weighting coefficient at each step and $M_\emptyset$ is the corresponding normalization constant (Giorgino 2009; Sarda-Espinosa, 2017). After all the optimal DTW distances are calculated, all series can be clustered with different clustering methods[4], and the prototypes of each category can be extracted with various functions[5].

This study utilizes the shape-based time-series clustering with Dynamic Time Warping (DTW) algorithms to group cities based on their urbanization trends. Urban population level and Gross Regional Production (GRP) level are selected as two indicators for demographic and economic development across all prefecture-level cities. The trends from 2006 to 2015 of these two metrics are used to cluster cities for their urban trajectories. There are 4 clusters identified for the urban population trend while 2 clusters are suggested for the GRP trend[6]. If we use the widely employed approach that calculates the changes between the starting and ending time points of the

[4] *Clustering methods for DTW include partitional clustering, hierarchical clustering, TADPole clustering and fuzzy clustering. This study utilizes the widely used partitional methods to group all the dynamic warping distances between each pair of time series.*

[5] *Prototype extraction functions for the centroids/patterns include: mean, median, DTW Barycenter Averaging (DBA), Partition around medoids (PAM), Fuzzy c-means, and Fuzzy c-medoids. This study uses the Partition around medoids (PAM) to extract the central pattern. This type extract function ensures central patterns or cluster centroids are always one of the time series data.*

[6] *This study employs the "CVI" function to evaluate the clustering results to identify the optimal cluster numbers for both urban population and Gross Regional Production (GRP). The indexes for evaluation include Silhoustte Index (maximized), Score Function (maximized), Calinski-Harabaz Index (maximized), Davies-Bouldin Index (minimized), Modified Davies-Bouldin Index (minimized), Dunn Index (maximized) and COP index (minimized). Appendix 2 and 3 show the results of Silhoustte Index for urban population and GRP respectively. The optimal cluster number is 4 for urban population and 2 for GRP.*

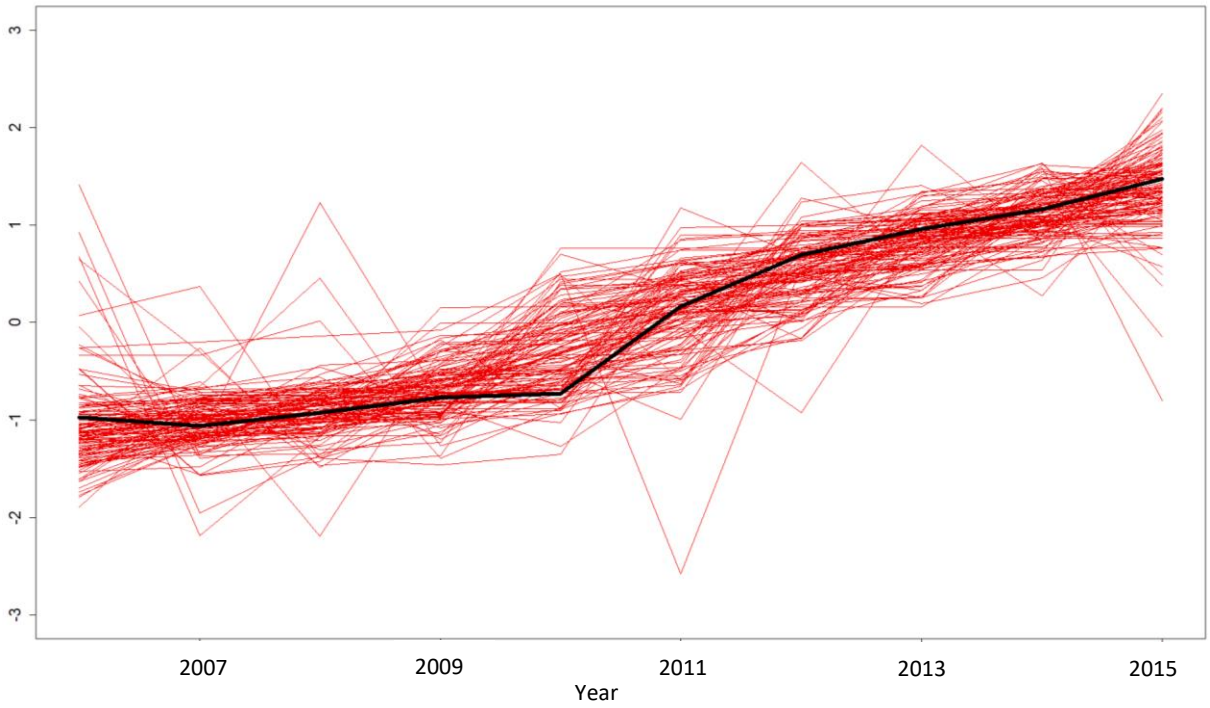
study period, most cities will be identified with growth in urban population and economy from 2006 to 2015, however, the various patterns of urban trajectories will be disguised.

Figure 4 demonstrates the time-series clustering results for the urban population. The urban population data is normalized using z-scores. This normalization has been iterated for each city over 10 years from 2006 to 2015 to eliminate the impacts of changing sizes on clustering and only focus on the changing patterns[7].

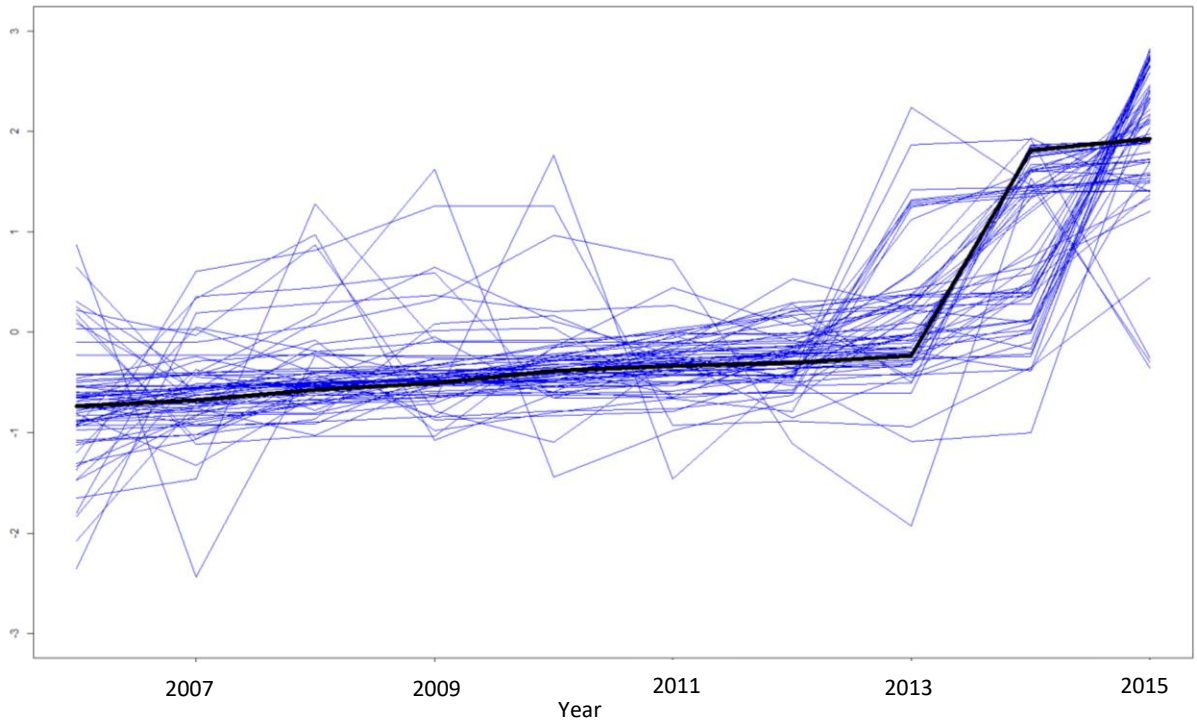
There are 191 cities (66.3%) grouped into the growing trend, which is further divided into 2 clusters (UP1 and UP2) of long-term/continuous growth (126 cities, 43.8%) and recent short-term growth (65 cities, 22.6%). In contrast, 97 cities (33.7%) are clustered into shrinking clusters (UP3 and UP4) based on their urban population trends. In UP3, there are 36 cities (12.5%) experiencing dramatic urban population loss between 2006 to 2010 and stabilized shrinkage from 2011 to 2015. The total urban population level in 2015 for most cities in this category is still lower than the starting year 2006. For cities in the last category (UP4), despite increases, their urban population levels have become stagnant after 2010. Moreover, some cities in this cluster show the downward trend of shrinking urban population in recent years.

[7] *Thus, the y-axis only represents the normalized urban population level for each city. The measures can only be compared within city (2006 vs. 2015) and cannot be compared across cities. The purpose is to eliminate the effects of changing sizes and compare the changing patterns or similarities of trends.*

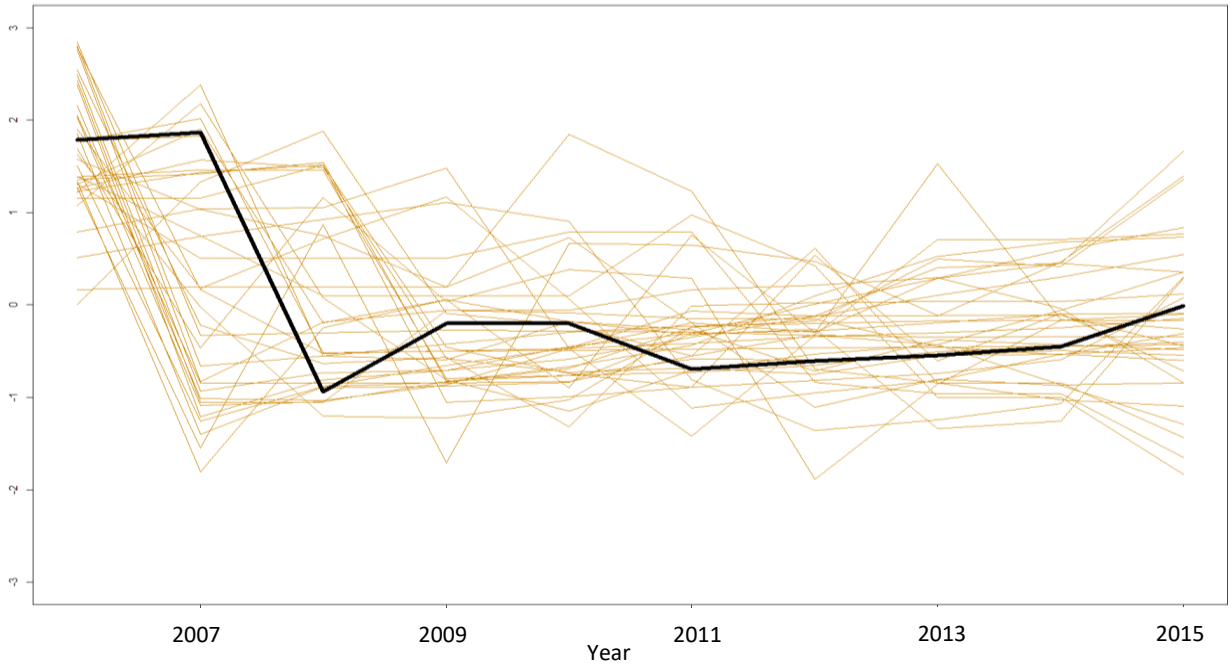
UP1: Growth I



UP2: Growth II



UP3: Shrinking/Stabilized Shrinkage



UP4: Stagnant/Recent Shrinking

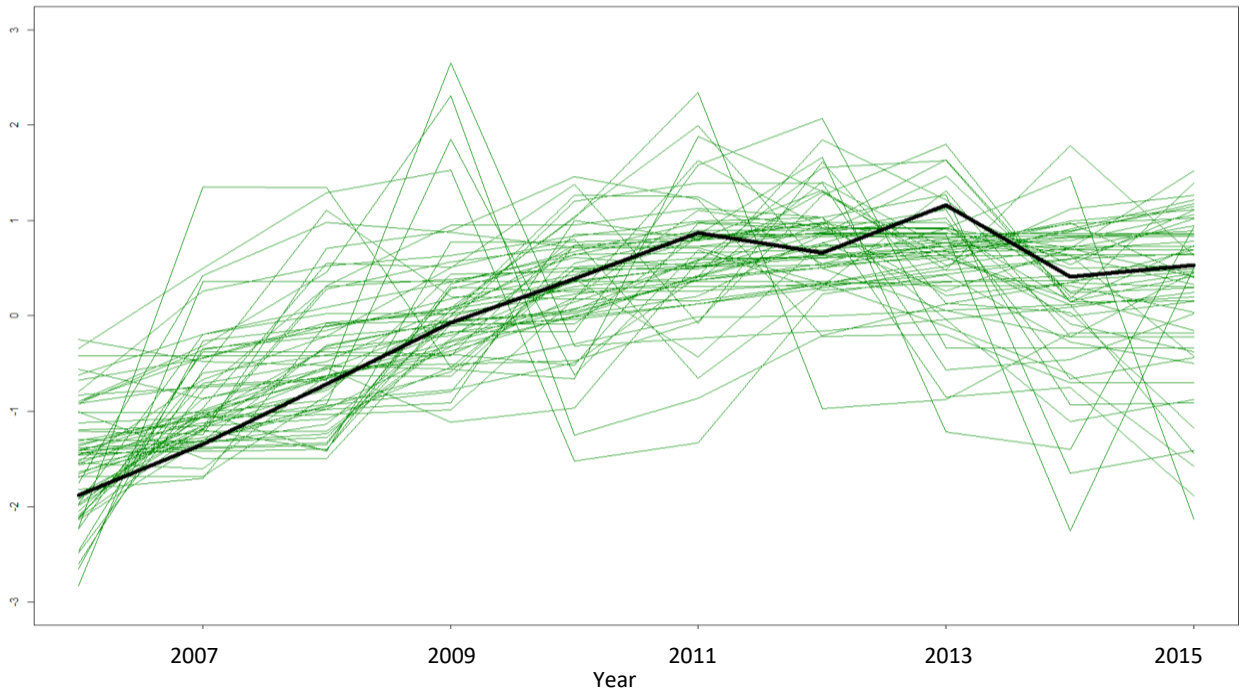


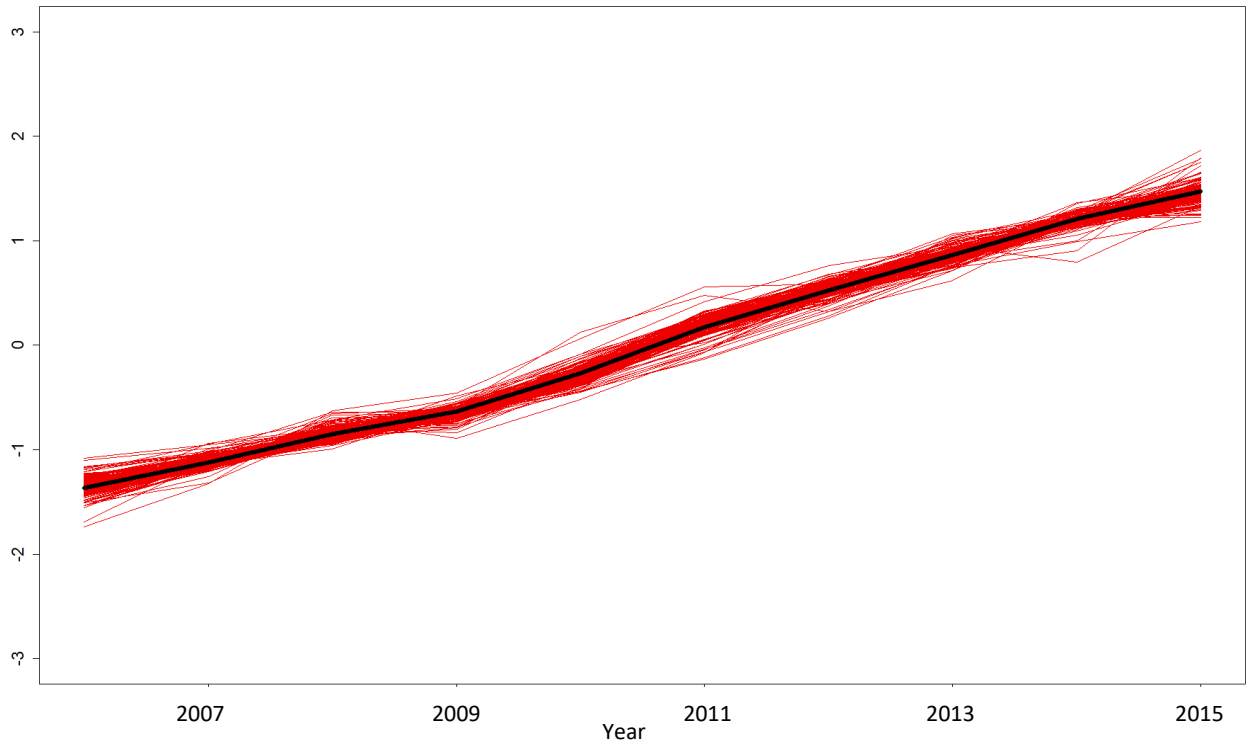
Figure 4 Dynamic Time Warping (DTW) Clustering Results of Urban Population

Data Source: China Urban Construction Statistical Yearbook 2006-2015

For the economic dimension of urbanization, cities are also clustered into 2 groups regarding their Gross Regional Production (GRP), including the majority of 203 (71.2%) continuous growing cities and 82 (28.8%) cities with slowing-down economic growth. In Figure 5, we can see the phenomenon of the economic decline of some cities in UE2 with negative GRP growth since 2012.

As the central fiscal stimulus in 2008 to protect the domestic economy from the Western financial crisis has been depleted, year 2012 is often being regarded as the turning point of China's economy with average GRP growth rate fell from previous 15%-20% to 7% or less to enter the "new normal" (Jin, 2015).

UE1: Growth



UE2: Slow-Down

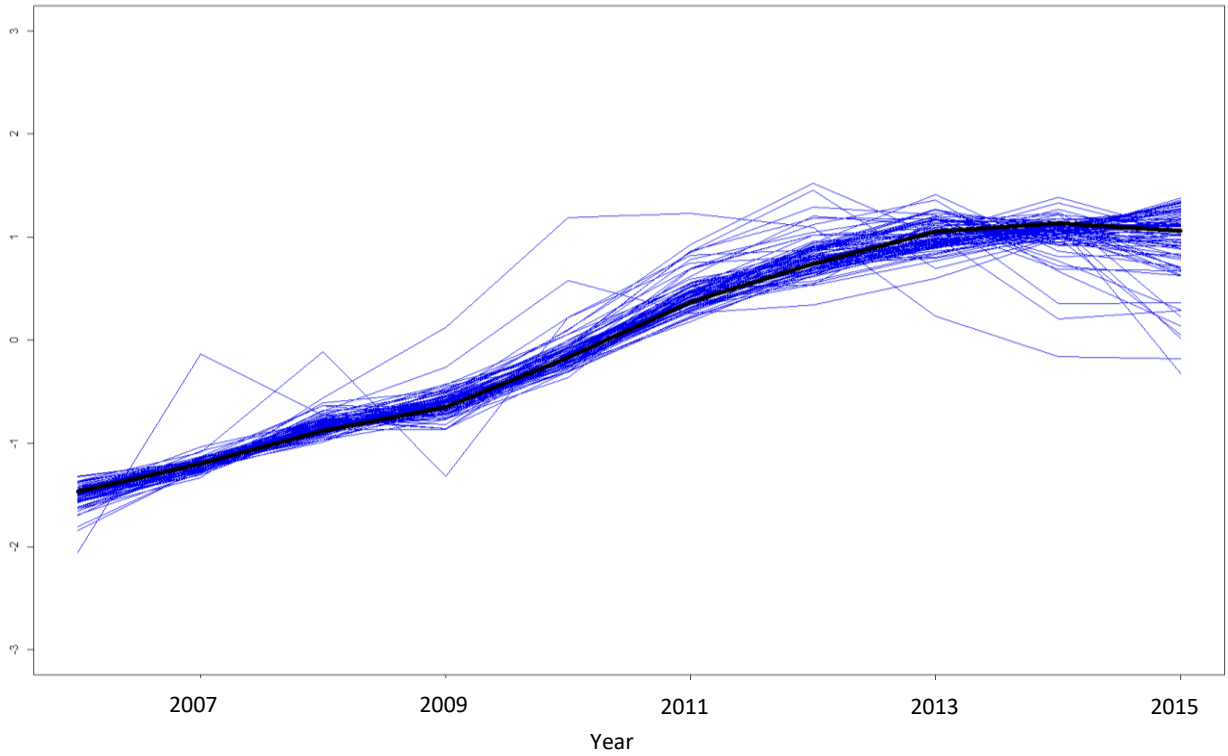


Figure 5 Dynamic Time Warping (DTW) Clustering Results of Gross Regional Production

Data Source: China City Statistical Yearbook 2007-2016

Figure 6 shows the spatial distributions of the shrinking and stagnant cities. The map on the left highlights the shrinking cities (UP3) in black and stagnant or recent shrinking cities in grey (UP4). For the 36 shrinking and stabilized shrinking cities (UP3): 11 of them have clustered in the northeastern region (the old industrial region or the "Rust Belt" in China); 13 are found in the southeastern coast; 8 come from western China; and 4 are in central China that 3 are in Middle Yellow River region and 1 is in the Middle Yangtze River region.

In the cluster (UP4) for the 61 cities with stagnant or recent shrinking urban populations: 11 are from the northeast; 17 are located in western China; only 5 cities are on the southeastern coast; 11 are found in the northern coast; and 17 are in central China that 10 are from the Middle

Yellow River region and 7 are from the Middle Yangtze River region. In addition, the northeast and the northwest are two regions that are disproportionately losing urban populations. There are 64.7% of cities in the northeast and 45.2% of cities in the northwest experiencing either urban population shrinkage or stagnant urban population growth in recent years.

The right map in Figure 6 shows the locations of cities with slowing-down or recent negative economic growth (UE2) in black cities to contrast with cities in a continuous growing economy (UE1) in hollow. The distribution of the economic slowing-down cities is very uneven that most are clustered in the northern China: 30 of them are in the northeast; 21 are from the Middle Yellow River region; 11 are found in the northwest; and 10 are located in northern coast, which accounts 87.8% of UE2.

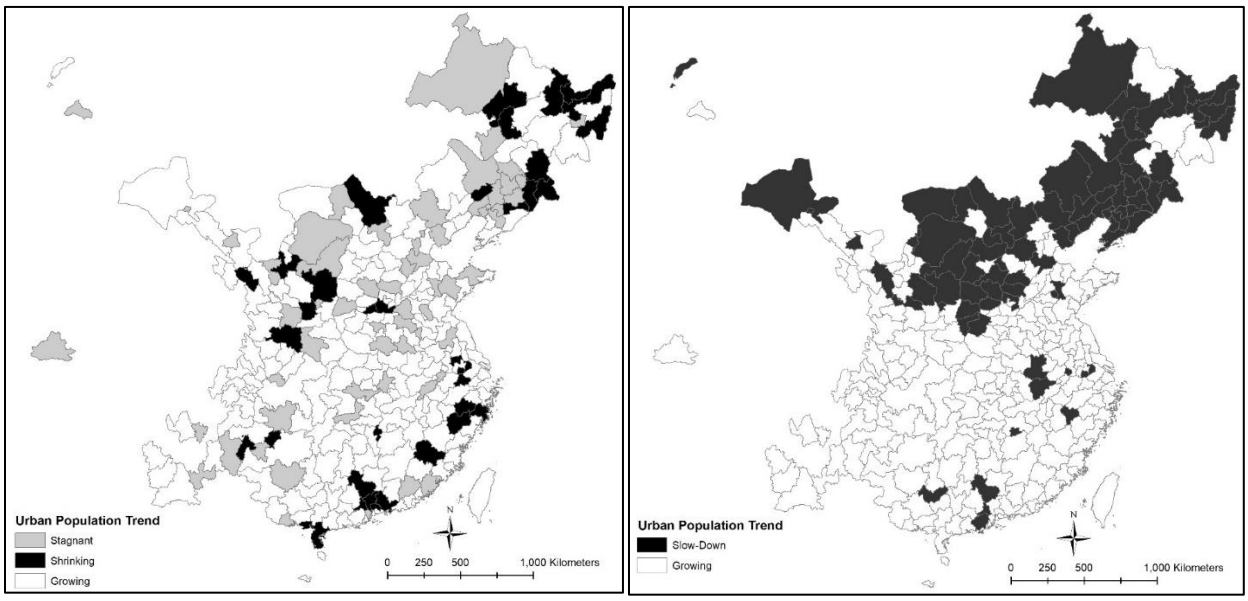


Figure 6 DTW Clustering Results of Urban Population (Left) Gross Regional Production (Right)

Data Source: China Urban Construction Statistical Yearbook 2006- 2015; China City Statistical Yearbook 2007-2016

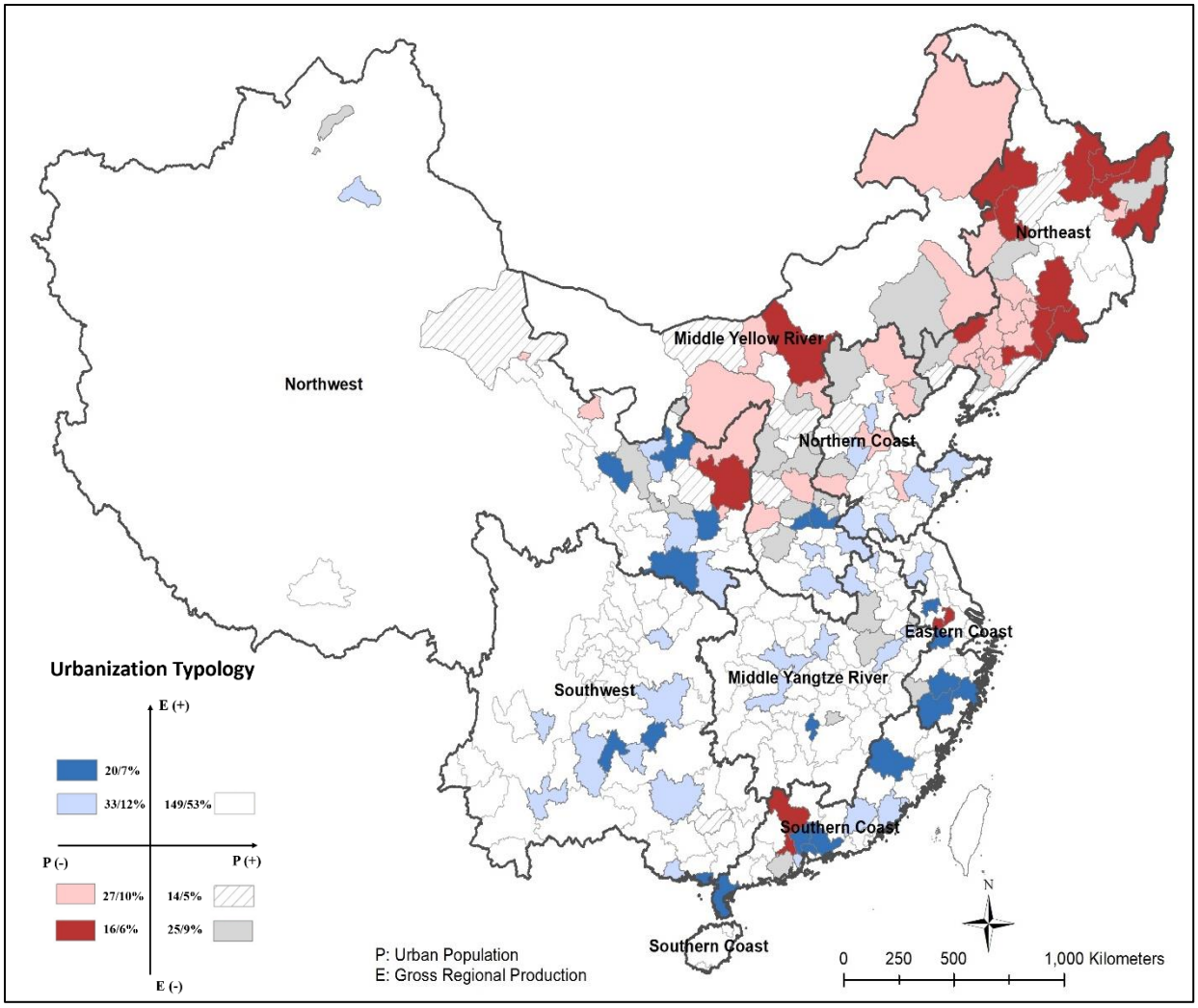
Moreover, the proportions of slowing-down or recent declining cities in these 4 northern regions are also very high that 88.2% of the northeast, 56.8% of the Middle Yellow River region, 36.7% of the northwest, and 33.3% of the northern coast are suffering from recent stagnant economic growth and downturns. Other slowing-down cities are found in the Middle Yangtze River (4 cities), the eastern coast (2 cities), the southwest (1 city), and the southern coast (3 cities).

Urbanization Typology

If we intersect the clustering results of urban trends in a two-dimensional table of urban population and GRP, there are 8 categories of urban trajectories from 2006 to 2015 in Figure 7.

Most cities have experienced both continuous urban population growth and economic growth (UPE1 = 100, 35.2%) or recent urban population growth and continuous economic growth (UPE2 = 49, 17.4%), which are represented in hollow polygons as a reference category. Cities with urban population growth and slowing-down economies are colored in grey (UPE5 = 25, 8.8%) and grey hatch (UPE6=14, 4.9%). They are concentrated in northern China, especially in the Middle Yellow River region and the northern coast, and parts of the northeast and northwest.

Urban population shrinkage cities are captured by the cities in colors. Cities in dark blue (UPE3 = 20, 7.0%) have their urban population shrinking in the first half of the study period and stay relatively stabilized in the second half while the economy is continuously growing. They show up on the southeastern coast and the northwest. The light blue highlights cities (UPE4 = 33, 11.6%) with recent stagnant or negative urban population growth and continuous economic growth. They are distributed mostly in south-central China (Middle Yangtze River region), the southwest and parts of the northern coast.



Economy/Population	UP1 (Continuous Growing)	UP2 (Recent Growing)	UP3 (Shrinking)	UP4 (Stagnant)	**Total**
UE1 (Growing)	UPE1 = 100 (35.2%)	UPE2 = 49 (17.4%)	UPE3 = 20 (7.0%)	UPE4 = 33 (11.6%)	202 (71.1%)
UE2 (Slow-Down)	UPE5 = 25 (8.8%)	UPE6 = 14 (4.9%)	UPE7 = 16 (5.6%)	UPE8 = 27 (9.5%)	82 (28.9%)
Total	125 (44.0%)	63 (22.2%)	36 (12.7%)	60 (21.1%)	284

Figure 7 A Two-Dimensional Urbanization Typology of Chinese Cities

Data Source: China Statistical Yearbook 2007-2016

The worst scenario happens in cities colored by red (UPE7 = 16, 5.6%) that have lost urban populations and experienced stagnant or declined economies in recent years. There are 11 of them in the northeast and concentrated along the northeastern country border. Cities in pink (UPE8 = 27, 9.5%) are featured with stagnant or declining urban population and slowing-down economic growth in recent 5 years. They have a very similar spatial pattern as UPE7, and cluster in the northeast and distribute across other northern regions of the northern coast, Middle Yellow River, and the northwest.

The Multinomial Logistic Regression on Urbanization Typologies in China

To explore the factors that may affect urban trajectories, we run a multinomial logistic regression. The growth categories UPE1 and UPE2 are combined as the reference group. UPE5 and UPE6 are also combined since they both experience urban population growth and recent slowing down economy. Please see the formulas (3) to (7) below for models. In total, there are 6 categories for the dependent variable of typologies. All the independent variables are calculated for modeling purposes as the 10-year average from 2006 to 2015.

$$Ln\frac{\Pr(Yi=UPE3)}{\Pr(Yi=UPE1\&UPE2)} = \beta 1 \cdot Xi \quad (3)$$

$$Ln\frac{\Pr(Yi=UPE4)}{\Pr(Yi=UPE1\&UPE2)} = \beta 2 \cdot Xi \quad (4)$$

$$Ln\frac{\Pr(Yi=UPE5\&UPE6)}{\Pr(Yi=UPE1\&UPE2)} = \beta 3 \cdot Xi \quad (5)$$

$$Ln\frac{\Pr(Yi=UPE7)}{\Pr(Yi=UPE1\&UPE2)} = \beta 4 \cdot Xi \quad (6)$$

$$Ln\frac{\Pr(Yi=UPE8)}{\Pr(Yi=UPE1\&UPE2)} = \beta 5 \cdot Xi \quad (7)$$

where $\beta 1, \beta 2, \beta 3, \beta 4, \beta 5$ are the coefficients of model results for each typology, Xi is the independent variables for city i, which includes the following variables.

State Spatial Selectivity

State rescaling is measured by state funds to capture the effects of intergovernmental transfers on urban construction, maintenance and investment. The two types of funds included in the model are state funds for urban maintenance and state funds for urban investment. State fund for maintenance is allocated for the purpose to support local capacity in maintaining urban facilities and services while state fund for investment is to encourage local fixed assets investment. The former focuses on the spending responsibilities for current items of urban services, which are strongly linked with urbanization for people. Fixed assets investment is popular in China's urbanization since it can bring about the expansion of physical structure of cities, which not only boosts economic growth via investment but also is a more visible achievement of local officials. To reflect the "selectivity" or "favor" of the state from rescaling, these two funds are calculated as the percentage in urban finance at local level. They can either play a redistributive role to be given to cities in need or function as a complement to privilege places in capacity to promote more competitions.

In Table 1, state funds for urban maintenance are higher in UPE1&2, UPE5&6 and UPE7. From Figure 6, we know that UPE1 and UPE2 are growth categories, UPE5 and UPE6 are economic stagnant groups, and UPE7 suffers declines in both population and economy. This indicates a very divergent spatial logic of state funds for urban maintenance to be both capacity-privileging and redistributive. However, such redistributive functions are not found in other shrinking groups, as cities in UPE3, UPE4 and UPE8 tend to have smaller shares (around 1.8%, 2.0% and 2.8%) of such funds in their urban finance sources. State funds for urban investment are

more evenly distributed across these urban typologies at 12% on average except for UPE4. The share of state funds in urban investment is 16.9% for cities with population growth and recent stagnant or declined economy.

Another measure for state rescaling is the state designated special zones before 2015. These state-level zones include: Economic and Technological Development Zone, High-tech Industrial Development Zone, Bonded Area, Boarder Economic Cooperation Zone, Export Processing Zone, Comprehensive Bonded Zone, and Bonded Port Area. Table 1 shows cities in the growth categories in UPE1 and UPE2 have 2.2 zones on average while localities in UPE4 with recent stagnant or declined economies can only have 0.95 zones per city. In general, cities with slowing-down economy in UPE5, UPE6, UPE7 and UPE8 are likely to have fewer zones than cities in the economic growth trajectories.

Local Response

I am also interested in the diversity of local responses to state rescaling in China's context. Since not every locality gets selected by the state for funds or special zones, cities are expected to respond with various local development policies and their own urban finance sources, such as increasing debt, competing for foreign investment, and leasing more state-owned urban land, which may affect urban trajectories. These local resources can also reflect if a city is favored by the market regardless of being selected by state. All the local resource variables are normalized by the local economy (GRP).

First, the government loan for urban constructions and fixed assets investment is included. It, to some extent, explains the source of economic growth in the scenario of population shrinkage for UPE3 and UPE4 since the percentages are higher in these two typologies. Even if cities in these two groups have experienced population shrinkage or recent urban population stagnancy, debt is

still sustaining the economic growth. Foreign direct investment is higher in the referent growth category and doesn't vary much across the rest of the shrinking typologies. Land lease revenue is a good indicator to capture the preference of the market for these cities that is higher in groups with continuous economic growth. This means cities in UPE1, UPE2, UPE3 and UPE4 are more likely to lease their land for more revenues compared to those cites in recent economic stagnancy and decline. In other words, more land revenues are very critical in China's local economic development. However, localities may pursue such land effort regardless of the leasing price. For example, cities in UPE8 lease the most land in terms of the administrative area even though they can hardly capture the economic benefits by receiving high land revenues. This inefficient land activity is also found in UPE5 and UPE6. By contrast, cities in the growth categories, UPE1 and UPE2, are pursuing land-based urban model more efficiently with smaller share of land lease area to the total urban area and higher land revenues share in the local economy. In addition, cities in population shrinking contexts, such as UPE3, UPE4, and UPE8, are also leasing relative more lands, which may cause that land urbanization to outpace the population urbanization and result in "ghost cities" phenomenon.

Neighboring Effects

I also consider the neighboring effects on the population and economic changes of targeted cities. The effect could be a gravitational pulling or competition from neighbors to result in population and economic loss if the neighboring cities have more attraction in people, capital and business. Cities may also benefit from the spillover effects of neighbors' population and economic growth. Therefore, I expect the spatial diversity of neighboring effects across different typologies.

I have developed a variable that measures if a city is a neighbor of a high-level city. A high-level city refers to state-designated municipalities directly under the Central Government, the

provincial capital, sub-provincial city and a city under separate state planning. This study employs contiguity-based (Queen) spatial weight matrix to generate the proximity information of cities to these high-level cities. Compared to the referent growth category, shrinking localities are associated with a higher percentage (around 50%-55%) to be neighboring high-level cities, especially for UPE3 (shrinking population and growing economy) to have 65% of its cities near the high-level cities. In addition, two spatial lag terms on weighted neighboring urban population changes and economic (GRP) changes are calculated using the same contiguity-based (Queen) spatial weight matrix to explore if neighboring population and economic growth will pull the people and economic activities of the targeted city or reversely provide spillover effects to benefit the city's urban population and economic growth.

Economic Structure

Following the deindustrialization theory on urban shrinkage, our model includes the economic structure measures that may cause shrinking. The percentages of employment in the primary sector, mining sector, and the manufacturing sector are calculated to capture resource-based and industrialized cities. According to Table 1, the shares of mining employment are higher in UPE5, UPE6, UPE7 and UPE8 (more than 10%) that are experiencing economic stagnation and decline after 2010. The share of manufacturing jobs seems not to differentiate much across typologies (around 25%) but generally, the percentage is higher in economic growth categories of cities. The primary sector contains jobs on farming, forestry, animal husbandry, sideline production and fishery, which is very high (around 11%) in UPE7. These natural resource cities have experienced shrinking urban population and recent stagnant or declined economy.

Table 1 Descriptive Statistics of Independent Variables, Chinese Prefectural Cities 2006-2015

	UPE1 & 2	UPE3	UPE4	UPE5 & 6	UPE7	UPE8
State Spatial Selectivity						
State Fund for Urban Maintenance% [a]	3.783 (6.101)	1.757 (2.283)	2.006 (2.382)	4.055 (4.841)	7.111 (6.380)	2.815 (3.688)
State Fund for Urban Investment% [a]	12.255 (9.464)	11.634 (8.860)	16.895 (11.647)	11.266 (7.354)	13.490 (9.257)	11.200 (8.737)
State Designated Special Zones [b]	2.195 (3.110)	2.000 (2.000)	1.545 (1.622)	0.949 (1.255)	1.000 (1.506)	1.074 (1.238)
Neighboring Effects						
If Neighboring High-Level City [c]	0.349 (0.478)	0.650 (0.489)	0.545 (0.506)	0.513 (0.506)	0.563 (0.512)	0.519 (0.509)
Neighboring Urban Population Change% [a]	3.057 (2.143)	3.209 (2.054)	3.131 (1.596)	1.933 (1.264)	0.820 (1.308)	1.475 (1.392)
Neighboring GRP Change% [d]	14.170 (2.876)	14.127 (1.983)	14.089 (3.053)	13.234 (3.052)	13.511 (1.613)	13.526 (1.455)
Local Response to Rescaling						
Government Loan% [a]	0.489 (0.633)	1.040 (1.990)	0.522 (0.915)	0.288 (0.346)	0.152 (0.186)	0.383 (0.541)
Foreign Direct Investment% [b]	2.156 (1.748)	1.877 (1.796)	1.666 (1.523)	1.836 (2.040)	1.646 (0.877)	1.659 (1.544)
Land Lease Revenue% [e]	4.632 (2.662)	4.563 (2.343)	4.788 (2.932)	3.379 (2.152)	2.385 (1.645)	2.892 (1.675)
Land Lease Area% [e]	0.734 (0.721)	1.038 (1.556)	0.864 (1.168)	0.895 (1.439)	0.460 (0.498)	1.105 (1.965)
Economic Structure						
Employment in Mining% [b]	3.352 (5.936)	3.958 (7.697)	4.948 (9.522)	11.495 (12.707)	10.393 (11.869)	11.704 (13.091)
Employment in Manufacturing% [b]	26.075 (12.802)	30.228 (13.171)	25.517 (13.806)	21.024 (11.898)	22.672 (16.659)	22.837 (14.529)
Employment in Primary Sector% [b]	2.396 (4.813)	1.408 (1.794)	1.912 (2.664)	3.001 (4.720)	10.897 (15.019)	6.252 (9.971)
Control						
Natural Population Growth Rate% [b]	6.777 (4.038)	6.791 (3.557)	7.274 (4.557)	5.425 (3.283)	2.001 (3.102)	4.166 (4.099)

UPE1&2 (N =149): Growth in Urban Population and Economy;
UPE3 (N = 20): Shrinking Urban Population and Growth in Economy;
UPE4 (N = 33): Recent Stagnant/Shrinking Urban Population and Growth in Economy;
UPE5 & 6 (N = 39): Growth in Urban Population and Recent Stagnant/Declined Economy;
UPE7 (N = 16): Shrinking Urban Population and Recent Stagnant/Decline Economy
UPE8 (N = 27): Recent Stagnant/Declined Urban Population and Economy
Table shows the Mean Values (Standard Deviations);
a: China Urban Construction Yearbook 2006-2015 b: Ministry of Commerce of the People's Republic of China; c: National Development and Reform Commission; d: China City Statistical Yearbook; 2007-2016; e: China Land and Resource Statistical Yearbook 2006-2015

Control

Lastly, we control the model with the natural population growth rate. From Table 1, we can see the lowest natural growth rate in UPE7 that also has the highest share of employment in the primary sector. Moreover, the natural population growth rates are generally higher in cities

with economic growth (UPE1, UPE2, UPE3, and UPE4) compared to the cities with the slow-down economy (UPE5, UPE6, UPE7 and UPE8).

Model Results

Table 2 shows the multinomial logistical regression model results on urbanization typologies by choosing combined UPE1 and UPE2 as the base category. The following section will discuss the results for each urbanization trajectory to explain what factors affect shrinkage across typologies. The results are discussed by comparing each category with the reference group of both the growing population and economy.

<u>UPE3 – Shrinking Cities with Debt-Supported Fixed Assets Economies</u>

Three factors are identified to significantly affect the probability of cities being in UPE3 – Urban Population Shrinkage and Continuous Economic Growth. First, cities in this category are not supported by state fund for the urban maintenance purpose. In other words, the increase of state fund for urban maintenance can reduce the likelihood (0.776<1) of losing urban population for these cities. This may be explained by the improvement of urban facilities and service through more state support on maintenance function in urbanization that can keep and attract more population. When a city is a neighbor with a high-level city, the gravitational pulling effect by the neighboring high-level city can increase the relative risk (5.834) of targeted cities to incur urban population shrinkage. The government loan for fixed assets investment reveals why cities in this category can still have continuous economic growth despite their shrinking population. These cities tend to have a higher government loan for fixed assets investment to sustain their economic growth.

In general, UPE3 typology captures cities that are not spatially supported by the state for urban maintenance purpose on facilities and services. They are more likely to be the neighbors of state-selected high-level cities and thus their urban population is pulled. They rely more on government debt to sustain economic growth via fixed assets investment. This urban shell growth only may result in "ghost city" problems. These cities are in the southeast coastal regions and the northwest. For examples, Jinhua and Huzhou in Zhejiang Province, Jiaozuo in Henan Province, and Hanzhong in Shaanxi Province are cities in this case.

UPE4 – Recent Stagnant Cities with State and Debt Supported Fixed Assets Economies

Table 2 shows a very similar model result for cities in UPE4 - Recent Stagnant or Shrinking Urban Population and Continuous Economic Growth. Similarly, the recent stagnant or shrinking urban population can be explained by the lower support of state fund in urban maintenance and being proximity to the state-selected high-level cities. Specifically, urban maintenance fund share can reduce the relative risk (to 0.838) of being in this shrinking category; the neighbor pulling effect can increase the likelihood (to 2.531) of having recent stagnant or shrinking urban population trend.

This type of shrinking city is also featured with higher government loan for fixed assets investment that holds the local economic growth in a shrinking population context. In addition, the economic growth of these cities is also supported by higher state fund for fixed assets investment. The more reliance on urban investment funds from the state, the more likely cities have a stagnant urban population in recent years. Thus, in contrast to the impacts of state fund for maintenance, such a state fund for investment is a function of fixed assets development instead of sustaining urban population growth.

Table 2 Multinomial Logistical Regressions on Urbanization Typologies in China

Variables/Urbanization Typology	UPE3			UPE4			UPE5 & UPE6			UPE7			UPE8		
	Coef.	RRR		Coef.	RRR		Coef.	RRR		Coef.	RRR		Coef.	RRR	
State Spatial Selectivity															
State Fund for Urban Maintenance% [a]	-0.253	0.776	*	-0.177	0.838	*	-0.010	0.990		-0.015	0.985		-0.172	0.842	*
State Fund for Urban Investment% [a]	0.019	1.019		0.060	1.061	**	-0.040	0.960		-0.024	0.977		-0.025	0.975	
State Designated Special Zones [b]	-0.098	0.907		-0.155	0.856		-0.447	0.640	*	-0.165	0.848		-0.424	0.655	
Neighboring Effects															
If Neighboring High-Level City [c]	1.764	5.834	**	0.929	2.531	*	0.549	1.732		1.004	2.729		0.487	1.628	
Neighboring Urban Population Change% [a]	0.098	1.102		0.023	1.024		-0.303	0.739	*	-0.818	0.441	**	-0.635	0.530	**
Neighboring GRP Change% [d]	0.061	1.063		0.013	1.013		-0.110	0.896		0.232	1.261		0.098	1.103	
Local Response to Rescaling															
Government Loan% [a]	1.023	2.782	***	0.683	1.981	*	-0.372	0.689		-2.275	0.103		0.739	2.095	
Foreign Direct Investment% [b]	-2.559	0.077		-2.219	0.109		2.196	8.993		2.411	11.146		0.294	1.342	
Land Lease Revenue% [e]	0.072	1.074		0.149	1.160		-0.238	0.788	*	-0.620	0.538		-0.560	0.571	**
Land Lease Area% [e]	0.204	1.227		0.110	1.116		0.350	1.419		-0.081	0.922		0.573	1.773	**
Economic Structure															
Employment in Mining% [b]	0.038	1.039		0.040	1.040		0.069	1.071	**	0.077	1.080	*	0.093	1.097	**
Employment in Manufacturing% [b]	0.044	1.045		0.023	1.023		-0.018	0.983		0.051	1.052		0.033	1.034	
Employment in Primary Sector% [b]	-0.112	0.894		-0.046	0.955		-0.033	0.967		0.029	1.030	*	0.036	1.037	
Control															
Natural Population Growth Rate% [b]	0.050	1.051		0.055	1.056		-0.160	0.852	*	-0.422	0.655	**	-0.289	0.749	***

** p<0.05; ** p<0.01; *** p<0.001; N = 284 for all prefecture-level cities with available data. Log likelihood = -298.95*

The model picks UPE1 and UPE2 with growth in both urban population and economy as base category to calculate the odds of other urbanization typologies relative to it that is the probability of a city being in certain typology relative to the base category. For each column (typology), the results include direct coefficients (Coef.), calculated relative risk ratios (RRR) and significance levels. UPE6 are combined as one typology with urban population growth and recent economic stagnant or decline.

Relative Risk Ratio = $\frac{\Pr(y=1|x+1)/\Pr(y=base|x+1)}{\Pr(y=1|x)/\Pr(y=base|x)}$ *captures the increased odds of cities being in different typologies when x increases by 1 unit. If RRR>1, it indicates cities in the comparison typology relative to the risk of falling in the referent typology (UPE1 and UPE2) increases as x increases while when RRR<1, the risk of falling in the comparison typology relative to the risk of falling in the base typology decreases as x increases. In general, if the RRR < 1, the outcome is more likely to be in the base group.*

a: China Urban Construction Yearbook 2006-2015; b: Ministry of Commerce of the People's Republic of China; c: National Development and Reform Commission; d: China City Statistical Yearbook 2007-2016; e: China Land and Resource Statistical Yearbook 2006-2015

Cities in this category have very similar features as cities in UPE3 that get lower state support for urban maintenance, are near the high-level cities and have more debt-driven economies via fixed assets investment. In addition, cities in UPE4 receive higher urban investment funds from the state, which however has not generated a continuous population growth path but only a growth of fixed assets of physical structure. Examples of cities in UPE4 are Langfang in Hebei Province, Wuhu in Anhui Province, Weifang and Yantai in Shandong Province etc.

UPE5 and UPE6 – Mining Cities with Lower Economic Competitiveness and State Support

For cities in UPE5 and UPE6, they are different from the reference group in the economic dimension because they experience recent slowing-down or even declining economies. First, cities in this category are featured with fewer state designated special zones. The lack of being economic development support from state undermines local economic growth. The increase of state designated special zones will reduce the likelihood of cities to suffer from recent slowing-down or declined economy. These cities also have more share of employment in the mining sector and lower natural growth rate. Thus, the urban population growth is more driven by the mining jobs and this mining-based growth is hard to attract state selectivity in terms of rescaling special development zones. Moreover, these growing mining cities are also not favored by the market that can be reflected by lower revenues from land leasing to developers, which is the core source of urban finance and development for local governments in China. Regionally, cities can benefit from neighboring urban population growth while the competitive core-peripheries dynamics is not the case for these cities regarding their geographic locations.

Cities in UPE5 and UPE6 are mining-based cities, which are not attractive to get selected by the state through designated special zones and not favored by the market and thus have lower land revenues to invest for economic growth. Therefore, although the urban population grows (for

mining jobs), the economy is slowing down. Cities such as Jincheng, Lvliang and Yangquan in Shanxi Province, Chifeng in Inner Mongolia, Xingtai in Hebei Province, Shuangyasha in Heilongjiang Province, Yingkou and Dandong in Liaoning Province, and Kelamayi in Xinjiang Province are in this case.

UPE7 – The Resource-Depleted Border Cities

Compared with the reference growth typology, urban trajectories in UPE7 are shrinking in both population and economic dimensions. Cities in this category are correlated with a higher share in mining and primary sectors, including farming, forestry, animal husbandry, sideline production and fishery, indicating local economies are less developed and resource based. The natural growth rate of the population is also very low in these cities. The positive coefficient of neighboring urban population growth shows it can generate positive spillover effects to reduce shrinkage of these cities, however, most the cities are shrinking in clusters. Both the indicators of state support and market attractiveness are not significant in this category, which suggest these cities are left behind by state and market for development interests.

These cities are resource-depleted mining cities with both population shrinkage and recent economic decline and stagnancy. Most of them are in the border regions of the northeast, mainly in Heilongjiang Province (Figure 6) and have a relative higher share in primary sectors (Table 1). The cities are not only surrounded by lower growth cities but also suffer the lower natural population growth rate. Examples are Wulanchanbu in Inner Mongolia, Baishan in Jilin Province, Benxi and Fuxin in Liaoning Province, Yichun, Jixi, Daqing Qiqihaer and Hegang in Heilongjiang Province.

UPE8 – Shrinking Mining Cities with Cheap Land Leases

Cities in UPE8 experience shrinkage in urban population and economy in recent years (2010-2015). They share common features of higher mining share and lower natural population growth rate with cites in UPE5, UPE6 and UPE7. The neighboring urban population change can also reduce the likelihood of being in this category but cities in this trajectory are found in shrinking clusters mainly in northern China. Cities in this category are also not supported by state funds for urban maintenance, which is important to reduce the risk (0.842) of losing population and experience declined economies for these cities.

The interesting difference between cities in UPE8 is their land lease activities. Although cities cannot capture the economic benefits by leasing land at a higher price to obtain higher land revenues to support economic growth, they still try to lease more land cheaply. This rapid land urbanization in population shrinking context may further result in the phenomenon of "ghost cities". From the results, lower land revenues and more leased land areas are associated with this category and a higher risk of experiencing recent stagnant or shrinkage in urban population and economy. This suggests the land-based urbanization model is not sustainable for mining cities with lower natural population growth rate, lower share in state assistance of urban maintenance (Table 1), and located in lower growth and economically attractive regions, of the northeast and the central north.

Cities in this scenario include Ordos and Baotou in Inner Mongolia, Datong and Changzhi in Shanxi Province, Handan, Tangshan and Cangzhou in Hebei Province, Qitaihe in Heilongjiang Province, Baicheng and Liaoyuan in Jilin Province, Panjin, Jinzhou, Fushun and Anshan in Liaoning Province, and Jichang in Gansu Province etc.

Conclusion

This paper has measured urban growth and shrinkage in Chin and uncover regional differences of urban changes from a non-geographic model. It innovatively applies Dynamic Time Warping (DTW) time-series clustering technique and identifies four different trajectories of urban population change (continuous growth, recent growth, stabilized shrinking, and recent stagnant or shrinking), and two trajectories of economic change (continuous growth and recent slow-down or decline) for all municipalities in China from 2006 to 2015. Then, the two-dimensional trajectories matrix is created to show the geographies of shrinkage typologies. The multinomial logistic regression models further explore different factors of state spatial selectivity, local responses to rescaling, neighboring effects and economic restructuring to affect shrinkage across typologies. The results are summarized in Figure 8 and Table 3.

We see clearly different mechanisms of shrinking cities, which is generally south-north division. In more developed southern regions (UPE3 and UPE4), such as the southeastern coastal region and the central-south region (the Middle Yangtze River), population shrinking can be attributed into two sources. First, these cities are neighboring the state-selected high-level cities, which has the gravitational pulling effects of the population from these surrounding cities. Second, the out-migration is exacerbated by the lack of support of state on the urban maintenance function in these cities. People would migrate to cities with better urban facilities and services, especially when those cities are neighbors. However, these shrinking cities still sustain their economic growth through more fixed assets investment. Higher local government loan and state fund for fixed assets investment is found in these cities. Although economic growth is sustained in a shrinking context via debt and state-supported fixed assets investment, it is a growth of urban shell and fixed assets

rather than the outcomes of real urbanization in population. The imbalanced growth in physical structure overpopulation may generate “ghost cities” problems.

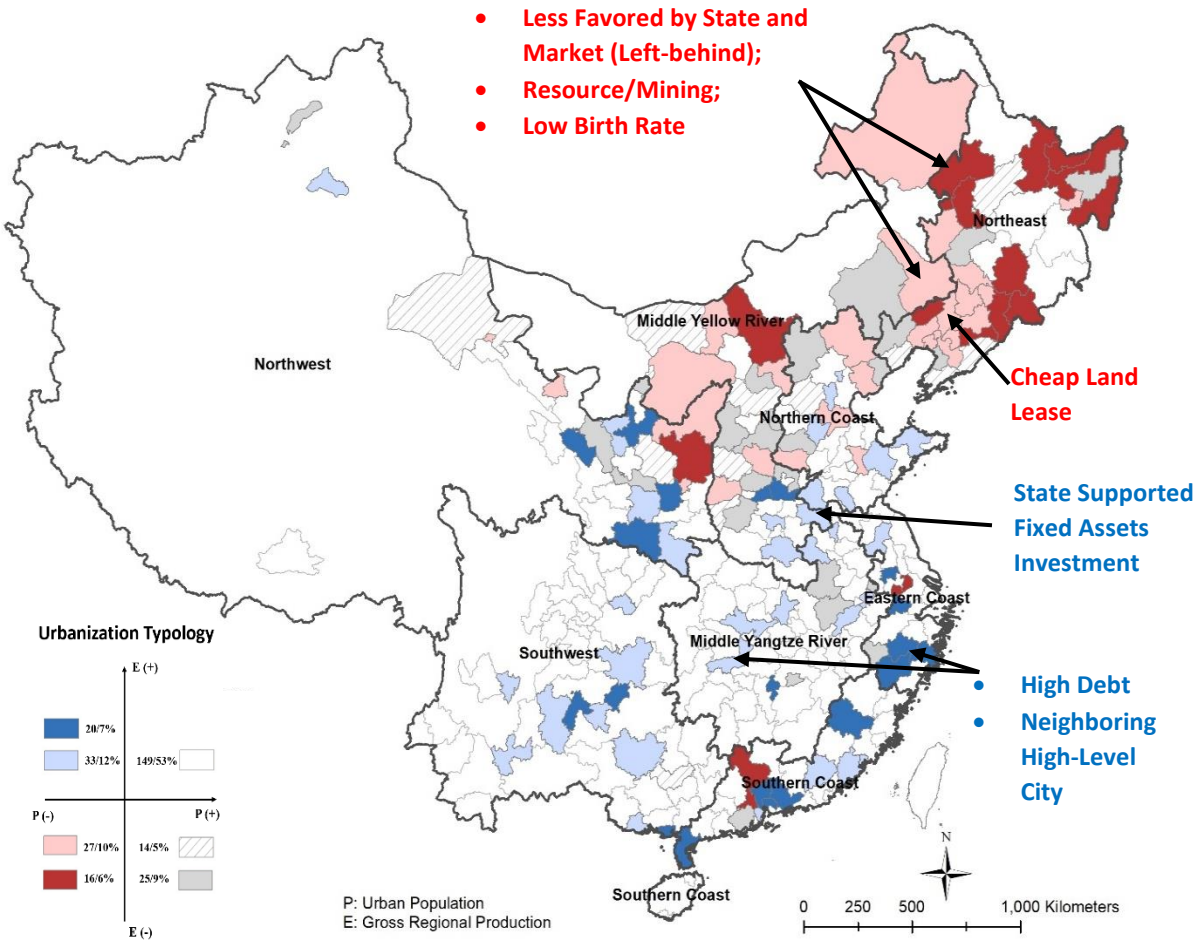


Figure 8 Diverse Mechanisms of Shrinking Cities in China

Data Source: China Statistical Yearbook 2007-2016; China Urban Construction Yearbook 2006-2015; China Land and Resource Statistical Yearbook 2006-2015

In the less developed northern regions, we found population shrinking is accompanied with recent economic slowing-down and declined. These cities are concentrated in the central-north China (Middle Yellow River region) and the northeast. The shrinkage and decline are mainly blamed to their local economic structure on mining (UPE5 and UPE6) and resource-based sectors

Table 3 Diverse Mechanisms of Shrinking Cities in China

	State Policy	Local Policy and Economy	Geography and Region	Development Trajectories
UPE3	Not supported by state fund for urban maintenance on facilities and services	High government debt for fixed assets investment	Neighboring state-selected high-level cities; majorly in developed southeastern coastal regions, and some are in northwest	Shrinking cities with economic growth (urban shell) via debt-supported fixed assets investment
UPE4	Not supported by state fund for urban maintenance; supported by state fund for fixed assets investment	High government debt for fixed assets investment	Neighboring state-selected high-level cities; majorly in the south-central China, (the Middle Yangtze River region) and part of northern coast	Recent stagnant or shrinking cities with economic growth (urban shell) via debt- and state-supported fixed assets investment
UPE5 **UPE6**	Not selected by state for development priority via special zones	Mining cities; low revenues of land leasing to invest for growth	Economic decline in clusters; concentrated in the north-central China (the Middle Yellow River region) and parts of northeast and northwest	Population growth possibly driven by mining jobs; slowing-down or declining economies with lack of economic competitiveness and attractiveness to state
UPE7	Not significant	Resource cities in mining and primary sectors; local policy is not significant	Shrinking in clusters; concentrated in the border region of the northeast	Less developed cities in border region, experiencing shrinking in both population and economy
UPE8	Not supported by state fund for urban maintenance	Mining cities; largely lease land but with low revenues	Shrinking in clusters; Concentrated in the northeast and distribute across other northern regions of the northern coast, the Middle Yellow River, and the northwest	Recent shrinking mining cities in both population and economy; Potential ghost cities with cheap and fast land leases

(UPE7). In contrast to the competitive neighboring dynamic, these cities can benefit from the neighboring growth, but they tend to show up in shrinking clusters. In general, cities in this mechanism have lower economic competitiveness and attractiveness to not only people to stay or migrate but also to the state and market to invest. For example, these left-behind cities are not privileged by state-designated special zones for development (UPE5 and UPE6) as well as not supported by state in urban maintenance (UPE8). What's worse, they are not attractive to developers to lease or capitalize land for resources (UPE5, UPE6 and UPE8) in urban investment and finance. These explain the declining trend of local economies in these cities. When these left-behind cities have to rely on their own source, they may choose to lease more land at cheap prices for extra resources, which could also result in the oversupply issue of "ghost cities".

Discussion

This study contributes to the urban shrinkage field both theoretically and methodologically. It shows the asymmetric features of state rescaling with respect to its functional and territorial dimensions, and how these features connect to different development outcomes across regions.

First, the function of state policy matters. For example, state fund on urban maintenance and urban facilities and services can reduce the risk of cities losing population. The migration of people should be understood as a function of not only the economic opportunities but also the quality of urban facilities and services. The central state in China is mediating the population flows from the large cities, especially those in coastal regions, to the inland small and middle size cities. This will reduce the urban environment cost of living and maintaining those megacities (e.g., Beijing, Shanghai, Shenzhen, and Guangzhou etc.) However, the prevailing policy is to use hukou, the urban citizenship registration, or other state-imposed regulations (Mykhnenko and Li, 2018) as the limits to entering and evacuating migrant workers. These tools are not efficient and migrant

workers are still concentrated in those large cities. This study shows another policy tool to divert the population through more state support in urban facilities and service maintenance for those small and middle size cities.

State fund for fixed assets investment is linked with economic growth rather than population growth. It also stimulates more local effort in debt-finance to invest for fixed assets investment. In this sense, the growth is driven by investment in physical structure instead of real urbanization in population, which is not sustainable and as shown by UPE4 with recent shrinking in population and slow-down of economies. Local officials in China believe "If you build it, they will come," and they also want to exhibit development effort and higher economic growth rate to the central state to compete with peers. Therefore, state policy in this type needs to be careful to not encourage destructive economic competition through irrational land leases and increased local debt to finance fixed assets investment. It also needs to pay attention to the efficiency and sustainability of local fixed assets investment to not result in growth only in the urban shell and create the potential "ghost" problems. In this sense, the investment of fixed assets in Chinese cities does not address future maintenance costs with corresponding fiscal streams. This link, which is missing in China's urban model, is essential for growth machine.

Second, the territorial selectivity of state policy matters. State rescaling is not geographically even that some cities are selected by the state with more political and economic powers and resources, such as provincial capital, sub-provincial city and a city under separate state planning. For example, this study shows that recent economic declined mining cities are not as attractive as others to state to designate special development zones. These state-designated political and economic geographies are expected to generate spillover effects to those are not selected. This study shows the pulling effects of the population from the state-selected high-level cities in more

developed southern regions. In contrast to the competitive relationships, the spillover effect is positive in the less developed northern regions to make cities grow and shrink together. This spillover effect of state rescaling and its diversity across regions are lack of being addressed in the literature. Thus, state needs to consider the externalities under its asymmetric rescaling of territory. by balancing spatial development policies with more support of localities that are not growth privileged. This support may include the increase of maintenance fund on urban facilities and services based on the previous discussion that can offset the spillover effects for the population pulling.

In general, this paper improves on the development of trajectory typologies of urban growth and decline with time-series clustering, which enables the typology to be identified based on the pattern of urban processes rather than simple changes between time points. It also provides theoretical explanations on shrinking cities regarding dimensions of population and economy in China. The study emphasizes the essence of "state-led" in China's urban model and highlights the importance of being selected by the state, the spillover effects of state-designated economic geographies, local policy responses under rescaling, and industrial restructuring in explaining various typologies of urban growth and decline in China. It not only shows the importance of nuanced understanding and theories in urban shrinkage for developing context, but also provides implications in state rescaling policy in terms of its functional and territorial designs for balance between spatial development and planning, local efficiencies and reduction of regional disparities.

References

Aggarwal, C. C. & Reddy, C. K. (2013). Time-series data clustering. In Data Clustering: Algorithms and Applications, chapter 15. CRC Press.

Aghabozorgi, S., Shirkhorshidi, A. S., Wah, T. Y. (2015). Time-series clustering - A decade review. *Information Systems*, 53: 16 -38. https://doi.org/10.1016/j.is.2015.04.007.

Beauregard, R. (2009). Urban population loss in historical perspective: United States, 1820–2000. *Environment and Planning A*, 41:514–528.

Berndt, D. J. & Clifford, J. (1994). Using Dynamic Time Warping to find patterns in time series. In KDD Workshop, 10: 359-370. Seattle, WA.

Berry, B.J. L. (1977). *Urbanization and Counter Urbanization*. London: Sage.

Birch, K. & Mykhnenko, V. (2009). Varieties of neoliberalism? Restructuring in large industrially-dependent regions across Western and Eastern Europe. *Journal of Economic Geography*, 9: 355–380.

Bontje, M. (2004). Facing the challenge of shrinking cities in East Germany: The case of Leipzig. *GeoJournal*, 61 (1): 13–23.

Booth, D. (1987) Regional long waves and urban policy. *Urban Studies*, 24 (6): 447–459.

Brenner, N. (2004) *New State Spaces: Urban Governance and the Rescaling of Statehood*. Oxford: Oxford University Press.

Brenner, N. (2009). Open questions on state rescaling. *Cambridge Journal of Regions, Economy and Society*, 2(1): 123–139.

Cartier, C. (2010). ‘Zone Fever’, the arable land debate, and real estate speculation: China’s evolving land use regime and its geographical contradictions. *The Journal of Contemporary China*, 10 (28): 445-469.

Castells, M. (2004). *The Network Society*. Cheltenham: Edward Edgar Publishing Ltd.

Chung, J. H. (1994). Beijing confronting the provinces: The 1994 tax-sharing reform and its implications for central-provincial relations in China. *China Information*, 9 (3): 1–23.

Cox, K. R. (2009). ‘Rescaling the state’ in question. Cambridge Journal of Regions, Economy and Society, 2 (1): 107–121.

Downs, A. (1997). The challenge of our declining big cities. *Housing Policy Debate*, 8 (2): 359–408.

Feng, X. (2013). Local government debt and municipal bonds in China: Problems and a framework of rules. *The Copenhagen Journal of Asian Studies*, 31: 23–53.

Giorgino, T. (2009). Computing and visualizing Dynamic Time Warping Alignments in R: The dtw package. *Journal of Statistical Software*, 31 (7): 1-24. https://doi.org/10.18637/jss.v031.i07.

Guo, G. (2009). China’s local political budget cycles. *American Journal of Political Science*, 53: 621–632.

Harvey, D. (1982). *The Limits to Capital*. Oxford: Blackwell.

Harvey D. (2006). *Spaces of Global Capitalism: Towards a Theory of Uneven Geographical Development.* London: Verso.

He, C., Zhou, Y. & Huang, Z. (2015). Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geography*, 37 (3): 436–457.

He, S. Y. (2014). When growth grinds to a halt: Population and economic development of resource-depleted cities in China. In H. W. Richardson, & C. W. Nam (Eds.), *Shrinking cities: A global perspective* (pp. 138–151). London, UK: Routledge.

He, S., Lee, J., Zhou, T. & Wu, D. (2017). Shrinking cities and resource-based economy: The economic restructuring in China's mining cities. *Cities*, 60: 75–83.

Hall, P. & Hay, D. (1980). *Growth Centres in the European Urban System*. London: Heinemann Educational.

Hartt, M. (2018). The diversity of North American shrinking cities. *Urban Studies*, 55 (13): 2946–2959.

Hill, E. W., Wolman, H. L., Kowalczyk, K. & St. Clair, T. (2012). Forces affecting city population growth or decline: the effects of interregional and inter-municipal competition. *Rebuilding America's Legacy Cities* (eds by Mallach, A.). Columbia University, New York: The American Assembly, pp 31–80.

Hollander, J. B., Pallagst, K., Schwarz, T. & Popper, F. (2009). Planning shrinking cities. *Progress in Planning*, 72 (4): 223–232.

Jackson, K. (1985). *Crabgrass Frontier: The Suburbanization of the United States*. New York, NY: Oxford University Press.

Jin, B. (2015). China's 'New normal': A milestone towards new thinking and innovation-driven growth. Chinese Economists, 10 (1), 1. Retrieved from https://www.chinausfocus.com/finance-economy/chinas-new-normal-a-milestone-towards-new-thinking-and-innovation-driven-growth

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, 99, 483–499.

Lesthaeghe, R. (1995). The second demographic transition in western countries: an interpretation. *Gender and Family Change in Industrialized Countries* (eds by Mason, K. O. & Jensen, A-M.). Oxford: Clarendon Press, pp 17–62.

Li, H., & Zhang, P. (2012). Main characteristics and driving factors of industry structure evolution in northeast China Since 1990. *Arid Land Geography*, 35: 829–837.

Li, H. & Zhou, L-A. (2005). Political turnover and economic performance: The incentive role of personnel control in China. *Journal of Public Economics*, 89: 1743–1762.

Liao, T. W. (2005). Clustering of time series data: A survey. *Pattern recognition*, 38 (11): 1857-1874.

Lichtenberg, E. & Ding, C. (2009). Local officials as land developers: Urban spatial expansion in China. *Journal of Urban Economics*, 66 (1): 57–64.

Lin, G. C. S. (2009). Scaling-up regional development in globalizing China: Local capital accumulation, land-centered politics, and reproduction of space. *Regional Studies*, 43 (3): 429–447.

Lin, G. C., Li, X., Yang, F. F. & Hu, Z. Y. (2014). Strategizing urbanism in the era of neoliberalization: State power reshuffling, land development and municipal finance in urbanizing China. *Urban Studies*, 52(11): 1962–1982.

Lin, G. C. S. & Yi, F. (2011). Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geography*, 32 (1): 50–79.

Lin, G. C. & Zhang, A. Y. (2014). Emerging spaces of neoliberal urbanism in China: Land commodification, municipal finance and local economic growth in prefecture-level cities. *Urban Studies*, 52 (15): 2774–2798.

Liu, T. & Lin, G. (2014). New geography of land commodification in Chinese cities: Uneven landscape of urban land development under market reforms and globalization. *Applied Geography*, 51: 118–130.

Long, Y. & Wu, K. (2016). Shrinking cities in rapidly urbanizing China. *Environment and Planning A*, 48 (2): 220–222.

Lowe, J. S. & Bates, L. K. (2013). Missing New Orleans: lessons from the cdc sector on vacancy, abandonment, and reconstructing the crescent city. *The City After Abandonment*

(eds by Dewar, M. & Thomas, J. M.). Philadelphia, PA: University of Pennsylvania Press, pp 151–173.

Lucy, W. & Philips, D. (2000). *Confronting Suburban Decline*. Washington, DC: Island Press.

Martinez-Fernandez, C., Audirac, I., Fol, S. & Cunningham-Sabot, E. (2012) Shrinking cities: Urban challenges of globalization. *International Journal of Urban and Regional Research*, 36 (2): 213–225.

Martinez-Fernandez, C., Weyman, T., Fol, S., Fol, S., Audirac, I., Cunningham-Sabot, E., Wiechmann, T. & Yahagi, H. (2015) Shrinking cities in Australia, Japan, Europe and the USA: From a global process to local policy responses. *Progress in Planning*, 105: 5–12.

Martinez-Fernandez, C. and T. Wu (2007) Urban development in a different reality: shrinking cities in Australia. *Berliner Debatte Initial*, 1: 45–60

Mykhnenko, V. & Li, H. (2018). Urban shrinkage with Chinese characteristics. *The Geographical Journal published by John Wiley & Sons Ltd on behalf of Royal Geographical Society (with the Institute of British Geographers)*, 184 (4):8, 398-412, DOI: 10.1111/geoj.12266

National Development and Reform Commission, PRC (2007). Revitalization Plan for the Northeast. Retrieved from http://www.gov.cn/gzdt/2007-08/20/content_721632.html

National Development and Reform Commission, PRC (2015). The introduction on the implementation of Northeast revitalization strategy. Retrieved from http://dbzxs.ndrc.gov.cn/dbzx/201509/t20150904_750086.html

Oswalt, P. (ed.) (2006). *Shrinking Cities*, Volume 1, International research. Hatje Cantz Verlag, Ostfildern, Germany.

Oswalt, P. & Rieniets, T. (eds). (2006). *Atlas of Shrinking Cities* (Hatje Cantz, Ostfildern).

Pallagst, K., Wiechmann, T. & Martinez-Fernandez, C. (eds) (2013). *Shrinking Cities: International Perspectives and Policy Implications*. New York: Routledge.

Pan, F., Zhang, F., Zhu, S. & Wojcik, D. (2017). Developing by borrowing? Inter-jurisdictional competition, land finance and local debt accumulation. *Urban Studies*, 54 (4): 897-916.

Peck, J. & Tickell, A. (1994) Searching for a new institutional fix: The after-Fordist crisis and the global-local disorder, in post-Fordism: A Reader (ed Amin A.), Blackwell Publishers Ltd, Oxford, UK.

Peck, J. & Zhang, J. (2013). A variety of capitalism with Chinese characteristics? *Journal of Economic Geography*, 13: 357–396.

Rani, S. & Sikka, G. (2012). Recent techniques of clustering of time series data: A survey. *International Journal of Computer Applications*, 52(15). https://doi.org/10.5120/8282-1278.

Ratanamahatana, C. A. & Keogh, E. (2004). Everything you know about dynamic time warping is wrong." In third workshop on mining temporal and sequential data. Citeseer.

Reckien, D. & Martinez-Fernandez, C. (2011). Why do cities shrink? *European Planning Studies*, 19: 1375–1397.

Rink, D., Haase, A, Grosmann, K., Couch, C. & Cocks, M. (2012). From long-term shrinkage to re-growth? The urban development trajectories of Liverpool and Leipzig. *Built Environment*, 38 (2): 162–178.

Rithmire, M. (2013). Land politics and local state capacities: the political economy of urban change in China. *The China Quarterly*, 216: 872–895.

Sarda-Espinosa, A. (2017). Comparing time-series clustering algorithms in R - Using the dtwclust package. *Available at https://cran.r-project.org/web/packages/dtwclust/vignettes/dtwclust.pdf*.

Sassen, S. (2001). *The Global City: New York, London, Tokyo*. 2nd edition. Princeton, NJ: Princeton University Press.

Schilling, J. & Mallach, A. (2012). Cities in transition: a guide for practicing planners. *Planning Advisory Service Report Number 568*, American Planning Association, Chicago, IL.

Schumpeter, J. A. (1939). *Business Cycles.* New York: McGraw-Hill.

Scott, A. J. (1988). *Metropolis: FromPa the Division of Labor to Urban Form*. Berkeley, CA: University of California Press.

Scott, A. (1998). *Regions and the World Economy: The Coming Shape of Global Production, Competition, and Political Orde*r. Oxford: Oxford University Press.

Scott, A. & Storper, M. (2003). Regions, globalization, development. *Regional Studies*, 37 (7): 579–593.

Storper, M. (1997). *The Regional World: Territorial Development in a Global Economy*. New York and London: Guilford Press.

Soja, E.W. (2000) *Postmetropolis: Critical Studies of Cities and Regions*. Oxford, UK: Blackwell Publishers.

Tao, R., Su, F., Liu M. & Cao, G. (2010). Land leasing and local public finance in China's regional development: Evidence from prefecture-level cities. *Urban Studies,* 47: 2217–2236.

Turok, I. & Mykhnenko, V. (2007). The trajectories of European cities, 1960–2005. *Cities*: *The International Journal of Urban Policy and Planning.* 24: 165–182.

van den Berg, L., Drewett, R. & Klaasen, L. (1982). *Urban Europe: A Study of Growth and Decline.* Oxford: Pergamon.

Tsui, K. Y. (2011). China's infrastructure investment boom and local debt crisis. *Eurasian Geography and Economics*, 52: 686–711.

Warner, M. E., & Pratt, J. E. (2005). Spatial Diversity in Local Government Revenue Effort Under Decentralization: A Neural-Network Approach. *Environment and Planning C, Government & Policy.*, *23*(5), 657-678.

Wei, Y. D. (2015). Zone fever, project fever: Development policy, economic transition and urban expansion in China. *Geographical Review,* 105 (2):156–177.

Wiechmann, T. (2008). Errors expected – Aligning urban strategy with demographic uncertainty in shrinking cities. *International Planning Studies*, 13 (4): 431–446.

Wiechmann, T. & Bontje, M. (2015). Responding to tough times: Policy and planning strategies in shrinking cities. *European Planning Studies*, 23 (1): 1–11.

Wiechmann, T. & Pallagst, K. M. (2012). Urban shrinkage in Germany and the USA: A comparison of transformation patterns and local strategies. *International Journal of Urban and Regional Research*, 36: 261–280.

Wong, C. P. W. (2000). Central-local relations revisited: The 1994 tax sharing reform and public expenditure management in China. *China Perspectives*, 31: 52–63.

Woodworth, M. D. & Wallace, J. (2017). See ghosts: parsing China's "ghost city" controversy. *Urban Geography*, 38 (8): 1270–1281.

World Bank (2014). Urban China: Toward efficient, inclusive, and sustainable urbanization. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/18865

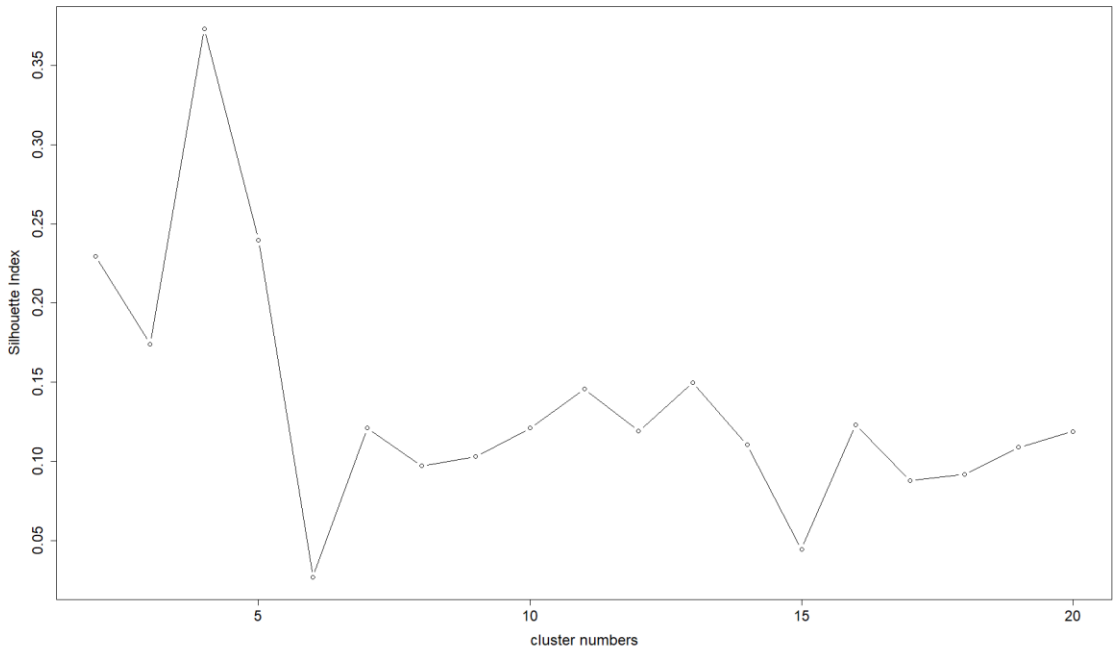
Wu, W. (2010). Urban infrastructure financing and economic performance in China. *Urban Geography*,31: 648–667.

Yang, Z. & Dunford, M. (2018) City shrinkage in China: scalar processes of urban and hukou population losses. *Regional Studies*, 52:8, 1111-1121, DOI:10.1080/00343404.2017.1335865

Zeng, Z. D. (2010). Building Engines for Growth and Competitiveness in China Experience with Special Economic Zones and Industrial Clusters. *Published by 2010 The International Bank for Reconstruction and Development / The World Bank.*

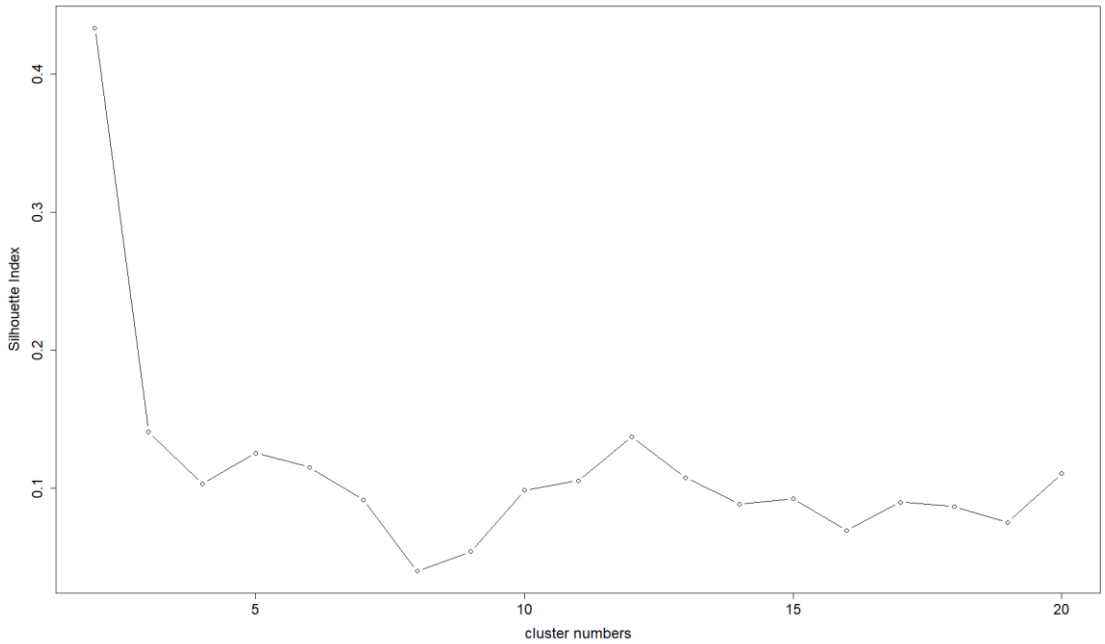
Zhang, P. (2008). Revitalizing old industrial base of Northeast China: Process, policy and challenge. *Chinese Geographical Science*, 18: 109 - 118.

Appendix 1 The Clustering Numbers and Silhouette Index of Urban Population Trend 2006-2015



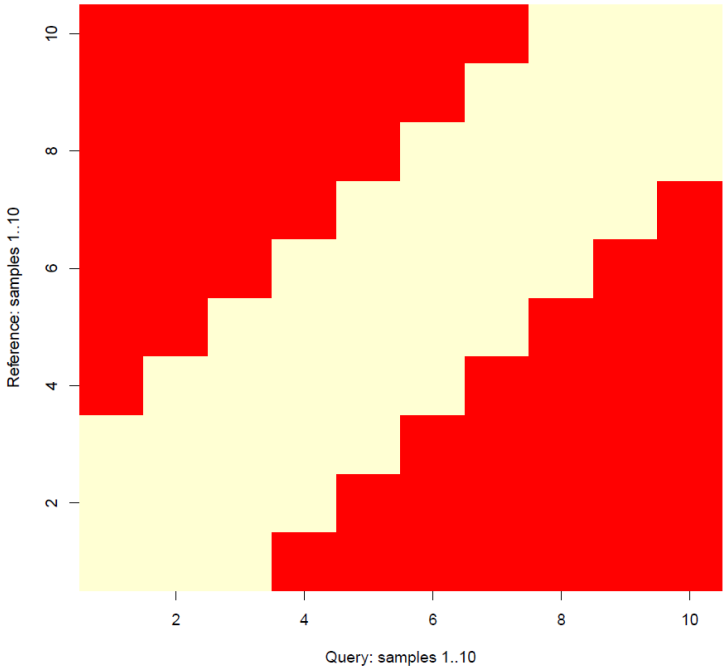
Data Source: China Urban Construction Statistical Yearbook 2006-2015

Appendix 2 The Clustering Numbers and Silhouette Index of Urban Economic Trend 2006-2015



Data Source: China City Statistical Yearbook 2006-2015

Appendix 3 Visualization of the Sakoe-Chiba constraint for DTW



Source: Sarda-Espinosa (2017)

The yellow area is the allowed region for Dynamic Time Warping or the "window" when using DTW to traverse the LCM under the Sakoe-Chiba constraint.

CHAPTER 4

LAND-BASED URBANIZATION IN CHINA: THE SPATIAL DIVERSITY OF ASYMMETRIC STATE RESCALING

Abstract

This paper provides an institutional understanding of China's rapid land urbanization. It examines China's asymmetrical state rescaling process that is featured by the decentralization of fiscal responsibility, the large local economic power of land use, and political centralization. This asymmetrical rescaling has created different fiscal, political and economic incentives to drive local land transactions. Thus, local land planning and development tend to misalign with real population and economic growth demand, and generating areas of systematic over-provision that waste public resources, which are commonly referred to as "ghost cities", "zone fever", "pseudo-urbanization" etc.

This paper examines how the institutional factors of fiscal decentralization, intergovernmental transfers, and intergovernmental competition have driven local land urbanization. The data include the most recent socioeconomic data, government finance data as well as land development data for all prefectural-level cities (N=290) from the China City Statistical Yearbook, China City Construction Yearbook, China Land and Resources Yearbook from 2006 to 2014. To further capture the spatiotemporal diversity of institutional mechanisms of land urbanization, this paper employs the Geographical and Temporal Weighted Regression (GTWR) technique to model how these driving forces vary across space and time.

In general, land urbanization is positively driven by local fiscal gap and inter-city competition. State funds for urban maintenance play a substitutive role to reduce the fiscal

incentive of local land use. Cities are competing with neighbors for state funds in urban investment by showing more land development effort to the central state. According to the GTWR results, these institutional impacts are particularly strong in less developed inland regions, such as the northeast, the northwest, the southwest and the Middle Yellow River region. These cities are more responsive to the state rescaling and the embedded institutional incentives.

This study enriches the urbanization literature by providing an institutional perspective of land urbanization in a transitional economy. It raises attention to different incentives within a multilevel system and their impacts on local planning and urban policies.

It also contributes to state rescaling theory by showing the possible asymmetric features of rescaling or decentralization across different policy domains, and the consequent fiscal, political and economic incentives in local planning. This shows a "supply-side" story of the "state-led" urbanization in China, as a key explanation of the current rapid land urbanization and the potential oversupply and overbuilding problems, known as ghost cities.

It also further links the impacts of rescaling to various development contexts across China's regions with the use of innovative Geographical and Temporal Weighted Regression technique. Through the divergent local responses, this paper completes state rescaling theory by showing the left behind places do act and respond to incentives differently. Thus, state policy should pay attention to them.

Keywords: Land Urbanization, Institutional Incentives, State Rescaling, Geographical and Temporal Weighted Regression

Introduction

China has experienced a rapid urbanization process and the country's urbanization rate reached more than 50 percent in 2011. However, along with the magnificent urbanization stories, issues including an oversupply of urban housing, underutilization of infrastructure, lack of public service provision, and inefficient use of land and other public fiscal resources, have been reported in China's cities as well. "Ghost cities" (e.g., Woodworth and Wallace, 2017) and "zone fever" (Cartier, 2010) are examples of the extreme manifestations of these urbanization problems, showing the detachment of urban development from real market demand.

Previous attempts to understand China's urbanization often applied western theories, such as growth machine (Logan and Molotch, 1987) to show a growth-oriented strategy for urbanization (Lin, 2007; Ma and Wu, 2005; Zhang, 2008; Han, 2010; Ping, 2011). While they provided a useful analytical framework, these "market-led" standpoints (Liu and Jiang, 2005; Jiang et al., 2012) with emphasis on the demand of migration, foreign investment, and local economic growth, only tell part of the story (Ping, 2011). It has missed the "supply-side" story, the central piece of the "state-led" in China's urbanization process as a key explanation of the current rapid land urbanization process, especially for the oversupply and overbuilding problems of some cities, known as ghost cities.

In China's case, the urban model is primarily state-led and centered on land. Highly influenced by China's political and economic transformation, the local state has played a critical role in developing cities using land as the major fiscal, financial, economic and policy tool to generate revenues, finance urban construction, maintenance and investment, stimulate economic growth and compete with peers etc. Such a land-based model and its institutional mechanisms provide insight into oversupply issues and rapid land urbanization in China. This paper explores

this land-based urban model by answering questions: What institutional factors drive land urbanization? What are the spatiotemporal variations of these motives? It examines the most critical institutional factors of fiscal decentralization, political centralization and inter-jurisdictional competition in China and further reveals the spatiotemporal diversity of local economic, political and fiscal motives to plan land resources in decentralized and urbanized China.

Literature Review

This section reviews the asymmetric rescaling process in China and its impacts on unbalanced growth outcomes. Specifically, political power is centralized in China while fiscal responsibilities and economic power to use land have been decentralized. Together, these have created the fiscal, political and economic incentives in local planning to pursue land urbanization for multiple purposes of revenue generation, urban finance, economic growth, inter-city competition, and political promotion. Different manifestations of land urbanization practices have different development outcomes. This paper not only provides a multilevel institutional framework to explain local planning and rapid land urbanization but also contributes to the complex notion of state rescaling (e.g., Brenner, 2004) across different policy domains and links rescaling to various development consequences and emerging urban phenomena.

Institutional Context of Land Urbanization

Fiscal Decentralization (Fiscal Incentive): Fiscal reform in China has fundamentally changed central-local fiscal relations (Wong, 2000). Before the reform, the central state collected all local revenues and reallocated money to each local government. The reform began in the 1980s with the fiscal contracting system that allows provincial governments to keep surplus after a lump-sum remittance is made to the central government (Knight and Shi, 1999). Although local development interest in the fiscal effort was significantly aroused, the revenue of the central

government decreased relatively, and fiscal control of the central government was weakened. Thus, in 1994, a tax-sharing system was initiated to request local governments to proportionally share the local taxes rather than a fixed remittance (Chung, 1994). Since 1994, the share of central government revenue has been increased by keeping more "lucrative sources of revenue"[8](He et al., 2015) at the central level. This tax sharing system has increased the central share in revenue (Lin and Yi, 2011; Liu and Lin, 2014; Tsui, 2011; Wu, 2010).

At the same time, local governments have been decentralized with more urban development responsibilities while the revenues are more centralized. Thus, the vertical imbalance between local revenue and expenditure has been growing over time. Moreover, local governments also do not have the authority to adjust local tax rates to meet the changing urbanization demand. About 85% of total public expenditure responsibilities are now decentralized to local governments, while only 55% of total government revenues can be used by at the local level (World Bank, 2014).

Land Governance System (Economic Incentive): Another important institutional reform lies in the land governance system. According to the *Chinese Land Management Law*, China has a dualist land management system where the ownership of rural land belongs to the village collectives while urban land is owned by the state. Only the use rights of urban land can be traded in the market by local governments for a certain amount of time: 70 years for residential, 40 years for commercial land use and 50 years for industrial purposes. Thus, local governments often requisition rural land, compensate farmers with a non-market price (mostly lower than market prices). Then, they sell rights to use the land to developers at higher market prices through tendering, auction and listing for land premiums, and even through negotiations to use land as a

[8] Includes value-added tax, resource tax, stamp duty tax, business tax for finance and insurance, corporate and personal income tax etc.

competition tool. As local governments are the sole land supplier, they can reap such monopoly rents to complete capital accumulation through land development practices (Lin, 2009; Lin and Yi, 2011). Therefore, land revenues have become the major local off-budgetary revenue source to finance infrastructure development and urbanization (Lin and Zhang, 2014; Lin et al., 2014; Tao et al., 2010). This not only creates a large authority of land use and revenue seeking space for local governments but also contributes to unprecedented land urbanization and land competition. The fiscal and economic incentives for future revenue generation have become the primary rationale for local governments to allocate land resources (Lichtenberg and Ding, 2009; Lin and Yi, 2011; Rithmire, 2013).

Political Centralization (Political Incentive): China has a multilevel administrative hierarchy, including from top to bottom: provincial-level government, deputy-provincial level government, prefecture-level government, county-level government and town government. Although the political powers have been decentralized since the reform in the 1980s, the hierarchical nature remains that upper-level governments still control the key personnel appointments and resource allocations in their subordinate units (He et al., 2015).

What accompanies the political centralization system is an economy-based cadre evaluation system. To achieve political conformity, local governments seek to meet the allocated benchmark of economic performance from the higher-level government (Li and Zhou, 2005; Blanchard and Shleifer, 2001). Local government officials will be evaluated and get promoted based on how well they boost economic growth, industrialization and urbanization to meet the benchmarks during their short terms (5-year) in office (Guo, 2009; Li and Zhou, 2005). They often try their best to ‘polish’ their resumes within their terms (Pan et al., 2017) through more land development and competition with peers in order to get promoted.

In general, based on the unique institutional settings and reforms in China, local governments have actively engaged in land-based urbanization. This local land-based engineered model has been widely pursued to fuel GDP growth to attract investment, achieve highly visible symbols of political accomplishments (e.g. mega projects), increase local coffers through leasing land use rights, using land as collateral to borrow and finance, and improve administrative status of jurisdictions and get personal promotions, in short, to "kill many birds with one stone".

Divergent Practices of Land Urbanization

This local "state-led" land urbanization can be explained by a theory of administrative urbanization that is manifested as a variety of local development responses to state rescaling.

Administrative Upgrading: One type of China's administrative urbanization is the "climb-up" the administrative ladder to achieve instant and convenient urbanization. The effort to seek urban designations and upgrading has generated many prefecture-level and county-level cities within the past decades (Chan, 2010). These newly emerged "cities" are designated for different purposes, ranging from resource extraction, manufacturing concentrations and transportation hubs etc. The administrative upgrading process with newly designated cities and towns was an important contributor to China's urbanization. According to Chan (2010), 54% of existing cities were former counties as a result of administrative upgrading (Chan, 2010). The increase of 200 million in urban population can be decomposed into 50 million from natural growth, 60-70 million from rural conversion, and about 80 million from administrative reorganization (Chan and Hu, 2003).

This type of urbanization through the "emergence of administrative region" (MAR) is the easiest way to increase their jurisdictional area and obtain more power and resources (Liu, et al., 2014). To seek "instant" urbanization, various MAR initiatives are conducted by local

governments including “Turning Counties into Districts”, “Turning Counties into Cities”, and “Combine Villages and Towns” and other conversion of suburbs and rural areas through boundary redrawing and expansions (Ma, 2005; Lin and Ho, 2005). However, the administrative upgrading models have been criticized as pseudo-urbanization because they are only urbanized administratively but not based on the market demand to achieve real urban function in the newly designated area. In other words, the transformation to “real” urbanization is questionable and often hard to be realized. The designation or upgrading to “cities” does not guarantee that the areas will function as cities. It also often ignores the other problems on the deprivation of farmers (Ma, 2002).

The Proliferation of Zones: Administrative urbanization can be engineered by local governments establishing a variety of special development zones. They typically enjoy preferential policies, such as lower tariffs, large tax breaks, higher retention rates etc. Local governments can pursue urbanization through establishing such “zones” to compete for business, financial and land resources (Cartier, 2010; Wei, 2015; Zeng, 2010). The development zone approach has been pursued by local officials to realize the economic dimension of urbanization. According to the Ministry of Land and Resources, there were three past large waves of zone development in 1992, 1997 and 2003, which are known as “zone fever” (Cartier, 2010; Wei, 2015).

With the proliferation of zones, most of them were established illegally and under poor management and lacking foreign investment (Wei, 2015). To cope with the high standard from the central government to restrict “zone fever”, local governments are “adaptive” to continue establishing zones in a subtle way under the guise of new concepts, such as “ecological zones”, “industrial corridor”, “tourist resorts”, “high-tech clusters” or “agglomeration center”. As the motives are often distorted by competitive pressure under the political evaluation system, and land speculation for revenues (Yang and Wang, 2008), these zones often fail in practice due to lack of

careful planning, exceeding actual demand, inadequate investment, insufficient financial power or administrative ability.

Building the Urban Façade: Another route of state-led land urbanization is to construct an urban façade without considering real demand and economic development projections (Sorace and Hurst, 2016). These fixed-assets investments or "place-making" activities are to build a showy exterior to exhibit political achievements or trophy projects to a higher level of government (Sorace and Hurst, 2016). No matter whether these projects contribute to urbanization, they are believed by governments as the road toward "urbanization", the symbols of modernity and the keys to promotion. Many examples can be found, including luxurious villas, modern apartment communities, oversized shopping malls, large public squares, tall statues in both large and small cities. Various terminologies including "pseudo-urbanization (Liu, et al., 2014; McGee, 1967), "impetuous urbanization" (Yuan, 2008), "half urbanization" (ARDHMC 2010-2011), "phantom urbanization" (Sorace and Hurst, 2016), and "city to exhibit city" (Ren, 2012), have been used by scholars to reveal this problem.

These "urban shells" lack consideration of real demand of people and their social and economic activities. Most of them have thus turned into ghost cities (Woodworth and Wallace, 2017), such as Kabashi in Ordos and Tieling new town in Liaoning Province. The obsession with image-engineering projects for "place-making" is often financially detrimental. The developers tend to be very speculative in supplying housing in these areas to generate a number of "half-buildings" and "unfinished projects". Furthermore, urban infrastructure and housing are likely to be overdeveloped and oversupplied at the expense of rising local debt. The debt for urban infrastructure has accumulated to 131.7 billion RMB in 2004 (Su and Zhao, 2006). The short length of political tenure has created incentives for local officials to be less accountable in public spending

since they can pass debt to their successors (Su and Zhao, 2006). Thus, public financial losses accumulate through these projects, and local economies are undermined. Planning is further distorted as the debts or losses can only be compensated through more land speculation. In addition, there are large environmental and social costs of these unproductive and underutilized urban infrastructure projects.

Research Question

This paper focuses on the land-based urban development model in China. It provides an institutional perspective to explain why cities have actively pursued land transaction and land urbanization in China, by examining the institutional driving factors that resulted from China's state rescaling in fiscal, political and economic dimensions. The spatiotemporal diversity of these institutional motives is further modeled to show how these incentives have disproportionately affected municipal land use planning practices across space and time.

Data Source

The data are divided into government finance data for urban construction and investment, land transaction data, and other socioeconomic data from 2006 to 2014. Government finance data is retrieved from China's City Construction Statistical Yearbook. Land-based development data is collected by author from the China Land and Resources Statistical Yearbook and LandChina.

This analysis focuses on the prefecture-level cities (municipalities, N = 290). In China's government system, there are 6 levels of administrative entities. From top to bottom, they are the Central Government/State, Provincial Government, Prefecture Government, County Government, Town Government and Neighborhood Office. Prefecture-level cities are below provinces and above counties. They are one important part of China's local government apparatus since they are

assigned with important fiscal, economic and demographic development and management responsibility. Most prefecture cities geographically include urban districts, counties, townships and villages. Therefore, these are areas with both urban and rural settings. Besides the significance in urbanization, prefecture cities also provide a good balance of fine-level of study unit and stable boundary for overtime analysis.

Dependent Variable

Land Transaction: The control of land development is the most important policy tool for China's city governments to serve multiple purposes in urbanization, which is termed as "kill many birds with one stone", e.g. revenue generation, municipal finance, economic growth, inter-city competition, political promotion etc. First, as a fiscal tool, land use rights can be traded to developers to generate extra-budgetary revenues through land conveyance fees. Second, as a financial tool, land can also be used as collateral for municipalities to borrow, and further finance urban construction and maintenance. Third, land is also the major policy tool for local governments to compete with peers by lowering the land costs for developers and further attract more investment. Figure 9 displays the example of land (use rights) transaction distributions in the year 2008 for all different purposes: residential (70-year lease), industrial (40-year lease) and commercial uses (50-year lease). Each green dot represents one land transaction. Such a land-based urbanization tool can not only generate one-time land concession fees through bidding, auction and negotiation, but also attract investment to develop the land and economy. Thus, land transaction area (**LAND**)[9] of each green dot are aggregated by prefecture-level city boundary in the model as the dependent variable to capture the rapid land urbanization process in China.

[9] *The natural logarithm of land transaction area is used to make the dependent variable follow normal distribution.*

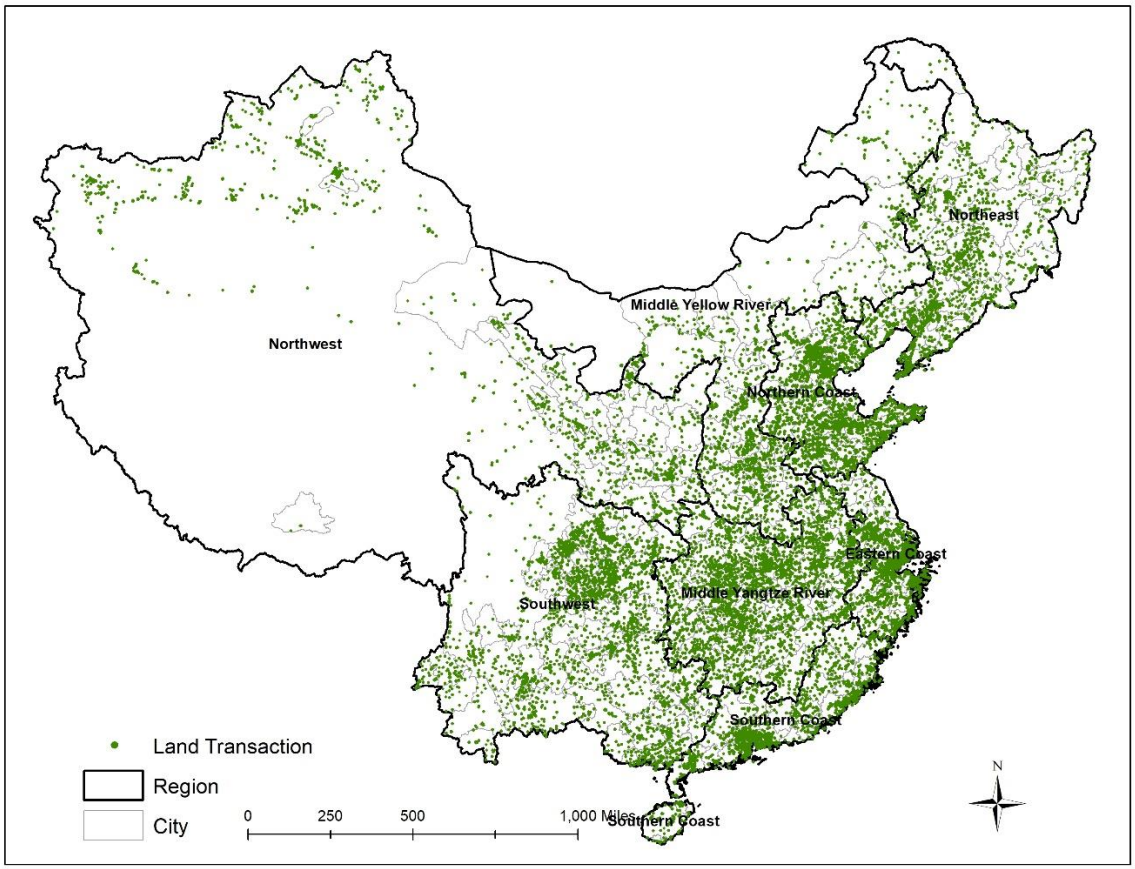


Figure 9 China's Land Transactions in 2008

Data Source: LandChina website

Measuring Institutional Incentives

Fiscal Decentralization: Fiscal decentralization in China has created a large fiscal gap and tightened the budget constraints at the local level, forcing local governments to lease more land for extra-budgetary revenues. The larger fiscal gap is expected to drive more local land transactions. This gap (**FGAP**) is calculated as the difference between local expenditure and local budgetary revenues for every city to capture the fiscal incentives for using the land-based development tool. The average fiscal gap is 2300 RMB per capita.

Intergovernmental transfers are also included to explore the role of the central state in a multilevel system to finance urbanization. It is divided into two types. One is the allocation of state funds for urban facilities maintenance (**SFM**) and the other is state funds for urban infrastructure investment (**SFI**). All fund transfers are calculated as percentage of all urban finance resources. In general, state funds for maintenance account for almost 4% while the investment fund is about 10% at the city level. State funds are expected to play a substitutive role and help reduce the fiscalization of land use practices of local governments.

Table 4 Descriptive Statistics of Land Transaction Model Variables 2006-2015

	Mean	Stdev
Land Transaction Area (Hectare) [a]	**891.54**	**950.21**
Natural Logarithm of Land Transaction Area [a]	**6.33**	**1.04**
Fiscal Decentralization		
Decentralized Budgetary Gap (10,000 RMB) [b]	0.23	0.43
State Fund for Urban Maintenance% [c]	3.70%	9.10%
State Fund for Urban Investment% [c]	10.38%	22.18%
Inter-City Competition		
Neighboring Land Transaction Area [a]	6.18	1.31
Neighboring State Fund for Urban Maintenance% [c]	3.74%	5.08%
Neighboring State Fund for Urban Investment % [c]	10.11%	16.77%
Demand		
Economic Production in Industrial Sector % [b]	49.99%	10.90%
Economic Production in Service Sector % [b]	36.11%	8.80%
Fixed Assets Investment of Economy % [b]	65.99%	24.67%
Control		
Jurisdictional Population [b]	433.42	306.96
Jurisdictional Area [b]	1.66e+06	2.19e+05

a: China Land and Resource Statistical Yearbook 2006-2014
b: China City Statistical Yearbook; 2007-2015
c: China Urban Construction Yearbook 2006-2014

Inter-City Competition: Given the centralized political system and economic-based evaluations, we also expect inter-city competition will drive local governments to sell more land and promote more economic growth. Local governments can compete with peers through more land transactions showing their effort in development. This paper uses spatial lag terms to measure

the reaction of each city to its neighbors. These spatially weighted lag terms[10], include neighbors' land transactions (**NLAND**), neighbors' state funds for maintenance level (**NSFM**), neighbors' state funds for investment level (**NSFI**). These are calculated to capture how each city uses land to respond to its neighbors'. Based on the competition hypothesis, positive coefficients are expected for these spatial lag terms as a city will choose to lease more land when neighboring land transactions are high. In addition, we expect that when neighboring cities are more favored by the state with a higher level of state funds in urban finance, the target city will develop more land to show more development effort to the central state and thus compete for funds.

Demand Factors and Controls: Besides the institutional factors that drive local land development practices, the model also includes the demand factors, such as the percentage of the local economy in industrial sectors (**SEC**), tertiary or service sectors (**TER**), and the percentage of fixed assets investment of the local economy (**FIX**). Both jurisdictional population (**POP**) and areas (**AREA**) are controlled.

Model Specification

Fixed Effects Model

We choose the fixed effects model to analyze our panel data and explore the impact of different institutional factors on local land rights issuance that vary over time. Fixed effects model can eliminate the impacts from the time-invariant characteristics through the de-mean process, so we can estimate the net effect of the predictors. We also assume the time-invariant characteristics do not correlate with other city's characteristics, otherwise, a random effects model is more

[10] *The contiguity-based spatial weight matrix (Queen) is used to calculate the spatial lag terms to measure competition. The neighbors are defined based on 1st order of contiguity for cities.*

appropriate. A Hausman test[11] is conducted for this assumption, with the result that the fixed effects model is more appropriate for our data.

$$LANDit = \beta 0 + \beta 1\, FGAPit + \beta 2\, \mathrm{SFM}it + \beta 3\, SFIit + \beta 4\, \mathrm{NLAND}it + \beta 6\, NSFMit + \beta 7\, NSIMit + \beta 8 SECit + \beta 9 \mathrm{TER}it + \beta 10\, FIXit + \beta 11\, POPit + \beta 12\, \mathrm{AREA}it + \alpha i + \varepsilon it$$

where[12]

$\beta 0$ is the intercept;

αi is the unobserved city-specific intercepts that do not vary over time*;*

$LANDit$ is the total land transaction area for city i in year t;

$FGAPit$ denotes fiscal gap for city i in year t;

$SFMit$ captures percentage of state fund in urban maintenance of city i in year t:

$SFIit$ measures percentage of state fund in urban investment/construction in city i in year t:

$NLANDit$ is the spatial lag term of neighboring land transactions of city i in year t;

$NSFMit$ is the spatial lag term of state fund reliance for urban maintenance from neighboring cities of city i in year t;

$NSIMit$ is the spatial lag term of state fund reliance for urban investment from neighboring cities of city i in year t;

$SECit$ is the percentage of local economic production in industrial sectors of city i in year t;

$TERit$ is the percentage of local economic production in service sectors of city i in year t;

---

[11] *The Hausman test is conducted for the selection between the random effects vs. the alternative hypothesis of fixed effects. Our result shows the unique errors (ui) are correlated with the regressors to reject the null hypothesis that the preferred model is random effects. Thus, a fixed effects model is more appropriate in this case.*

[12] *Multicollinearity is tested for Pooled OLS Model. VIF: max =1.98, min = 1.10, mean =1.37 < 7.5. No multicollinearity is found.*

$FIXit$ is the percentage of fixed assets investment in local economy of city i in year t;

$POPit$ is the total population of city i in year t;

$AREAit$ is the jurisdictional area of city i in year t;

Table 5 shows the model results for land urbanization in terms of land area leased. In general, we confirm our expectations that institutional factors matter in driving local land urbanization through decentralization and inter-city competition.

Table 5 Fixed Effects Model Results of Land Urbanization of Chinese Prefectural-Level Cities

Land Transaction Area (Hectare) [a]	Coefficient	Std Error
Fiscal Decentralization		
Decentralized Budgetary Gap [b]	+0.136***	0.042
State Funds for Urban Maintenance% [c]	-0.372**	0.145
State Fund for Urban Investment% [c]	-0.071	0.064
Inter-City Competition		
Neighboring Land Transaction Area [a]	+0.399***	0.022
Neighboring State Funds for Urban Maintenance% [c]	+0.404	0.259
Neighboring State Funds for Urban Investment % [c]	+0.187*	0.087
Demand		
Economic Production in Industrial Sector % [b]	+2.348***	0.582
Economic Production in Service Sector % [b]	+1.498	0.719
Fixed Assets Investment of Economy % [b]	+0.564***	0.077***
Control		
Jurisdictional Population [b]	+1.49e-03***	6.32e-04
Jurisdictional Area [b]	-6.27e+06	9.82e+06

** p<0.05; ** p<0.01; *** p<0.001; N = 2514 for all prefecture-level cities with available data from 2006-2014.*

R Squared (within) = 0.3162; R Squared (between) = 0.4059; R Squared (overall) = 0.3761;

a: China Land and Resource Statistical Yearbook 2006-2014
b: China City Statistical Yearbook; 2007-2015
c: China Urban Construction Yearbook 2006-2014

As we expected, the fiscalization of land use is shown by our model results. The budgetary gap of local government under China's decentralization is found to have a positive impact to create fiscal incentives to drive local governments to urbanize and lease more land and seek for more

extra-budgetary revenues. State funds for urban maintenance is found to have the expected substitutive effects as an important alternative source for urban finance under decentralization. In contrast, state funds for urban investment do not show significant impacts. This is probably because these investment funds are widely allocated to most cities in China.

Inter-city competition has positive impacts on local land development, encouraging more land-based competition among cities. The reactions of each city to its neighbors' land transaction and state funds for urban investment is positive and significant, as expected. First, the increase of neighbors' land development will drive more land transactions in the target city. Second, the city will also respond to the increase of neighbors' state funds for investment with more land transactions. In other words, when the neighboring cities are more favored by the state with more investment funds for urbanization, the target city will show more land development efforts to compete for future state funds for investment. The complementary role of state funds for urban investment, to encourage more land urbanization and competition, is manifested through its spillover effects and can be captured by the spatial interactions of cities.

Some other demand driving factors are significant as well. The demand for industrial development is significant to spur more land transactions while service sector development is not significantly associated with increasing land urbanization. Fixed assets investment is another significant demand factor to drive more land-based practices of local governments. Cities are actively engaged in investing fixed assets of urban facilities and infrastructure to attract developers, especially for industrial development which also requires more land area. For the controls, population shows a positive significant correlation with land transactions.

Geographical and Temporal Weighted Regression

The regression results in the global model only show the average overall effects. In ArGIS[13], I run Geographical and Temporal Weighted Regression (GTWR) models (Huang et al., 2010; Fotheringham et al., 2015) to capture the spatiotemporal variation of how the institutional factors affect local land practices. GTWR fits a regression equation and estimates a set of coefficients β_{kt} for every city in each year (see the formula below).

$$Y_{it} = \sum_k \beta_{kt}\,(u_i, v_i,\ t) X_{k,i,t} + \varepsilon_{it}$$

where k is the number of explanatory variables; i is the city; and t is the year.

GTWR calculates the optimal adaptive bandwidth to determine the subsamples for each local estimation. Every city in each year will have its own weighted spatiotemporal neighbors (cities) based on the kernel bandwidth results[14] to run local regressions. This process is repeated for every city in each year so there will be i*t set of coefficients. The R-squared is improved to 0.6470 in the GTWR model. The following section shows the GTWR results of the spatiotemporal variations of the impacts from the significant institutional factors. The coefficients for each city in each year are mapped in Figure 10- Figure 13.

In Figure 10, the spatiotemporal variations of the fiscal gap under decentralization are shown. Cities with yellow/orange/red color have local fiscal gap positively affecting their land supply and development practices. They are concentrated in the less developed regions of northern

[13] *The GTWR add-in was used to run the model. The AICc method was used for bandwidth selection. The kernel type is adaptive. https://www.esrichina.hk/events/gisConnect.aspx?year=2016&month=12&id=5*
[14] *There are 262 spatiotemporal neighbors for kernel bandwidth in this study.*

and western China, such as the northeast, the Middle Yellow River region, the northwest and the southwest. Cities in blue or light blue don't have many fiscal incentives to pursue more land

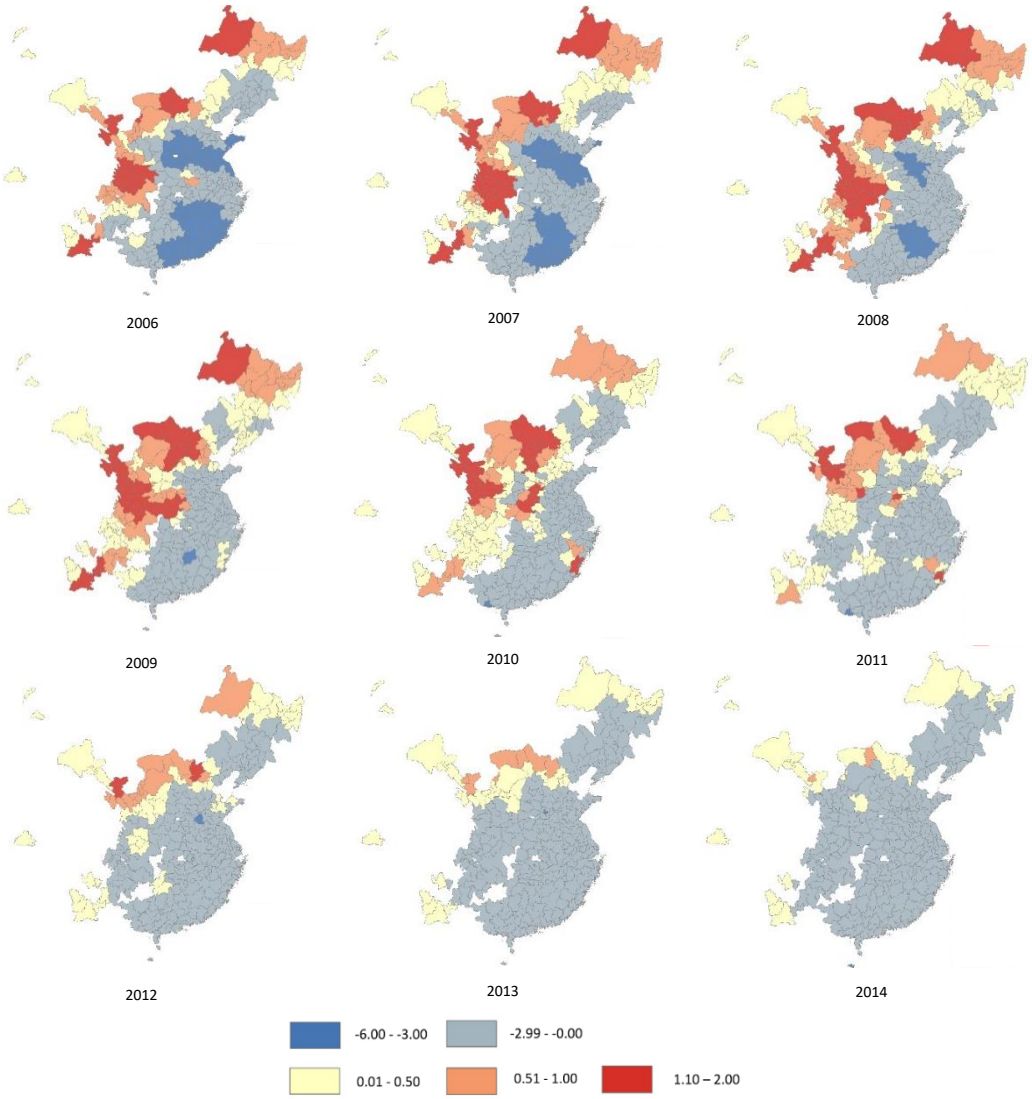


Figure 10 GTWR Coefficients of Local Fiscal Gap 2006-2014

(blue: - ; yellow/orange/red: +)

Data Source: China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

urbanization. From 2006 to 2010, we can see the fiscal incentives (yellow/orange/red) have expanded to the more developed eastern regions. We can see some cities in the Middle Yangtze

River region and the eastern coast region show up in yellow/orange/red to have fiscal incentives in local land urbanization. After 2010, the number of cities with fiscal incentives is shrinking (more blue area) and the magnitude of impacts of fiscal incentive is also dropping. However, fiscal incentives are robust in some cities from the northeast, Middle Yellow River region, the northwest and the southwest. These cities are primarily resource-based, and old-industrial cities, which consistently pursue more land transactions due to these fiscal incentives.

Figure 11 unfolds the coefficients of state funds for maintenance across space and time. The expected role of state funds is to be substitutive (blue) to help relieve local fiscal stress and further reduce the fiscalization of land use. From 2006 to 2014, we can see the dominant impacts (large area of blue) show these state funds as a substitutive of urban finance resource. However, the positive effect of state funds for urban maintenance has emerged in the southwestern region, parts of the northern coast, parts of Middle Yangtze River region and Middle Yellow River region. State funds for maintenance in these cities plays a different complementary role to drive more local land urbanization. Some of these less developed regions, such as the southwest and the Middle Yellow River region are also having higher fiscal incentives. State funds are not helping these cities to ameliorate the reliance on land finance but complementarily encourage more land transactions and efforts to compete for state funds. This indicates the divergent local impacts of intergovernmental transfers in a multilevel system, and the need to understand the spatial logic of state funds and different local responses to it.

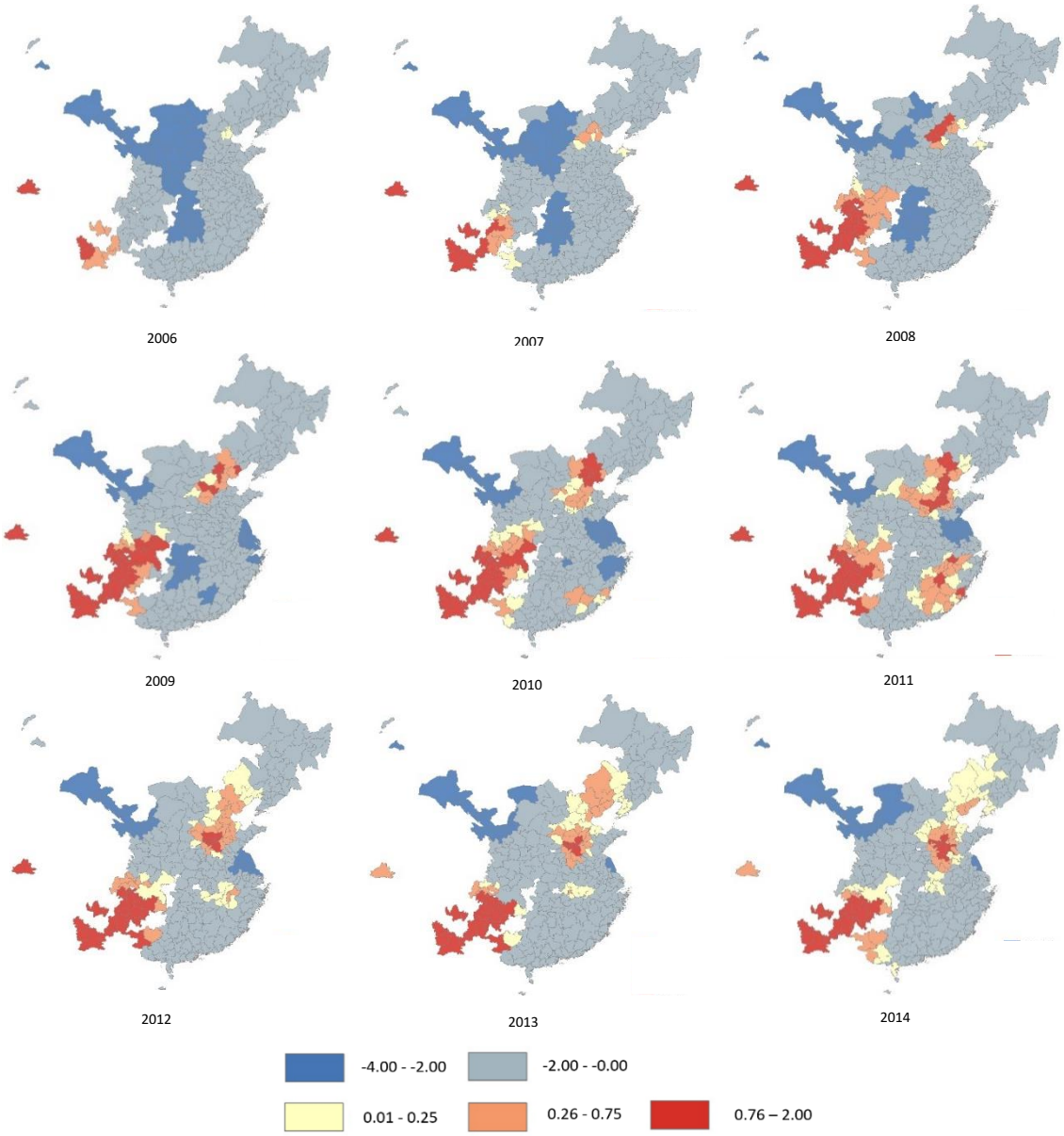


Figure 11 GTWR Coefficients of State Fund for Urban Maintenance Fund 2006-2014

(blue: - ; yellow/orange/red: +)

Data Source: China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

The GTWR coefficients of competition from the impacts of neighboring land transactions are presented in Figure 12. The GTWR results confirms the dominant competition effect in local land urbanization from the global model. Most cities are positively affected by the neighboring

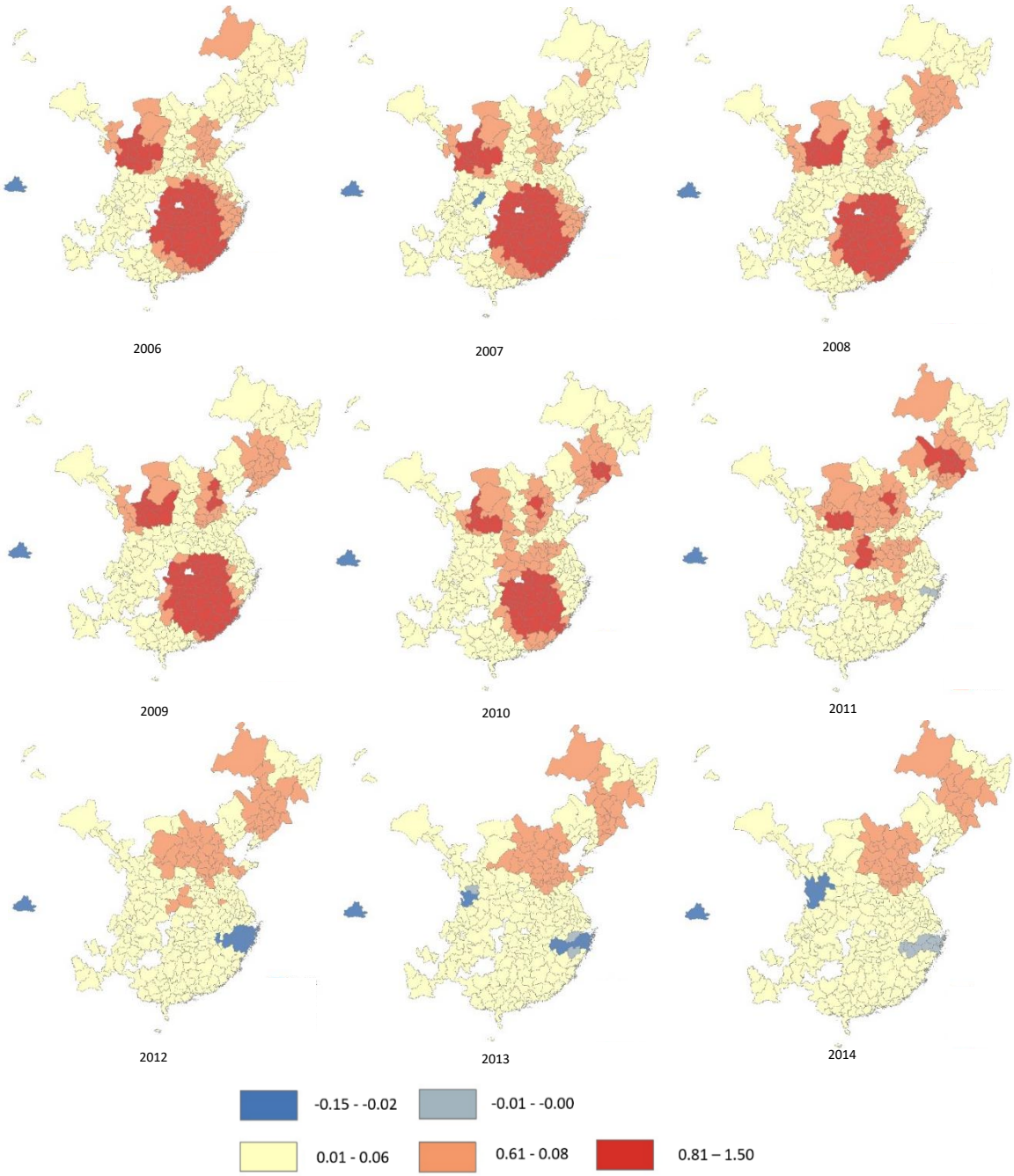


Figure 12 GTWR Coefficients of Neighboring Land Transactions 2006-2014

(blue: - ; yellow/orange/red: +)

Data Source: China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

land transactions and respond with more land urbanization practices. Such competition is strong in the developed southeastern region of the eastern coast, southern coast and Middle Yangtze River from 2006 to 2010, but not that strong in post-2010. Inter-city land competition becomes stronger in China's rustbelt region in the northeast region after 2010. Cities in other less developed resource-based regions of the northwest and Middle Yellow River area are also competing with neighbors through leasing more land (orange and red) over time.

The impacts of neighboring state funds for investment have been disaggregated as well in Figure 13. It is interesting to see cities (yellow/orange/red +) respond to the higher neighboring state investment funds with more land transactions and development effort. These cities are concentrated in western and northern China in general, such as the northwest, the southwest, the northeast and the Middle Yellow River region from 2006 to 2010. When their neighbors get more state funds for urban investment, they will choose to develop more land and show more efforts to the central state to compete for future funds. This impact of competition for state investment funds on local land urbanization is less strong in terms of magnitude (less red/orange) but spread to more areas (less blue). The land transactions in cities from the rustbelt region of the northeast are driven more by this mechanism to compete with neighbors for state investment funds.

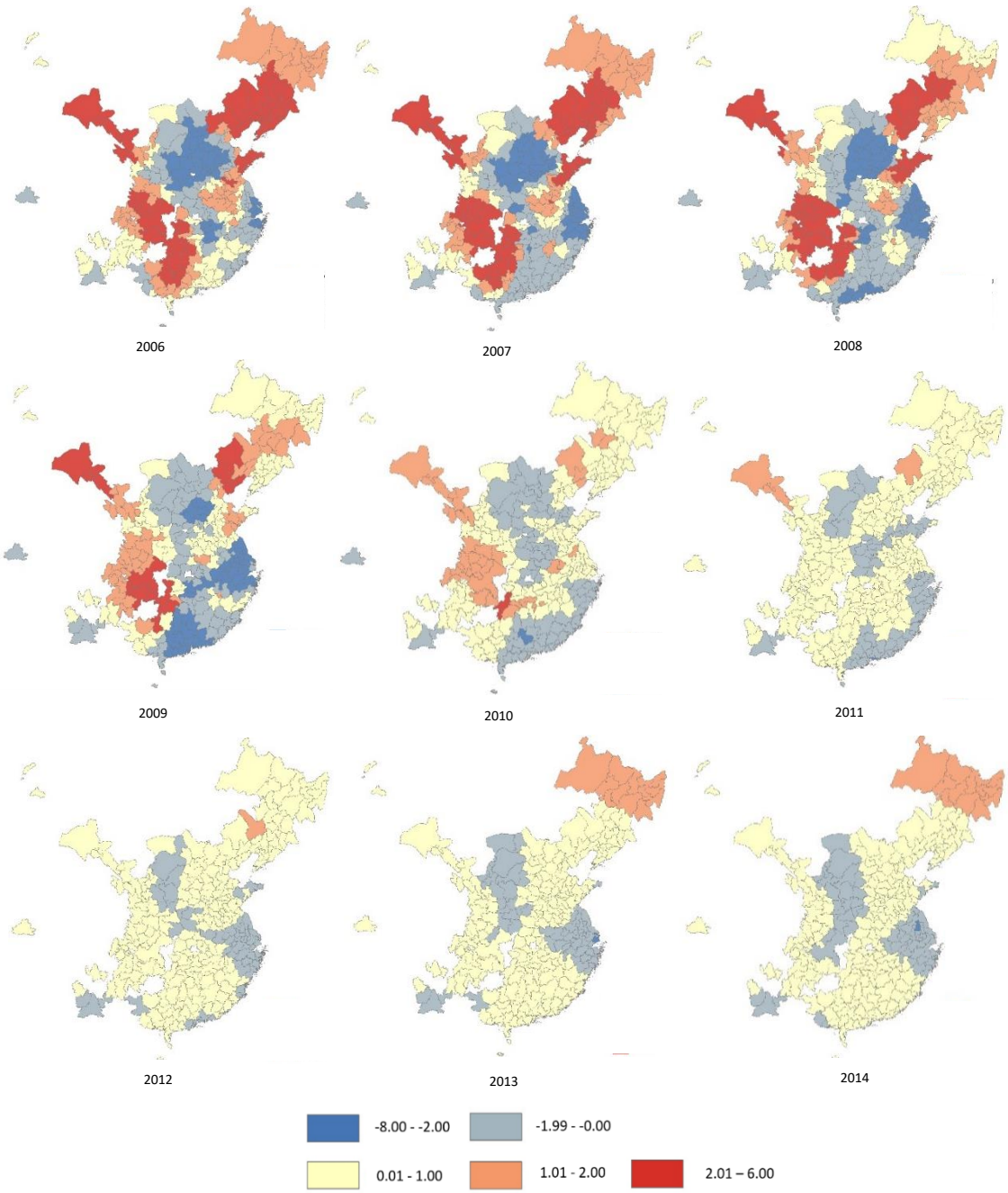


Figure 13 GTWR Coefficients of Neighboring State Fund for Urban Investment 2006-2014

(blue: - ; yellow/orange/red: +)

Data Source: China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

Conclusion

Cities in China are development engines, led by local government through fiscalization of the most important urban asset – urban land use rights. This land-based development has been pursued by municipal governments to generate revenue, fund urban maintenance, stimulate economic growth and compete for investment etc. to "kill many birds with one stone".

However, the land-based model is affected by China's multilevel governance system. The impacts of institutional factors, such as fiscal incentives from the decentralized fiscal gap, political incentives from inter-city competition under China's political centralization and economy-based cadre evaluation system, as well as the spatial divergent impacts of intergovernmental transfers are examined in this study. It highlights the importance of structural effects on local planning and policy making. For example, the decentralized fiscal gap provides a strong fiscal incentive for municipal governments to pursue more land urbanization practices through leasing more land. Inter-city competition also stimulates municipal governments to lease more land and rely more on land revenues. Intergovernmental funds from the central state for urban maintenance can reduce the fiscal incentives and thus ameliorate the land urbanization pressure, while state investment funds to neighboring cities encourage more land development effort as cities compete for these funds.

By exploring the institutional mechanisms of the land-based urban development model in China, this study enriches urbanization studies with an asymmetric decentralization perspective. It shows the complexity of rescaling across different policy fields and the possible fiscal, political, and economic incentives in local planning. It also links the impacts of rescaling to various development contexts across China's regions with the innovative methodology of Geographical

and Temporal Weighted Regression. This approach can unfold the spatial complexity of state rescaling by showing divergent local responses and uneven institutional impacts.

Discussion

Local governments in China need more fiscal tools and wider tax powers to match the rising responsibilities in urbanization. In China's fiscal decentralization, local governments do not have authority to change the tax rates based on local demands. In addition, they do not have stable fiscal resources, such as property tax, to link the spending/investment, improvement/growth and revenues. Local taxes in China are mainly on the income and added values of corporations, which drives local effort to focus on attracting business instead of being people-oriented urbanization.

With limited resources and tools at the local level, cities are likely to stick with the land-based urban development model regardless of whether it is compatible with local demand and generates reasonable fiscal and economic returns. This fiscalization of land use mode is particularly harmful to the less developed inland region with lower growth of economy and population. It will generate the potential "ghost" phenomenon and the waste of land and public resource.

The political promotion system needs to be reformed as well. It should include more diversified objectives of local development, such as the concerns of environment protection, public service provision, inequality reduction, and welfare enhancement etc. rather than just based on the economic achievement. Thus, the benchmarks that are passed down by the central state should involve more dimensions to reduce inter-city competition

State also needs to pay attention to the divergent and spillover impacts of its fund to cities. First, in some places, state fund for urban maintenance is complementarily "facilitating" more

fiscalization of land use. It also results in spillover effects to encourage more inter-city competition for state fund via showing land development effort. Therefore, state should connect the fiscal transfers with assigned land quota by increasing the scrutiny of local land leases.

The spatiotemporal varied effects of the institutional factors from Geographical and Temporal Weighted Regression technique are summarized in Table 6. In general, the impacts of institutional factors on local land urbanization are stronger in the less developed inland regions since more "yes" responses to institutional incentives can be seen in these regions. This shows the other side of state rescaling on those left-behind cities (not selected) that they are more sensitive and responsive to state policy and the institutional incentives under rescaling.

Table 6 Summary of Geographical and Temporal Weighted Regression Results of Land Urbanization of Prefecture-Level Cities by Regions 2006-2014

Institutional Factors	**Fiscal Incentive**	**Complementary Response to State Fund for Maintenance**	**Inter-City Competition in Land**	**Inter-City Competition for State Fund of Urban Investment**
Eastern Coast			Yes	
Southern Coast				
Middle Yangtze River				Yes
Northern Coast		Yes		
Northeast (less developed)	Yes		Yes	Yes
Northwest (less developed)	Yes		Yes	Yes
Middle Yellow River (less developed)	Yes	Yes	Yes	Yes
Southwest (less developed)	Yes	Yes		Yes

For example, fiscal incentives are strong in western and northern China and increased from 2006 to 2011. The complementary effect of state funds for maintenance are found in the southwest, the Middle Yellow River region and parts of the northern coast. These drive more land urbanization instead of ameliorating the fiscalization of land use. Cities in these regions will lease more land to complementarily respond to the increase in state funds.

Inter-city competition through land transactions is strong for all model years in the northwest and the Middle Yellow River region. Although such competition is strong in southeastern China in pre-2010, it shifts to the northeast in the post-2010 period. The competition for state investment funds is found in all the western and northern regions. State funds for urban investment in these regions need to pay attention to the possible spillover effects to stimulate land urbanization to compete for the future fund.

Therefore, land is not a sustainable urban finance tool, as the amount of urban land is fixed. Therefore, there is an urgent need to introduce more sustainable alternative fiscal tools and urban finance sources for municipal governments. More spatially targeted state funds with attention to the potential incentives driving local land competition is needed to facilitate long-term economic and population growth that is not centered on land.

This is especially critical for the left behind cities and the less developed regions. In China's principal-agent system, these places do act through more fiscalization of land use to achieve political conformity and political competitiveness. This is different from the response of left-behind places in the western rescaling context that use populism and voting for political "revenge" (Rodriguez-Pose's, 2018). Therefore, the institutional context matters on the impacts of state rescaling on these "unselected" places. Thus, state policy needs to pay attention to these places and their actions.

References

ARDHMC. (2011). Annual Report of the Development of the Housing Market in China 2010-2011 Greenbook Edition. Shanghai: Shehui Kexu Wenxian Chubanshe.

Blanchard, O. & Shleifer, A. (2001). Federalism with and without political centralization: China versus Russia. *IMF Staff Papers*, 48(4): 171–179.

Brenner, N. (2004) New State Spaces: Urban Governance and the Rescaling of Statehood. Oxford: Oxford University Press.

Cartier, C. (2010). 'Zone Fever', the arable land debate, and real estate speculation: China's evolving land use regime and its geographical contradictions. *The Journal of Contemporary China,* 10 (28): 445-469.

Chapman, J. I. (2008). The Fiscalization of Land Use: The Increasing Role of Innovative Revenue Raising Instruments to Finance Public Infrastructure. Public Works Management and Policy, 12(4), 551-567.

Chan, K. W. (2010). Fundamentals of China's urbanization and policy. *The China Review*, 10 (1): 63–94.

Chan, K. W. & Hu, Y. (2003). Urbanization in China in the 1990s: new definition, different series, and revised trends. *The China Review*, 3 (2): 49–71.

Chung, J. H. (1994). Beijing confronting the provinces: The 1994 tax-sharing reform and its implications for central-provincial relations in China. *China Information*, 9(2–3): 1–23.

Ding, C. (2007). Policy and praxis of land acquisition in China. *Land Use Policy*, 24(1), 1–13.

Donald, B., Glasmeier, A., Gray, M., Lobao, L. (2014) Austerity in the city: economic crisis and urban service decline? Cambridge Journal of Regions, Economy and Society, 7: 3–15.

Eckaus, R. S. (2003). Some consequences of fiscal reliance on extra-budgetary revenues in China. *China Economic Review*, 14: 72–88.

Friedmann, J. (2006). Four theses in the study of China's urbanization. *International Journal of Urban and Regional Research*, 30 (2): 440-451.

Fotheringham, S., Crespo, R. and Yao, J. (2015). Geographical and Temporal Weighted Regression (GTWR). *Geographical Analysis*, 47: 431-452.

Han, S. S. (2010). Urban expansion in contemporary China: What can we learn from a small town? *Land Use Policy*, 27: 780–787.

Harvey, D. (2005) A Brief History of Neoliberalism. New York: Oxford University Press

He, C., Zhou, Y. & Huang, Z. (2015). Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geography*, 37 (3): 436–457.

Huang, B., Wu, B. & Barry, M. (2010). Geographically and temporally weighted regression for modeling spatio-temporal variation in house prices. *International Journal of Geographical Information Science*, 24(3): 383-401.

Hsing, Y. (2010). *The Great Urban Transformation: Politics of Land and Property in China.* New York: Oxford University Press.

Jessop, B. (2002) Liberalism, neoliberalism, and urban governance: a state–theoretical perspective, Antipode, 34: 452–472.

Jin, B. (2015). China's 'New normal': A milestone towards new thinking and innovation-driven growth. Chinese Economists. Retrieved from http://www.chinausfocus.com/finance-economy/chinas-new-normal-a-milestone-towards-new-thinking-andinnovation-driven-growth/

Jiang, L., Deng, X. & Seto, K. C. (2012). Multi-level modeling of urban expansion and cultivated land conversion for urban hotspot counties in China. *Landscape and Urban Planning*, 108: 131–139.

Knight, J. & Shi, L. (1999). Fiscal decentralization: Incentives, redistribution and reform in China. *Oxford Development Studies*, 27(1): 5–32.

Li, H. & Zhou, L. (2005). Political turnover and economic performance: The incentive role of personnel control in China. *Journal of Public Economics*, 89(9–10): 1743–1762.

Lichtenberg, E. & Ding, C. (2009). Local officials as land developers: Urban spatial expansion in China. *Journal of Urban Economics*, 66 (1): 57–64.

Lin, G. C. S. (2009). Scaling-up regional development in globalizing China: Local capital accumulation, land-centered politics, and reproduction of space. *Regional Studies*, 43 (3): 429–447.

Lin, G. C. S. (2007). Reproducing spaces of Chinese urbanization: New city-based and land centered urban transformation. *Urban Studies*, 44 (9): 1827–1855.

Lin, G. C. S. & Ho, S. (2005). The state, land system, and land development processes in contemporary China. *Annals of the Association of American Geographers*, 95 (2): 411–436.

Lin, G. C. S. & Yi, F. (2011). Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geography*, 32 (1): 50–79.

Liu, M., Tao, R. Yuan, F. & Cao, G. (2008). Instrumental land use investment driven growth in China. *Journal of the Asia Pacific Economy*, 13 (3): 313–331.

Liu, S. & Jiang, X. (2005). Financial risks of land financing by local governments. *China Land Science*, 19 (5): 3–9.

Liu, Y., Li, Z. & Jin, J. (2014). Pseudo-urbanization or real urbanization? Urban China's mergence of administrative regions and its effects: A case study of Zhongshan City, Guangdong Province. *The China Review*, 14 (1): 37–59.

Lobao, L. M., Adua, L. (2011) State rescaling and local governments' austerity policies across the USA, 2001–2008, Cambridge Journal of Regions, Economy and Society, 4: 419–435.

Logan, J. R. & Molotch, H. L. (1987). *Urban Fortunes: The Political Economy of Place*. Berkeley, CA: University of California Press.

Ma, L. J. C. (2002). Urban transformation in China, 1949–2000: A review and research agenda. *Environment and Planning A*, 34 (9): 1545–1569.

Ma, L. J. C. (2005). Urban administrative restructuring, changing scale relations, and local economic development in China. *Political Geography*, 24: 477–497.

Ma, L. J. C. & Wu, F. (2005). Restructuring the Chinese city: Diverse processes and reconstituted spaces. In L. J. C. Ma and F. Wu, editors, *Restructuring the Chinese City: Changing Society, Economy, and Space*. London, UK: Routledge, 1–20.

McGee, T. G. (1967). *The Southeast Asian City*. London: Bell.

Mitchell, D. J. B. (2012) Public Jobs and Political Agendas: The Public Sector in an Era of Economic Stress. Champaign, IL: Labor and Employment Relations Association

Peck, J. (2014) Pushing austerity: state failure, municipal bankruptcy and the crises of fiscal federalism in the USA, Cambridge Journal of Regions, Economy and Society, 7: 17–44.

Peck, J., Tickell, A. (2002) Neoliberalizing space, Antipode, 34: 380–404.

Pei, P., & Yang, F. (2008). Study on revitalizing northeast China through a new road of industrialization. Canadian Social Science, 4(2), 74–80.

Ping, Y. C. (2011). Explaining land use change in a Guangdong county: The supply side of the story. *The China Quarterly*, 207 (1): 626–648.

Ren, X. (2012). "Green" as spectacle in China. *Journal of International Affairs*, 65 (2): 19–30.

Rithmire, M. (2013). Land politics and local state capacities: the political economy of urban change in China. *The China Quarterly*, 216: 872–895.

Rodríguez-Pose, A. (2018). The revenge of the places that don't matter (and what to do about It). *Cambridge Journal of Regions, Economy and Society*, 11 (1): 189–209.

Siemiatycki, M. (2010). Delivering transportation infrastructure through public–private partnerships: Planning concerns. Journal of the American Planning Association, 76(1), 43–58.

Siemiatycki, M. (2007). What's the secret? Confidentiality in planning infrastructure using public/private partnerships. Journal of the American Planning Association, 73 (4), 388–403.

Sorace, C. & Hurst, W. (2016). China's phantom urbanization and the pathology of ghost cities. *Journal of Contemporary Asia*, 46 (2): 304–322.

Su, M. & Zhao, Q. (2006). The Fiscal Framework and Urban Infrastructure Finance in China, World Bank Policy Research Working Paper 4051 (The World Bank, 2006).

Tao, R., Su, F., Liu, M. & Cao, G. (2010). Land leasing and local public finance in China's regional development: Evidence from prefecture level cities. *Urban Studies*, 47 (10): 2217–2236.

Warner, M. E., Clifton J. (2014) Marketization, public services and the city: the potential for Polanyian counter movements, Cambridge Journal of Regions, Economy and Society, 7: 45–61.

Warner, M. E., Zheng, L. (2013) Business incentive adoption in the recession, Economic Development Quarterly, 27: 90–101.

Warner, M. E., Pratt, J. E. (2005) Spatial diversity in local government revenue effort under decentralization: a neural-network approach, Environment and Planning C, Government & Policy, 23: 657–678.

Weber, R. (2010) Selling City Futures: The Financialization of Urban Redevelopment Policy, Economic Geography 86(3): 251-274.

Wei, Y. D. (2015). Zone fever, project fever: Development policy, economic transition and urban expansion in China. *Geographical Review*, 105 (2):156–177.

Woodworth, M. D. & Wallace, J. (2017). See ghosts: parsing China's "ghost city" controversy. *Urban Geography*, 38 (8): 1270–1281.

Wong, C. P. W. (2000). Central-local relations revisited: The 1994 tax sharing reform and public expenditure management in China. *China Perspectives*, 31: 52–63.

World Bank (2014). Urban China: Toward efficient, inclusive, and sustainable urbanization Washington, DC: World Bank.

Xu, Y, & Warner, M. E. (2015). "Understanding employment growth in the recession: the geographic diversity of state rescaling." *Cambridge Journal of Regions, Economy and Society* 8 (2):359-377.

Xu, Y. & Warner, M. E. (2016). "Does devolution crowd out development? A spatial analysis of US local government fiscal effort." *Environment and Planning A* 48 (5):871-890.

Yang, D. Y. R. & Wang, H. K. (2008). Dilemmas of local governance under the development zone fever in China: A case study of the Suzhou region. *Urban Studies*, 45(5–6): 1037–1054.

Yeh, A. G. O. (2005). Dual land market and internal spatial structure of Chinese cities. In L. J. C.

Ma and F. Wu, editors, *Restructuring the Chinese City: Changing Society, Economy, and Space*. London, UK: Routledge, 52–69.

Yuan, S. (2008). Land Problems Due to Impetuous Urbanization. *Reform and Policy-Making Internal reference 16*.

Zeng, Z. D. (2010). Building Engines for Growth and Competitiveness in China Experience with Special Economic Zones and Industrial Clusters. *Published by 2010 The International Bank for Reconstruction and Development / The World Bank.*

Zhang, L. (2008). Conceptualizing China's urbanization under reforms. *Habitat International*, 32 (4): 452–470.

Zhang, Q., Wallace, J., Seto, K. & Deng, X. (2014). Central vs. local states: Which matters more for China's urban growth? *Land Use Policy*, 38: 487–496.

Zhu, J. (1999). Local growth coalition: The context and implications of China's gradualist urban land reforms. *International Journal of Urban and Regional Research*, 23 (3): 534-548.

CHAPTER 5

FINANCIALIZATION OF CHINA'S URBANIZATION: WHAT DRIVES LOCAL GOVERNMENT TO BORROW?

Abstract

This paper explores different institutional motivations behind the prevalent debt-financed investment and urbanization in China. Under the state rescaling framework, I discuss China's unique institutional settings, such as vertically unbalanced fiscal decentralization, local financial limitations, political centralization, the dualist land management system and inter-city competition. They together gave birth to the local government financial platforms (LGFPs) and turned their urban investment bond issuances into the major urban finance source for local governments. Urban investment bonds have been used by local governments as fiscal or debt management tools and even competition tools rather than for development only. Specifically, my model shows that the budgetary fiscal gap, existing loans, land premiums, neighbors' issuances, and state fund transfers affect local issuance. This raises planning and governance concerns on the risks of government debt, draws attention to the efficiency and accountability of local finance and investment, questions the sustainability of the current reliance on the land-based and debt-based urbanization model, and highlights the role of state policy in a multilevel structure.

I collected WIND financial data for each bond issuance of LGFPs from 2002 to 2016. I also use government finance data, land lease data, and socioeconomic data from 2006 to 2015, for a study on all prefecture-level cities (N=290) in China. A spatial panel model, Geographical Weighted Panel Regression, is developed in this paper, which combines the nonparametric Geographical Weighted Regression technique for optimal adaptive subsampling and fixed effects

econometric methods for panel regression, to show the spatial diversity of the mechanisms behind local borrowing. This methodological advancement enables future studies to explore the spatial heterogeneity of statistical relations using different panel datasets.

Generally, cities in more developed coastal regions tend to issue bonds for competition purposes (competition game), while issuances of localities in less developed regions are mostly driven by previous debt-repayment need and the capitalization of land resources (hunger game). State policy, through fund transfers, also plays important but divergent roles across space. It either functions as a substitutive finance tool for places with less capacity and higher need, such as the north and the west, or promotes more local debt-finance efforts and inter-jurisdictional competition for state funds in places with capacity, such as the east. Our models enable location-specific explanations of local debt-financed investment and provide regional implications for more efficient, sustainable and accountable urban finance schemes. This requires state to link local fiscal stresses, inter-city competition, land capitalization and local debt issuance together by increasing monitoring and scrutiny of local fiscal situation and debt, as well as implement spatial or regional plans to promote inter-city collaborations.

Keywords: Debt-Financed Investment, Local Government Financial Platforms, Inter-city Competition, State Rescaling, Geographical Weighted Panel Regression

Introduction

China has been experiencing dramatic urbanization in terms of scope and speed. The rapidly urban economic growth is driven by massive state-led infrastructure investment (Wu, 2010). Such investment is mostly undertaken at the municipal level with a unique debt-financed development

model via the formation of local government financial platforms (LGFPs) (e.g., Feng, 2013; Cheng et al., 2017; Pan et al., 2017).

It is important to understand the local debt-financed investment and urbanization model in a multi-level governance framework. The formation of LGFPs and their bond issuances can be understood as local responses to China's institutional reforms under state rescaling. These include fiscal decentralization, local financial limitations, political centralization, economic-based cadre promotion, the dual land system, and divergent impacts of state policy across space. Thus, urban investment bonds can be pursued for different purposes beyond development, such as inter-jurisdictional competition and debt-servicing. This raises the issue of efficiency and accountability of local debt finance.

Since late 2008, when the central government issued a 4 trillion RMB fiscal stimulus to shield the domestic economy from global crisis, LGFPs and urban investment bonds, have proliferated to become the major urban finance tool for China's cities (State Council, 2010). However, from US and European studies, with higher local shares of infrastructure responsibility (Pagano and Perry, 2008), and the increasing reliance on risky speculative development and financialization of urban assets (Davidson and Ward, 2013; Weber, 2012), the long-term flexibility, efficiency, equity and accountability of local planning and development might be undermined (Siemiatycki, 2010). In China, the rapidly rising debts of LGFPs has imposed burdens and risks on local governments in that most LGFP debts lack transparency, accountability, and repayment ability. They are often directly or indirectly guaranteed by local governments. This may further undermine the whole financial system and the macroeconomic stability of China.

Thus, this paper will explore different institutional motivations for the prevalent debt-financed investment and urbanization model in China. It examines different purposes of local bond

issuance in terms of fiscal, financial, political and economic reasons. Then a spatial panel model, Geographical Weighted Panel Regression, will be developed to show the spatial diversity of mechanisms behind local borrowing as well as the divergent direct and indirect/spillover impacts of state policy on local debt-finance across spaces.

Local Fiscal Gap

In the 1994 fiscal reform, China has established a tax sharing system to request local governments share their revenues proportionally to the central state (Wong, 2000; Knight and Shi, 1999; Chung, 1994), to increase the central share in revenue and fiscal control (Lin and Yi, 2011; Liu and Lin, 2014; Tsui, 2011; Wu, 2010). Meanwhile, more urbanization responsibilities have been decentralized to cities to increase local fiscal stress. According to the World Bank (2014), under China's fiscal decentralization, local governments undertake around 85% spending responsibilities but only shares 55% of total government revenues. Thus, local governments have to rely on extra-budgetary finance resource from the market.

Local Government Financial Platforms

The 'Budget Law' (Article 28) of China prohibits local borrowing through the bond market. Therefore, local governments created the quasi-government entities - Local Government Financing Platforms or local financing vehicle companies (hereafter referred to as 'LGFP') as their "credit cards", to borrow money for them. To meet borrowing requirements and smooth bond issuance, local governments also injected different public assets, such as land use rights, budget revenues, and other public facilities, into LGFPs (Tsui, 2011; Lu and Sun 2013; World Bank, 2009). LGFPs thus have become the major financing agent in urbanization.

The first such company was built by the Shanghai municipal government in 1992 to finance the development of New Pudong District, especially for the infrastructure of bridges connecting the Puxi and Pudong Districts. The success of Shanghai's mode inspired other cities in the coastal regions to follow this LGFP debt-financing mode. In addition, following the central policy of "Western Development", many inland cities in western regions also established LGFPs. In 2001, Huang Qifan, the chief in the Pudong District's development in Shanghai, brought the experience of LGFP to Chongqing after he was appointed Vice Mayor of Chongqing. In 2002, Chongqing municipal government established 8 LGFPs to undertake the investment and management of infrastructure and urban construction, to form the famous "Chongqing Big Eight Urban Investment Companies"[15]. This attracted the attention of the World Bank to conduct research (World Bank, 2009) on this "ideal off-budget platform of local government" in Chongqing.

In late 2008 recession, the central state issued a fiscal stimulus of 4 trillion RMB and left the 2.82 trillion RMB debt to local governments. LGFPs played an important role to help local governments approach credit and capital from the bond market for investment, and this brought about a local debt explosion in 2009. In addition, the People's Bank of China, China's Central Bank and the Regulatory Commission also supported local governments to explore different urban investment and finance sources, especially via the establishment of LGFPs and bond issuance in 2009.

[15] *The 8 LGFPs are: (1) Chongqingshi Chengshi Jianshe Touzi Gongsi, for infrastructure investment; (2) Chongqingshi Kaifa Touzi Youxian Gongsi, for financial services; (3)Chongqingshi Dichan Jituan, for real estate development; (4) Chongqingshi Shuiwu Konggu Jituan, for water supply and sewerage services; (5) Chongqingshi Gaosugonglu Fazhan Youxian Gongsi, for highways; (6) Chongqingshi Jiaotong Lvyou Jituan, for tourist facilities; (7) Chongqingshi Shuili Touzi Jituan, for hydroelectric power generation; (8) Chongqingshi Nengyuan Touzi Jituan, for energy supply.*

Thus, LGFPs have thrived as an urban finance innovation since 2009 with more and more local governments establishing new LGFPs. In May 2009, statistics from the China Banking Regulatory Commission showed 8,221 LGFPs have been established at the subnational level, among which 4,907 were registered at the county level. The number of LGFPs then increased to over 10,000 according to the 2010 Report on Regional Financial Operations of the People's Bank of China.

The mushrooming number of LGFPs is accompanied by rapidly increasing local debt. According to the National Audit Office of the People's Republic of China (NAO) in 2011, local debt had reached 5.57 trillion RMB before the global financial crisis. Encouraged by the central stimulus package and the proliferation of LGFPs, by the end of 2010, local government debt had almost doubled to reach 10.7 trillion RMB, with 4.97 trillion RMB from LGFPs (NAO, 2011). The total local government debt equaled to 27% of GDP in 2010 (NAO, 2011). Moreover, the State Council in 2010 issued more strengthened regulation on LGFPs and their bank loans. This caused urban investment bonds to replace bank loans as the major source of urban finance (State Council, 2010). However, this rising debt has imposed burdens and risks to local governments as they are often directly or indirectly guaranteed by local governments. They also usually lack transparency, accountability, and may increase the risks in the financial system and undermine the macroeconomic stability of China (Tsui, 2011).

Dualist Land Management System

If fiscal decentralization and financial limitations gave birth to the LGFPs and debt-financed investment, the unique land management system in China has enabled and enhanced such practices by increasing local debt-service capacity through the support of land revenues (Pan et al., 2017). China has a dualist land management system to divide national land into urban state land

and village collective owned rural land. The use rights of urban land can be traded or leased to developers through tendering, auction and listing and even through negotiations. As the sole land supplier, local governments are able to reap monopoly rents and use land as the major off-budgetary resource to finance urbanization (Lin and Zhang, 2014; Lin et al., 2014; Tao et al., 2010).

More importantly, land revenues have enabled LGFPs to pursue more debt-financed investment as the major source and subsidies to LGFPs for their operating and debt-servicing (Feng, 2013; Pan et al., 2017). Land and its using rights are also the most important assets or collateral to smooth the borrowing and issuance of LGFPs. The debt-repayment capacity of local government highly depends on its capacity to capitalize and financialize land resource, which is unstable and unsustainable, considering its limited amount and sensitivity to the general economy.

Political Centralization and Inter-City Competition

In China, there are multiple administrative levels, ranging from the central government, provincial government, deputy-provincial government, prefecture government, county government to town government. The upper-level governments control the key personnel appointments and resource allocations to their subordinate units (He et al., 2015). A unique economic based promotion system – the 'cadre evaluation system' is embedded in this administrative hierarchy. Local governments are often assigned with economic growth benchmarks by the higher-level governments and promotions are based on how well local officials have met these benchmarks during their short terms (5-year) in office (Guo, 2009). The most two important benchmarks are infrastructure and economic growth (Tsui, 2011), which drive local officials to compete with peers with more local investment in infrastructure and boosting economic growth. Thus, such a political system facilitates and encourages more local competition via debt-financed development activities.

First, China's political system fits the Second-Generation Theory (SGT) of fiscal federalism (Oates, 2005) with Chinese characteristics (Peck and Zhang, 2013). It emphasizes a principal-agent model and the primacy of political conformity. The central government acts as a principal, seeking to get local governments, the agents, to behave in a way that promotes the objectives of central officials. SGT focuses on the "administrative federalism" rather than "economic federalism" in the First-generation Theory (FGT) of fiscal federalism (Inman, 2003; Inman and Rubinfeld, 1997; Oates, 1972 and 1999). However, it also creates problems, such as the "soft budget constraint" (Kornai, 1986), in which local governments, the agents, have the incentive to spend beyond their capacities as they have "expectations" that they will be bailed out by the central government through more transfers. Thus, the Leviathan, which is limited by the decentralization under the FGT is released (Brennan and Buchannan, 1980). Local governments are responsible to the principal instead of constituencies, and thus they tend to spend more and borrow more via LGFPs.

Second, the principal-agent model also indicates possible policy imitations and "regional isomorphism" (Chien, 2008). To compete, agents are likely to copy other's successful experiences, such as LGFPs, and follow the central policies for political conformity, e.g., the central supports of LGFPs and bond issuance in 2009. Thus, borrowing may not be based on the real investment demand but on the borrowing activities of peers, which send the signals and pressures to localities to follow the same finance channel through LGFPs. The inter-jurisdictional contest then is on.

Third, besides the economic-based evaluation system, China's principal-agent model has a quick turnover for local officials. They often serve a five-year term and try their best to 'polish' their resumes within their terms (Pan et al., 2017) to get promoted. Studies show a positive relationship between the turnover years, e.g. 4th or 5th year and local economic performance (Guo,

2009; Li and Zhou, 2005), which confirms the 'effort' of city officials for economic growth at the end of their terms for promotions. The debt-financed mode fits this system very well as local officials can borrow money to spur the short-term growth to get promoted and leave the debt burden to future administrations. Such incentives may result in short-sighted investment and myopic development plan to sacrifice the long-term goals as new officials may implement totally different policies and plans for their own later promotion. This highlights the important role of LGFPs as a tool for local officials to compete with peers.

Intergovernmental Relationships and State Rescaling

In the multi-scalar government system in China, the state or the central government is very critical in affecting local finance and debt accumulation.

The spatial logic behind state policies can be well described by the western state rescaling theory (e.g., Brenner, 2004 and 2009; Cox, 2009). The theory emphasizes the varieties of the spatial mechanisms of the state. According to Brenner (2004 and 2009), state policies are expected to be redistributive to function under the notion of "Spatial Keynesianism" to implement compensatory spatial policies for poorer areas and less developed places, which is called "old state space". However, within the context of globalization, a different spatial logic of western state policy has emerged, where places with more competitiveness become more favored and get more support from the state as the new scale (e.g., Peck and Tickell, 1994) and the "new state space" (Brenner, 2009) compete globally for the state. Therefore, state funds can play a substitutive role to transfer into places in need, to reduce their fiscal pressure and the incentives to borrow (e.g., Ladd and Yinger, 1994; Johnson et al. 1995; Warner, 2001), or it can also play a complementary role to flow into areas with more economic competitiveness, to encourage more local efforts by privileging places with higher capacity (e.g., Jessop, 2002; Scott, 2001; Sassen, 2005; Storper,

2013). These US and EU studies show that the former may result in a convergent regional landscape by ameliorating fiscal stress for distressed localities, while the latter may create divergent regional performance and exacerbate regional disparities. The diversity of "state spatial selectivity" results in the expectations of different impacts on local governments (Xu and Warner 2015 and 2016; Warner and Pratt, 2005; Lobao and Adua, 2011).

This study also considers the possible horizontal spillover effects from state rescaling, which have yet to be addressed both theoretically and methodologically. Based on the inter-city competition and principal-agent frameworks, the locality is expected to not only respond to the state transfers it receives, but also to react to the state funds received by neighboring localities. For example, if the neighboring cities are more favored as "new state spaces", and get more complementary transfers and funds, this may send the signal to the targeted locality to increase their own efforts via bond issuances, to compete with neighbors for state funds. In addition, cities may choose to decrease their effort when they observe the increasing state funds received by their neighbors. Thus, we expect the spatial diversity of both the direct and indirect/spillover effects of state rescaling via fund/transfers on local debt-financed development.

Research Question

This study will focus on debt-financed investment and urbanization in China and explore different institutional driving forces. These include fiscal stress under decentralization, premiums from land management, inter-city policy competition, economic competition and state fund competition etc. We also explore the spatial heterogeneity of the impacts from these factors. The study not only shows the spatial diversity of the mechanisms for local debt-financed activities but also captures the spatially varied direct and indirect effects of state rescaling on local debt accumulation.

Data and Methodology

Data Sources

I collect urban investment bond data from the WIND database from 2002 to 2016. I drop the duplicate bond data since WIND records a bond as two different bonds if it is traded on both exchange and inter-bank markets. The bond specific data contains rich information, such as the length of the bond, interest rate, issuing subject, issuing value, issuing date, issuing purpose, maturity date, shareholders, ratings of bonds and issuers etc. for all the 5487 bonds within the past 15 years. Other data in this study include urban finance data, collected from China Urban Construction Yearbook from 2006 to 2014; local government finance data, collected from the China City Yearbook from 2006 to 2014; land finance data, processed from China Land and Resources Statistical Yearbook including the amount of land supply and the revenue from land lease of municipal governments from 2006 to the most recent available year in 2014.

This study covers all municipal governments (N=290) in China from 2006-2014 to capture the proliferation period of urban investment bonds since 2009 and rapid local debt accumulation in the most recent years. We aggregate all local debts in terms of the quantity and value by municipalities. There are 4 state-directly-controlled municipalities (Beijing, Shanghai, Tianjin and Chongqing), 17 other provincial capitals, 15 sub-provincial cities, and 254 other prefecture cities included in this study. Municipal governments are below provinces and above counties/districts. They are one important part of China's local government apparatus since they are assigned with important fiscal, economic and demographic development and management responsibility. Most municipalities geographically include urban districts, counties, county-level cities, townships and villages, showing a more complete picture of local government debt through urban investment

bonds. In addition, the municipalities are also the unit with stable boundaries that enable studies of change over time.

Dependent Variable - Urban Investment Bonds

The dependent variable is the value of urban investment bond issuance as the proxy for local debt-finance, especially for infrastructure development. Compared to the municipal bonds in western countries, urban investment bonds can be regarded as 'quasi-municipal bonds' (Feng, 2013). First, they are issued by financing companies that are owned or directed by local governments on behalf of the local government. Since local governments provide them with assets and revenue guarantees, local governments and financing companies can be regarded as a single entity with mutual obligations. In addition, while they are issued as enterprise bonds and not tax-free, they function as municipal bonds for public projects, such as utilities, infrastructure, construction, real estate, energy and even finance etc. In fact, the explosion of urban investment bonds in China is related to the increasing demand of urbanization, as well as the demand of local governments to expand their spending when facing global financial crisis. The cost of financing for urban investment bond is often higher than the average level for enterprise bonds. The repayment responsibility largely falls on local government instead of the financing companies, which creates this mismatch between obligations of repayment and authority of borrowing, and relatively high risk of defaulting. In contrast to traditional municipal bonds, which local government is not allowed to issue, the issuance of urban investment bond via LGFPs is not subject to local democratic processes.

According to the Wind Financial Information database, from 2002 to 2006, 5487 urban investment bonds were issued with a value of 6.09 trillion RMB. Among them, there are 2380 bonds with value of 3.05 trillion RMB issued by LGFPs directed by provincial-level governments,

2293 bonds valued at 2.25 trillion RMB from LGFPs at prefecture-level governments, and 814 bonds were 0.78 trillion RMB issued by LGFPs at county-level governments. Figure 14 shows the change of urban investment bond issuances over the years. The bars represent the value of issuances from 2002 to 2016, decomposed by the types of government, while the trend line is measuring the count of urban investment bond issuance. Before 2009, there are a few cities that issued urban investment bonds to finance their urbanization. Since 2009, encouraged by the fiscal stimulus from the central government, urban investment bonds started to proliferate to become the major urban finance tool for local governments. The trend line for issue quantity helps identify 3 jumping points in 2012, 2014 and 2016. The bond issuance values in 2009 increased to 52.7 billion RMB from 7.0 billion RMB in 2008 while local government debt through urban investment bonds surged in 2012, reaching 574.6 billion RMB, an increase that is more than 3 times the level in 2011 and more than 10 times the level in 2009. After 2012, the issued value of urban investment bonds doubled by 2014 (1188.6 billion RMB) and doubled again by2016 (2014.1 billion RMB).

Before 2006, all urban investment bonds were issued by LGFPs of provincial governments. Prefectural-level issuance saw a dramatic growth between 2006 and 2013 and exceeded the provincial level issuance in 2011 (50% from prefectural-level vs. 35% from provincial-level) and 2012 (47% from prefectural-level vs. 41% from provincial-level). Starting from 2008, there is an increase of issuance at county-level government (16% in 2016), but the prefectural-level government and provincial-level governments are still the major subjects for debt-financing, accounting for around 40% for each. However, the growth of issuance from lower-level governments may undermine the quality of bonds and the capacity of repayment.

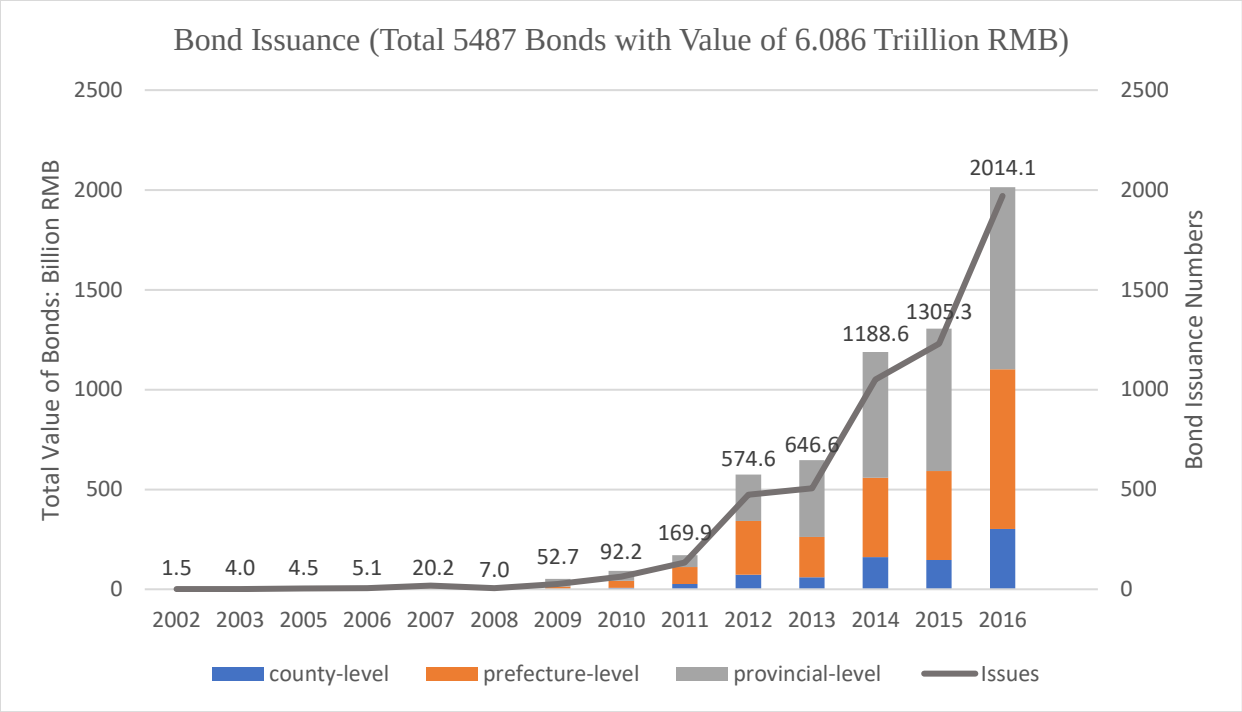


Figure 14 Bond Issuance in China from 2002 to 2016

Data Source: Wind Financial Data of Urban Investment Bond 2002-2016

Figure 15 displays the maturity date and the left value to pay for all the urban investment bond debts if no more bonds will be issued in the future. Most urban investment bonds are due between 2017 and 2024. In 2018, there is a leap in debt due, increasing from 296.8 billion RMB in 2017 to 911.6 billion RMB. Between 2019 and 2021, the left to pay for previous urban investment bonds is more than 1 trillion RMB and reaches the peak of 1.49 trillion RMB in 2021. Then the repayment due will drop to 813.9 billion RMB in 2022. If LGFPs no longer issue bonds after 2017, the debt pressure will be gone in 2025 with 47.6 billion RMB to pay. Except for year 2026 with 93.7 billion RMB to pay, local governments only need to pay a small amount of money for the left debt (if no more bonds will be issued) in the out going years. However, considering the limited and unstable fiscal capacity of local governments mentioned previously, local governments often borrow more money through bond issuances to pay and extend their existing debts. This may

change the “develop by borrowing” (Pan et al., 2017) into “debt-management by borrowing” to trap local governments in a vicious cycle.

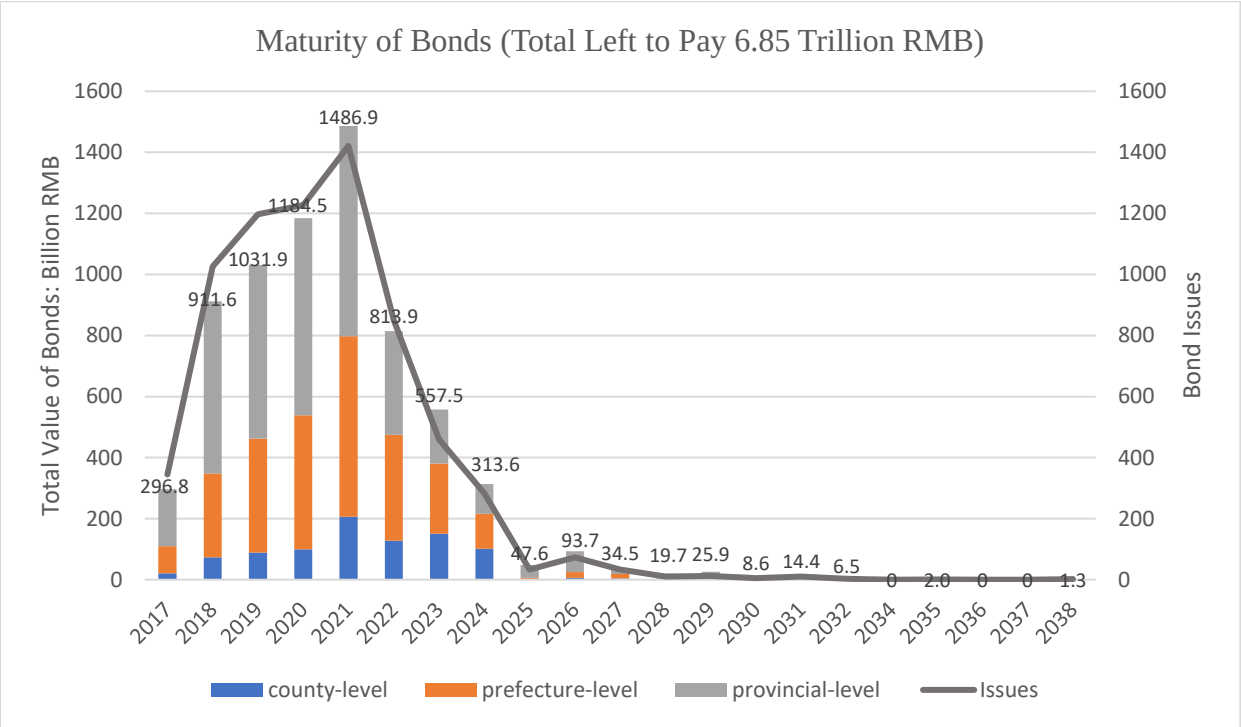


Figure 15 Maturity (The Left to Pay) of Bond Issuance in China 2017

Data Source: Wind Financial Data of Urban Investment Bond 2002-2016

Urban investment bond issuances are not geographically even. Figure 16 measures the total issuance values for all the municipalities from 2002 to 2016. From the map, we can see that urban investment bond issuances are higher in more developed areas, such as the Coastal regions, especially the Eastern Coast, as well as part of the Southwest and Middle Yangtze River regions. In contrast, municipalities in the Northwest, Northeast and Middle Yellow River region tend to issue fewer urban investment bonds. In table 7, two eastern coast provinces, Jiangsu and Zhejiang, are ranked as the 1st (997.0 billion RMB) and the 3rd (363.8 billion RMB) in terms of the highest issuance. Chongqing and Sichuan in the southwest issued 350.0 billion RMB and 276.5 billion RMB bonds to be ranked as 4th and 7th. Other provinces with higher issuance include Hunan (2nd,

379.5 billion RMB) and Hubei (10th, 213.4 billion RMB) in the Middle Yangtze River region, Tianjin (5th, 344.2 billion RMB), Beijing (8th, 268.3 billion RMB), Shandong (6th, 293.2 billion RMB) in the Northern Coast region, and Guangdong (9th, 236.7 billion RMB) in the Southern Coast region. In contrast, provinces in the bottom 10 are mostly from the Northwest, Northeast and Middle Yellow River region, such as Ningxia (12.5 billion RMB), Qinghai (28.0 billion RMB), Heilongjiang (67.9 billion RMB), Shanxi (73.7 billion RMB) etc. Table 7 also lists the maturity by provinces, which shows a very similar geographic pattern with issuance that more developed provinces in Eastern Coast, Middle Yangtze River, part of Northern Coast and Southwest will face more debt burdens compared to provinces in the general north.

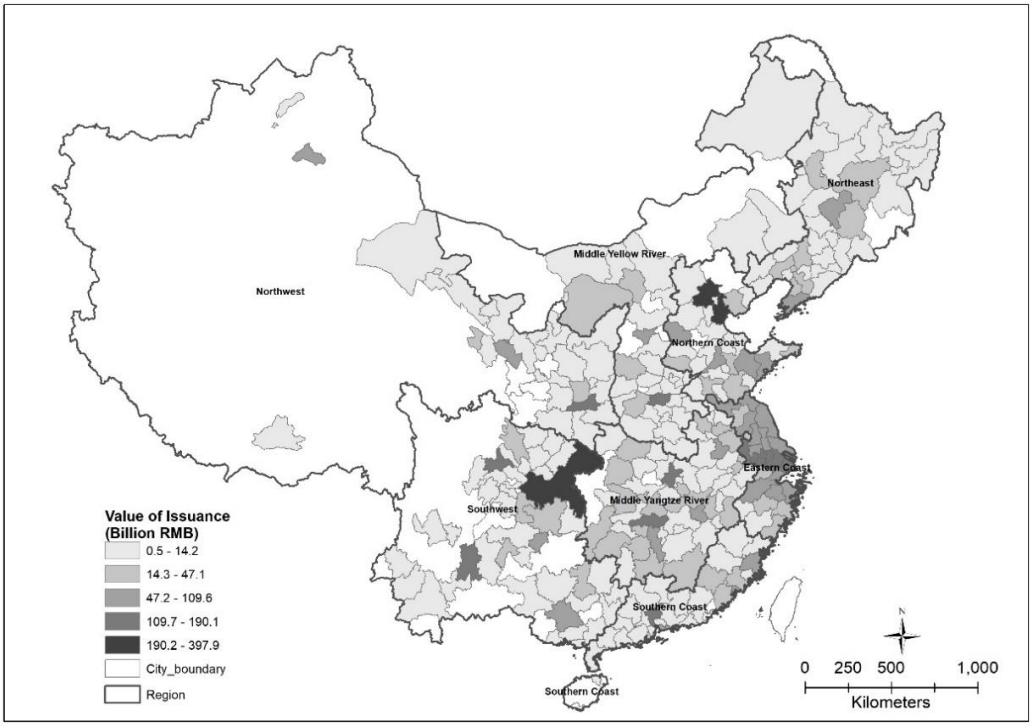


Figure 16 Total Urban Investment Bond Issuance by Municipalities 2002-2016

Data Source: Wind Financial Data of Urban Investment Bond 2002-2016

Table 7 Urban Investment Bond Issuance from 2002 to 2016 and the Left Debt to Pay 2017

Province	Issuance Quantity	Issuance Value	Region		Province	Value Left to Pay	Region
Jiangsu	1092.0	997.0	Eastern Coast		Jiangsu	1200.3	Eastern Coast
Hunan	311.0	379.5	Middle Yangtze River		Hunan	450.7	Eastern Coast
Zhejiang	380.0	363.8	Eastern Coast		Zhejiang	399.0	Northern Coast
Chongqing	316.0	350.0	Southwest		Tianjin	373.5	Northern Coast
Tianjin	184.0	344.2	Northern Coast		Chongqing	366.8	Middle Yangtze River
Shandong	285.0	293.2	Northern Coast		Sichuan	328.7	Southern Coast
Sichuan	273.0	276.5	Southwest		Beijing	310.4	Middle Yangtze River
Beijing	148.0	268.3	Northern Coast		Shandong	300.6	Southwest
Guangdong	179.0	236.7	Southern Coast		Guangdong	275.0	Middle Yangtze River
Hubei	209.0	213.4	Middle Yangtze River		Hubei	271.1	Southwest
Anhui	188.0	209.6	Middle Yangtze River		Anhui	253.8	Southern Coast
Fujian	219.0	207.7	Southern Coast		Fujian	231.9	Middle Yangtze River
Jiangxi	172.0	203.9	Middle Yangtze River		Henan	218.1	Southwest
Liaoning	160.0	202.2	Northeast		Jiangxi	210.5	Middle Yellow River
Henan	160.0	185.0	Middle Yellow River		Yunnan	193.0	Northern Coast
Guizhou	138.0	179.8	Southwest		Guizhou	189.4	Southwest
Yunnan	153.0	160.0	Southwest		Liaoning	181.7	Northeast
Shaanxi	138.0	152.1	Northwest		Shaanxi	171.8	Southwest
Guangxi	151.0	139.7	Southwest		Guangxi	165.2	Northwest
Shanghai	93.0	121.2	Eastern Coast		Shanghai	122.9	Northwest
Xinjiang	121.0	106.3	Northwest		Xinjiang	113.8	Eastern Coast
Hebei	87.0	94.8	Northern Coast		Hebei	101.2	Northern Coast
Shanxi	51.0	73.7	Middle Yellow River		Jilin	84.3	Northeast
Gansu	56.0	73.2	Northwest		Shanxi	77.9	Northeast
Jilin	57.0	70.0	Northeast		Gansu	76.9	Middle Yellow River
Heilongjiang	66.0	67.9	Northeast		Neimenggu	65.8	Middle Yellow River
Neimenggu	62.0	66.1	Middle Yellow River		Heilongjiang	64.9	Northwest
Qinghai	20.0	28.0	Northwest		Qinghai	27.8	Northwest
Ningxia	10.0	12.5	Northwest		Ningxia	13.7	Northwest
Hainan	7.0	9.2	Southern Coast		Hainan	9.2	Southern Coast
Xizang	1.0	0.9	Northwest		Xizang	0.9	Northwest

Unit: Billion RMB; Regional Division is based on the National Development and Reform Commission[16]

Data Source: Wind Financial Data of Urban Investment Bond 2002-2016 and Aggregated by Author

[16] *China is divided into eight regions based on their socioeconomic development levels.*

Independent Variables

Table 8 displays the descriptive statistics for all model variables. We expect local debt through bond issuance to be influenced by fiscal management and inter-city competition under decentralization within China's multilevel governance system.

Fiscal Management

Budgetary Fiscal Gap: within China's fiscal decentralization system, local governments are facing a widened fiscal gap and actively seek off-budgetary revenue sources, by issuing more urban investment bonds via LGFPs. This vertical imbalance is calculated as the difference between expenditure and revenue. In Table 8, the average fiscal gap for municipal governments at the prefectural level is 8.27 billion RMB from 2006 to 2014. The mismatch between budgetary revenue sources and spending responsibilities is high in the Southwest with 11.32 billion RMB per city per year as well as a large standard deviation of 18.99 billion RMB. Thus, we expect the positive impacts of the budgetary fiscal gap to drive more local bond issuances via LGFPs.

Government Loan: The existing government loan for urban construction and management in the previous year is another important factor to encourage more local issuance, to pay off previous loans (e.g., Cheng et al., 2017). The average government loan for urban construction is 1.16 billion RMB. Cities in two Coastal regions of the Eastern Coast and the Northern Coast have the highest level of government loans, with 2.58 billion RMB and 2.53 billion RMB. Urban investment bonds via LGFPs have been used as a repayment source or debt-servicing[17]. We expect existing loans and the repayment burdens will increase bond issuances because they are less restrictive and transparent via LGFPs.

[17] *16.9% of urban investment bonds from 2002 to 2016 are issued for financial purpose according to WIND data.*

Table 8 Descriptive Statistic of Model Variables of Local Bond Issuance by Regions 2006-2014

Variables/Regions	Total	EC	NC	SC	NE	MYL	NW	MYZ	SW
Bond Issuance [a] (billion RMB)	1.52	4.11	2.69	1.12	0.85	0.70	0.82	1.23	1.59
	(5.24)	(6.49)	(10.16)	(3.26)	(2.39)	(2.81)	(2.94)	(3.32)	(6.32)
Fiscal									
Budgetary Fiscal Gap [b] (billion RMB)	8.27	6.17	9.81	5.20	7.38	8.74	7.84	8.08	11.32
	(10.60)	(15.02)	(8.43)	(4.23)	(5.44)	(6.25)	(7.56)	(6.69)	(18.99)
Government Loan [c] (billion RMB)	1.16	2.58	2.23	0.99	0.78	0.26	0.81	0.97	1.24
	(4.15)	(4.71)	(6.70)	(4.06)	(2.24)	(0.97)	(2.90)	(4.36)	(4.55)
Negotiated Land Revenue [d] (billion RMB)	0.49	1.05	1.07	0.71	0.30	0.30	0.18	0.35	0.33
	(1.31)	(1.74)	(1.57)	(2.43)	(1.21)	(0.42)	(0.42)	(0.81)	(0.82)
Auctioned Land Revenue [d] (billion RMB)	7.58	24.83	13.79	7.28	5.50	3.41	1.74	5.45	5.63
	(15.41)	(25.71)	(23.32)	(10.85)	(12.15)	(5.14)	(3.28)	(7.68)	(15.68)
State Fund for Urban Maintenance [c] (%)	3.66	0.79	1.52	1.66	6.61	2.23	7.65	2.93	5.28
	(9.10)	(1.52)	(4.06)	(5.94)	(10.59)	(5.42)	(15.90)	(6.29)	(11.23)
State Fund for Urban Investment [c] (%)	12.81	6.93	10.31	10.31	10.74	10.91	13.28	8.90	11.39
	(22.18)	(16.81)	(22.81)	(23.81)	(17.47)	(24.81)	(24.73)	(21.58)	(22.77)
Competition									
Neighboring Issuance [a] (billion RMB)	1.08	2.41	1.92	0.79	0.62	0.63	0.55	0.97	1.21
	(2.46)	(4.00)	(4.24)	(1.64)	(1.09)	(1.31)	(1.35)	(1.68)	(2.67)
Neighboring Fixed Assets Investment [c]	3.73	5.63	7.11	3.05	3.17	2.21	1.86	3.94	3.65
(billion RMB)	(4.69)	(5.00)	(8.36)	(3.74)	(2.84)	(2.26)	(2.63)	(4.14)	(4.52)
Neighboring Gross Regional Production [b]	155.48	289.88	278.44	195.80	136.82	129.27	63.21	124.79	109.61
(billion RMB)	(137.18)	(213.24)	(159.35)	(173.24)	(73.52)	(64.35)	(60.14)	(78.01)	(94.52)
Neighboring State Fund for Urban	3.74	1.36	1.31	2.25	6.19	2.98	6.84	2.98	5.17
Maintenance [c] (%)	(0.05)	(1.57)	(1.73)	(3.38)	(5.17)	(3.46)	(7.87)	(3.29)	(6.58)
Neighboring State Fund for Urban	10.11	7.92	11.25	8.86	9.74	11.68	10.16	9.79	10.75
Investment [c] (%)	(0.17)	(14.38)	(20.81)	(15.36)	(12.60)	(19.94)	(15.63)	(17.85)	(15.23)
Total Population [b] (in 10,000)	433	545	634	382	308	443	242	448	475
	(307)	(268)	(299)	(195)	(206)	(282)	(166)	(228)	(468)
Gross Regional Production per capita [b]	34421	55785	43219	43163	36089	35072	30564	26584	20599
(RMB/person)	(28773)	(31176)	(27998)	(42260)	(24484)	(30355)	(28264)	(18400)	(12900)
Number of Cities	290	25	30	32	34	37	32	53	47

EC = Eastern Coast, NC = Northern Coast, SC = Southern Coast, NE = Northeast, MYL = Middle Yellow River region, NW = Northwest, MYZ = Middle Yangtze River region, SW = Southwest; From the left to the right, the regions are listed as from the most developed region to the less developed region based on the Gross Regional Production per capita for average city.
Table shows the Mean Values (Standard Deviations) per city per year: a: WIND Financial Data 2006-2014; b: China City Statistical Yearbook 2006-2014; c: China Urban Construction Yearbook 2006-2014; d: China Land and Resource Statistical Yearbook 2006-2014

Land Revenues: Land transfer revenues, as the important off-budgetary source for China's local governments, are included in the model as well. These are differentiated into revenues from the negotiated lease and lease through auctions on the market. The lease through auction often generates higher land revenues considering the bidding process from developers to compete for land with more economic potential. This gives local governments both fiscal and economic confidence to borrow more and invest more. Based on Table 8, land revenues of this type have a huge variation across regions. For example, cities in the three coastal regions are able to obtain higher revenues from their land, e.g. 24.83 billion RMB for cities in the Eastern Coast, 13.79 billion RMB for cities in the Northern Coast and 7.28 billion RMB for cities in the Southern Coast, while in other regions, land revenues are lower, e.g. 1.74 billion RMB in the Northwest and 3.41 billion RMB in the Middle Yellow River region. We expect land revenues from market auctions to be a complementary source to encourage local issuance rather than a substitute which might reduce issuance (Pan et al., 2017).

By contrast, the negotiated lease, which has a relatively lower price, is often used as a subsidy tool to attract developers and compete for capital. Relatively more negotiated land revenues may indicate the "less favored" character of a locality in terms of both development interest and bond market interest. Although negotiated land revenues are still higher in the coastal regions, the difference between coastal regions and other regions is smaller. In general, the negotiated land revenues can neither provide enough fiscal support for debt repayment nor strengthen the economic competitiveness of localities in the bond market. Thus, we expect land revenues from negotiated leases to be negatively associated with bond issuance.

State Fund: We are also interested in capturing the effects of intergovernmental transfers on localities. We consider two types of state funds that are for maintenance and for investment in

fixed assets. They are included as the percentage of urban finance sources for every city. This reveals the "state spatial selectivity" from rescaling (Brenner, 2004 and 2009). They can either play a substitutive role to reduce local fiscal stress and debt borrowing (e.g., "old state space" (Brenner, 2009)), or function as a complement to promote more local efforts on debt-financed investment (e.g., "new state space" (Brenner, 2009)).

In Table 8, 3.7% of urban maintenance revenues are from the state level with a standard deviation of 9.1%, while 12.8% of urban investment sources are funded by state funds with a standard deviation of 22.2%[18]. Cities in the less developed western regions have a higher dependence on state funds for both urban maintenance and investment, e.g. 5.28% and 11.39% in the Southwest and 7.65% and 13.28% in the Northwest. The Northeast, which suffers from economic decline, also has a higher reliance on state funds on average. It is interesting to see that the Northern Coast and the Southern Coast have a higher dependence on state funds for investment even though they are more developed and have the capacity. This is not true for the Eastern Coast. We can see very divergent spatial selectivity and logic of state funds. We thus expect spatial heterogeneity in the impacts of state funds on local effort for urban finance.

Inter-City Competition

Neighboring Issuance: Competition is first measured as the effects from the neighboring issuance in the previous year. A spatial lag term of neighboring issuance is calculated using a queen contiguity-based spatial weights matrix[19] and included to capture peer pressure of urban finance effort of neighboring localities. Such a (weighted) pressure is higher for cities in the

[18] *There is a large variation of state fund for urban construction and maintenance, ranging from 0 to 100% for urban investment, and 0% to 97.37% for urban maintenance*

[19] *This queen contiguity-based spatial weights matrix is developed and applied for all the spatial lag terms.*

developed coastal regions, e.g. Eastern Coast of 2.41 billion RMB and Northern Coast 1.92 billion RMB. It is also higher for cities in the less developed southwestern region with 1.21 billion RMB from neighboring cities. They are all greater than the average of 1.08 billion RMB. We expect that when neighboring issuances increase, the peer pressures of urban finance rise and localities will issue more urban investment bonds via LGFPs in the next year to compete by showing more debt-financed investment.

Neighboring Investment: We also measure competition effects on local borrowing by quantifying the indirect neighboring impacts through the fixed assets investment. To explicitly include this spatial lag term based on the Spatial Durbin Model, our model can show the reaction function of local borrowing to neighboring investment. It is expected to generate peer pressures from neighboring urban investment to further drive the targeted locality to pursue more issuance in the following year.

Neighboring Economic Development: Economic competition pressure is also included as a spatial lag term of neighboring gross regional production level. We expect that higher neighboring economic development level or regional production will create peer pressure for the locality to respond with more debt-financed investments to boost their short-term economic growth.

Neighboring State Fund Dependence: Competition pressure can stem from the spillover effects of state rescaling. If we assume state funds function as a complementary tool to support local borrowing for places with capacity when the neighboring cities are more favored by state capital, the targeted locality will respond by showing more local effort through debt-finance to compete for state funds. When state funds become more redistributive and flow into the neighboring cities with lower capacity and higher need, cities may choose to decrease their effort when they observe the increasing substitutive state funds of their neighbors. Therefore, we expect

both positive and negative of effects from neighboring state funds. This has fiscally captured the diversity of the indirect or spillover effects of state rescaling.

Model Specification

Fixed Effects Model

I choose the fixed effects model to explore the impact of different institutional factors on local issuance that vary over time. A Hausman test[20] is conducted to show that the fixed effects model is more appropriate compared to random effects model for the data.

$$UIB(i\ t+1) = \beta 0 + \beta 1\ FGAPit + \beta 2\ \mathrm{LOAN}it + \beta 3\ SFMit + \beta 4\ SFIit + \beta 5\ \mathrm{LREV}it + \beta 6\ SLGUIBit + \beta 7\ SLGFIXit + \beta 8 SLGGDPit + \beta 9 \mathrm{SLGSFM}it + \beta 10\ SLGSFIit + \beta 11\ POPit + \beta 12\ \mathrm{GDPc}it + \alpha i + \varepsilon it$$

where[21]

$\beta 0$ is the intercept;

αi is the unobserved city-specific intercepts that are not varied over time*;*

$UIB(i\ t+1)$ is the issuance value of urban investment bond for city i in year t+1;

$FGAPit$ denotes fiscal gap for city i in year t;

$LOANit$ the percentage of government loan in urban investment/construction in city i in year t;

$SMit$ captures percentage of state funds in urban maintenance of city i in year t:

$SIit$ measures percentage of state funds in urban investment/construction in city i in year t:

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[20] *The Hausman test is conducted for the selection between the random effects vs. the alternative the fixed effects. Our result shows the unique errors (ui) are correlated with the regressors to reject the null hypothesis that the preferred model is random effects. Thus, a fixed effects model is more appropriate in this case.*

[21] *Multicollinearity is tested for Pooled OLS Model. VIF: max =3.56, min = 1.12, mean =1.88 < 7.5. No multicollinearity is found.*

$LREVit$ represents the revenue from land transfers;

$SLGUIBit$ is the spatial lag term of issuance value from neighboring cities of city i in year t;

$SLGFIXit$ is the spatial lag term of fixed assets investment from neighboring cities of city i in year t;

$SLGGDPit$ is the spatial lag term of Gross Regional Production from neighboring cities of city i in year t;

$SLGSMit$ is the spatial lag term of state fund reliance for urban maintenance from neighboring cities of city i in year t;

$SLGSIit$ is the spatial lag term of state fund reliance for urban investment from neighboring cities of city i in year t;

$POPit$ is the total population of city i in year t;

$GDPcit$ is the Gross Regional Production pec capita of city i in year t;

Geographical Weighted Panel Regression

We are also interested in the spatial divergence of mechanisms for local bond issuance and impacts of state policy. Based on the global fixed effects model, we disaggregate the coefficients using a self-developed Geographical Weighted Panel Regression.

In contrast to the standard econometric global model, the Geographical Weighted Regression (GWR) model focuses on subsampling and weighting the data and enables the investigation of spatial variations in local relationships (e.g., Brunsdon et al., 1996 and 1998; Fotheringham et al., 2002). GWR allows the differential effects across space instead of uniform influence over all locations (Fotheringham et al., 2002).

To obtain local estimates for the target location, the GWR model will first calculate the optimal number of locations (adaptive bandwidth) that are going to be subsampled for local estimation through either a cross-validation method or AIC method. The optimal bandwidth is

calculated to find the most "closed" data points group and capture the spatial heterogeneity between groups. Then, the data or locations within the customized bandwidth or adaptive subsample will be properly weighted in each local regression for the target location. In general, GWR is often considered a nonparametric method that fits local regressions to each specific location in the data, with more weights on observations that are closer to the target. Therefore, for each location, there is a customized bandwidth and weighted subsample for local regression, as well as a set of local estimates.

However, GWR is a technique developed for cross-sectional data only where the weights and influence decline with distance (Fotheringham et al., 2002). Although recent literature of Geographical Temporal Weighted Regression (GTWR) (Fotheringham, 2015) has extended this approach to include time into the weighting scheme by assuming that data points close in both space and time can have a greater influence on the target location with respect to local estimations, the estimation process is still not econometrically focused and tailored, but only adds one dimension of time into the distance and weighting calculations.

In this study, I present a new solution to account for spatial non-stationarity of panel data that combines both the adaptive bandwidth selection, subsampling and weighting from GWR and the fixed effects estimations of panel data. It is different from GTWR, in which once a bandwidth is chosen, all the time observations of each subsampled location will receive the same weight, to reproduce the global fixed effects model at the local level. In other words, the weight is time-invariant and only affected by the data structure and locations of cities. Instead, I control the panel structure with local fixed effects models after subsampling and weighting.

The model has a very good balance of nonparametric method and econometric techniques, in which both spatial heterogeneity of statistical relationships and the very nature of data from the

repeated observations for each location are considered, with geographically weighted local fixed effects models.

The estimation process is divided into the following steps:

1) Demeaning the data: I calculate the mean value, Xi, of data for each locality i within the study period, and then calculate the difference between the observation in each year X*it* and the mean Xi. Thus, the de-meaned data X*it* - X*i* will replace the original data X*it* as inputs;

2) Calculate the optimal bandwidth: in R, I use the spatial layer of prefectural-level cities with demeaning data to calculate the optimal bandwidth based on Akaike information criterion (AIC). This suggests the kth (i.e. 12th in this study) nearest neighbor as the optimal adaptive bandwidth and subsample;

3) Calculate the distance matrix: Pairwise distances d*ij* are calculated for any two locations i and j. The distance matrix will be used to find the adaptive bandwidth h*ik* for the targeted city i. h*ik* is the adaptive bandwidth size. It can be defined as the kth nearest neighbor.

4) Select the adaptive subsample: in R, I developed a loop function to sort the cities by their distance to target city i, and find the nearest city k to each targeted city i to determine adaptive bandwidth for city i;

5) Assign the weights: Once a subsample is chosen for the spatial observations, a weight matrix will be built for each location *i* using the kernel function. I developed some other loop functions to assign the weight W*ij* to all the data in city j for the targeted city i, using the adaptive bi-square kernel function below to weight the data in each subsample:

$$W_{ij} = \begin{cases} (1 - dij^2/hi(k)^2)^{\ 2} & when\ dij < hi(k) \\ 0 & when\ \ dij > hi(k) \end{cases}$$

All the data in city j within the subsample, regardless of the observed years, will be weighted with W*ij* as I will treat the panel structure through the local fixed effects model. In contrast to GTWR (Fotheringham, 2015) that determines the weights based on both time and space proximity of data points, my approach only uses the GWR technique to select the subsample for each location and aims to reveal the nature of the panel structure with econometric technique at the local level, which is a fixed effects model. Thus, for each targeted city, I created a customized and weighted subsample with a size of 99 (10 nearest cities * 9 years and the 12th nearest city will get weight 0 for its distance is the h*i(k)*) for further local fixed effects regressions;

6) Run local fixed effects model: since the data is demeaned already, I just run the local fixed effects model for each city i with its customized subsample and store 290 local model results;

7) Outputs: I export the coefficients, standard error, t-value, p-value, r-squared and adjusted r-squared for 290 local fixed effects models and visualize the results by showing the significant fixed effect estimates and their spatial heterogeneity of these coefficients.

In general, the initial setup of the Geographical Weighted Panel Regressions can be regarded as an extension of the standard cross-sectional GWR model to help customize the subsample for each locality. The estimates of the pooled and weighted time-demeaned data consider the information of the whole sample period, similar to a global panel data model, but

using a local subsample for each regression point. Then I repeat the process for every location to generate a whole set of locally weighted fixed effects estimates.

Global Model Results

Table 9 shows the results of the global pooled OLS model and fixed effects model.

Table 9 Model Results of Pooled OLS and Fixed Effects of Bond Issuance for Chinese Prefectural-Level Cities from 2006 to 2014

	Pooled OLS		Fixed Effects	
Fiscal Management				
Budgetary Fiscal Gap [b] (billion RMB)	0.069	***	0.047	***
	(0.009)		(0.010)	
Government Loan [c] (billion RMB)	0.296	***	0.249	***
	(0.021)		(0.027)	
Negotiated Land Revenues [d] (billion RMB)	-0.111		-0.100	
	(0.060)		(0.070)	
Auctioned Land Revenues [d] (billion RMB)	0.144	***	0.169	***
	(0.007)		(0.010)	
State Fund for Urban Maintenance [c] (%)	0.398		-0.217	
	(0.860)		(0.997)	
State Fund for Urban Investment [c] (%)	-0.612		-0.823	
	(0.410)		(0.444)	
Inter-Competition				
Neighboring Issuance [a] (billion RMB)	0.252	***	0.347	***
	(0.043)		(0.049)	
Neighboring Fixed Assets Investment [c] (billion RMB)	0.023		-0.108	***
	(0.025)		(0.041)	
Neighboring Gross Regional Production [b] (billion RMB)	-0.004	***	-0.006	***
	(0.001)		(0.002)	
Neighboring State Fund for Urban Maintenance [c] (%)	0.627		1.363	
	(1.525)		(1.807)	
Neighboring State Fund for Urban Investment [c] (%)	3.135	***	1.726	**
	(0.557)		(0.597)	
Controls				
Total Population [b] (10,000)	1.59E-04		0.033	***
	(3.31E-04)		(0.005)	
Gross Regional Production per capita [b] (RMB/person)	2.20E-05	***	3.99E-05	***
	(3.40E-06)		(5.31E-06)	
Constant (Intercept)	-1.14977	***	-15.3477	***
	(0.214)		(1.936)	
N	2499		2499	
R-Squared	0.518		0.400	
Adjusted R-Squared	0.525		0.318	

** p<0.05; ** p<0.01; *** p<0.001*

a: WIND Financial Data 2006-2014; b: China City Statistical Yearbook 2006-2014; c: China Urban Construction Yearbook 2006-2014; d: China Land and Resource Statistical Yearbook 2006-2014

It sheds light on the significant impacts of fiscal management and inter-jurisdictional competition on driving local government borrowing from the bond market. The results are very similar across these two models. The goodness of model fit is shown with R-squared and Adjusted R-squared that are 0.518 and 0.525 for pooled OLS regression, and 0.400 and 0.318 for the fixed effects model. The discussion will focus on the fixed effects model results.

Fiscal Management by Borrowing

The budgetary fiscal gap is significant in both the Pooled OLS model and fixed effects model. According to the fixed effects model, an increase of 1 RMB of the budgetary fiscal gap under current fiscal decentralization will drive local governments to issue more urban investment bonds by 0.047 RMB in the next year. This is consistent with our hypothesis that the off-budgetary source through market borrowing has functioned as an important complementary tool to finance China's urbanization.

However, government loans are not playing a substitutive role in local bond issuance. On average, if the existing loan for local governments increases by 1 RMB more, they will issue 0.249 RMB more urban investment bonds in the next year via LGFPs. This positive impact indicates not only the complementary relationships of government loans and local urban investment bonds in China's urbanization but also the possible use of the less restrictive issuance via LGFPs for debt management and repayment.

Land lease also shows a strong positive impact on local issuance. Such an effect is significant for the market-oriented auctioned land revenue while the negotiated land lease revenue is not significant to affect local issuance. Our model confirms the expectations that higher land revenues, as the major repayment source, give more fiscal confidence to local governments and

encourages them to issue more bonds for urban development. For example, an increase of 1 RMB in land revenue from the market auction will support more borrowing of local government in the following year by 0.169 RMB. For the negotiated land lease, it is often used as a subsidy tool for local governments to attract business and compete for development. Development is usually accompanied with a lower level of land price and thus is not enough to build the local fiscal confidence and support local borrowing. In addition, the higher market auctioned land revenue suggests the locality is more economically favored by developers and business, which further justifies the need for urban investment and enhances the confidence of local issuance. In contrast, if local government uses more negotiated land-based urban finance, this indicates relatively lower economic competitiveness, and lower local bond issuance.

Our models also consider multilevel urban finance sources from state funds for urban maintenance and investment. However, we do not find the increased percentage of state funds[22] in urban finance to significantly affect local borrowing by either reducing local debt pressure as a substitutive tool or increasing local bond issuances as a complementary tool. As both positive and negative impacts of state funds are expected across different places, they may offset each other in the global model. We will further disaggregate this impact in our spatial model.

Competition by Borrowing

Urban investment bond issuance is also found to be a competition tool in our model. Considering the peer pressure from China's unique multilevel administration system and promotion scheme, local governments and their officials tend to devote themselves to debt-financed infrastructure development to boost their economic growth in the short-term. For example,

[22] *The p-value of state funds for urban investment% is 0.06 which is very close to significant level of 0.05.*

when the neighboring cities issue 1 RMB more bonds, they will send the signal to the targeted city in the next year to increase its issuance by 0.347 RMB to compete through debt-financed investment.

However, urban investment bond issuance, as the major urban financial tool for urban investment and construction, does not respond to competition pressure from neighbors' fixed assets investment. In fact, when the neighboring cities increase their investment in fixed assets by 1 RMB, the targeted city in the following year will drop its borrowing by 0.108 RMB on average. This may suggest the local competition is manifested as the debt-finance activity itself without consideration of the real demand of fixed assets investment.

Another competition pressure is expected from neighboring economic development. Our model shows when there is an increase, e.g. 1 RMB, of gross regional production in neighboring cities, it undermines the capacity for the targeted city in the next year to attract capital through bond markets by 0.006 RMB. A Higher neighboring economic development level indicates a relative disadvantage of economic competition of the locality in that region.

Although local debt through bond issuance is not responding to state funds, it is found to be driven by the neighbors' state funds for investment. For example, when the percentage of state funds for investment increases by 10% in neighboring cities' urban finance sources, the targeted local government will issue 0.173 billion RMB more urban investment bonds in the next year. This reflects the inter-jurisdictional competition for state funds when neighbors are more favored by state and rely more on state funds for their local investment and growth, the target locality will show more local effort via debt-financing, to compete with peers for more state funds. While this spillover effect of state funds is significant for fixed assets investment, it doesn't show up for urban maintenance purposes.

Controls

The Gross Regional Production per capita is included as a capacity measure. It has a positive impact to drive more local bond issuance. When the economic level increases by 1,000 RMB per person for Gross Regional Production, it will enhance the economic confidence of local governments to issue 0.040 billion RMB more in the next year. This confirms the previous discussion on the impacts of economic competition on local issuance as urban investment bond issuance depends on local capacity. Population size is found to be positively associated with bond issuance as a demand measure for urban investment. When the population grows by 10,000 more, localities need to invest and seek 0.033 billion RMB off-budgetary source from the bond market in the following year.

Geographical Weighted Panel Regression Results

I also run a Geographically Weighted Panel Regression (GWPR) model to show spatial diversity of the mechanisms for local borrowing and capture the spatially varied direct and indirect effects of state rescaling. This technique creates local models by fitting a fixed effects model to every city with customized subsamples. Table 10 displays the summary of our GWPR results for each variable. Although some variables are not significant in the global models, they are significant in GWPR for certain localities. For example, the state fund is not significant to affect local issuance in the global model, but it is significant in 42 cities for urban maintenance and in 95 cities for urban investment. Local significance is also found for negotiated land revenues for 89 cities and neighboring state funds of urban maintenance for 71 cities. Table 10 lists the mean, median, standard deviation, minimum and maximum values for all the significant coefficients to compare with the global average effects from the fixed effects model. One important result is that all the

variables with their significant local coefficients range from negative to positive, indicating a spatial diversity of mechanisms of local issuance and state rescaling effects.

Table 10 Geographical Weighted Panel Regression Results of Bond Issuance for Chinese Prefectural-Level Cities from 2006 to 2014

	Global Fixed Effects Model Coeff	Number of Cities with Significant Coeff	Median of Coeff	Mean of Coeff	Std. Dev. Of Coeff	Min of Coeff	Max of Coeff
Fiscal Management							
Budgetary Fiscal Gap [b] (billion RMB)	0.047***	124	0.083	0.020	0.499	-1.261	2.237
Government Loan [c] (billion RMB)	0.249***	139	0.440	0.327	0.944	-1.858	2.845
Negotiated Land Revenues [d] (billion RMB)	-0.100	89	0.721	0.794	2.692	-4.943	7.353
Auctioned Land Revenues [d] (billion RMB)	0.169***	156	0.162	0.174	0.307	-1.160	1.130
State Fund for Urban Maintenance [c] (%)	-0.217	42	-3.601	-8.011	29.205	-154.191	37.847
State Fund for Urban Investment [c] (%)	-0.823	95	-0.863	-0.219	12.659	-45.595	58.249
Inter-City Competition							
Neighboring Issuance [a] (billion RMB)	0.347***	88	0.213	0.008	0.668	-1.417	2.117
Neighboring Fixed Assets Investment [c] (billion RMB)	-0.108***	67	-0.249	-0.164	0.689	-2.552	1.599
Neighboring Gross Regional Production [b] (billion RMB)	-0.006***	64	-0.017	-0.016	0.044	-0.179	0.163
Neighboring State Fund for Urban Maintenance [c] (%)	1.363	71	-1.693	10.489	93.247	-190.927	381.674
Neighboring State Fund for Urban Investment [c] (%)	1.726**	120	4.469	7.567	15.548	-13.605	100.751
Controls							
Total Population [b] (10,000)	0.033***	128	0.071	0.099	0.153	-0.564	0.532
Gross Regional Production per capita [b] (RMB/person)	4.0E-05***	126	9.2E-05	1.6E-04	2.3E-04	-1.2E-04	2.0E-03

N =290 for all prefecture level cities
a: WIND Financial Data 2006-2014; b: China City Statistical Yearbook 2006-2014; c: China Urban Construction Yearbook 2006-2014; d: China Land and Resource Statistical Yearbook 2006-2014

I map the distribution of local significant coefficients for all variables and chose the most interesting ones to discuss below. They are land revenues from auctions in Figure 17, government loans in Figure 18, state funds for urban investment (direct effects of state rescaling) in Figure 19, inter-city competition of bond issuance in Figure 20, inter-city competition for state funds of investment (indirect effects of state rescaling) in Figure 21. In these figures, all the negative coefficients or impacts are represented in blue, while the positive coefficients are in yellow, orange and red. The non-significant localities are displayed with hollow polygons. The regional

boundaries are shown to differentiate more developed regions, such as the Eastern Coast, the Southern Coast, and part of the Northern Coast, from less developed western and central regions, such as the Northwest, the Southwest, the Middle Yangtze River region and the Middle Yellow River region, and the declining region of the Northeast.

Figure 17 shows the spatial variation of the impacts of auctioned land revenues on local issuance. The dominant impact is positive. It confirms our global model, as land resources and its

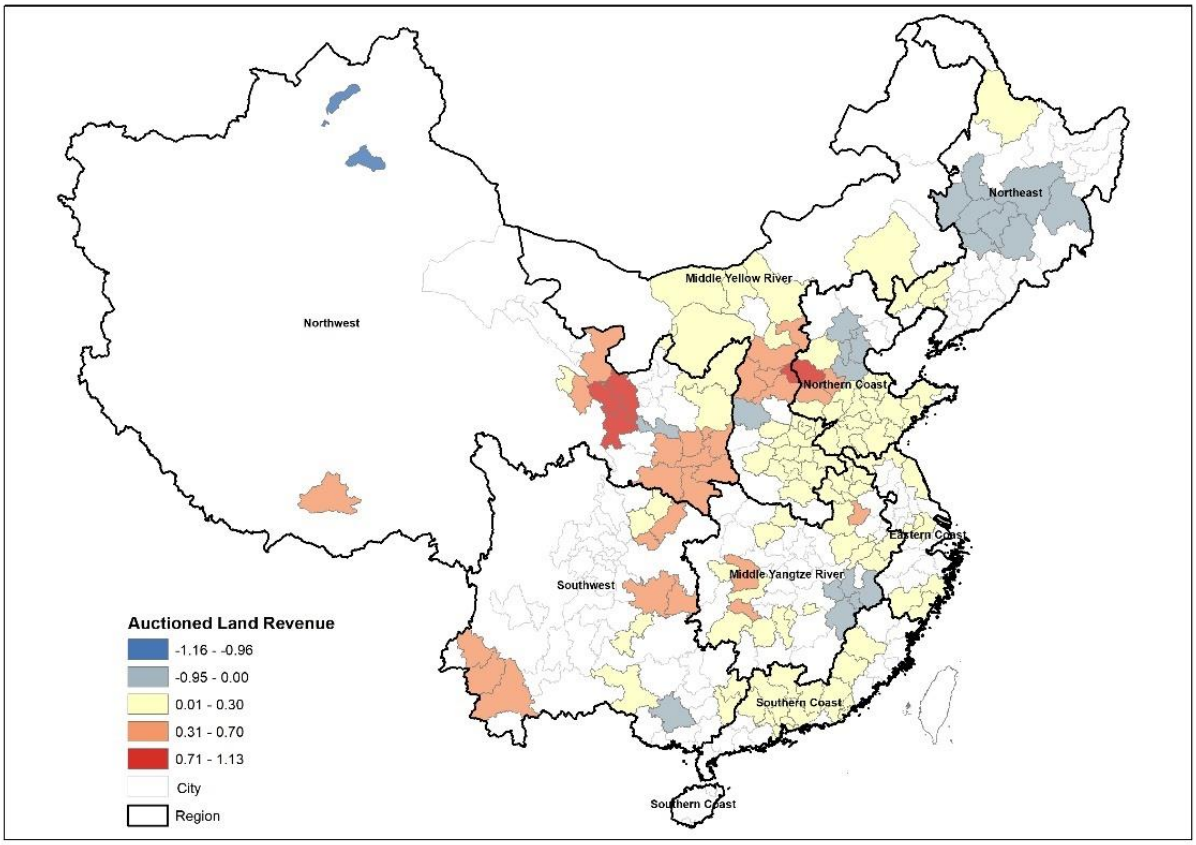

Figure 17 Spatially Varied Coefficients of Auctioned Land Revenues from GWPR 2006-2014

Data Source: Wind Financial Data 2006-2014; China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

revenues are used as the most important collateral for LGFPs to borrow and issue bonds and are the major sources for debt-servicing. From the map, we can see the land-supported local borrowing is prominent in the Western and Northern regions. The issuance of cities in the Northwest, part of the southwest, part of the Middle Yellow River region, and western part of Northern Coast region and Yangtze River region, tend to be affected or supported by land revenues. When 1 RMB increases in auctioned land revenues, cities in red will increase the issuance by more than 0.7 RMB and cities in yellow will expand their bond issuance by more than 0.3 RMB. However, land revenue of some cities has a negative impact on local issuance. These are concentrated in the central part of the Northeast, northern part of the Northern Coast, the eastern part of Middle Yangtze River region, and the far Northwest of China. In these cities, land revenues function as a substitutive urban finance tool for urban investment bonds.

Figure 18 similarly displays the relationships between another finance resource, government loan and local bond issuance. Both positive and negative relationships are found. The negative relationship means local governments choose either loans or bonds to finance urbanization rather than both. When government loan positively drives local issuance, the urban investment bond may be used as a debt repayment source. This debt-pay-debt mechanism of local issuance will further increase the risks of local finance and undermine general economic stability. The map highlights this prominent debt-service role of urban investment bonds mainly in Central China, as well as the northern part of the Southwest, and the boundary between the Northern Coast and Eastern Coast. The increase of 1 RMB of government loan can push 1.69 RMB – 2.85 RMB more bond issuance to possibly help for repayment.

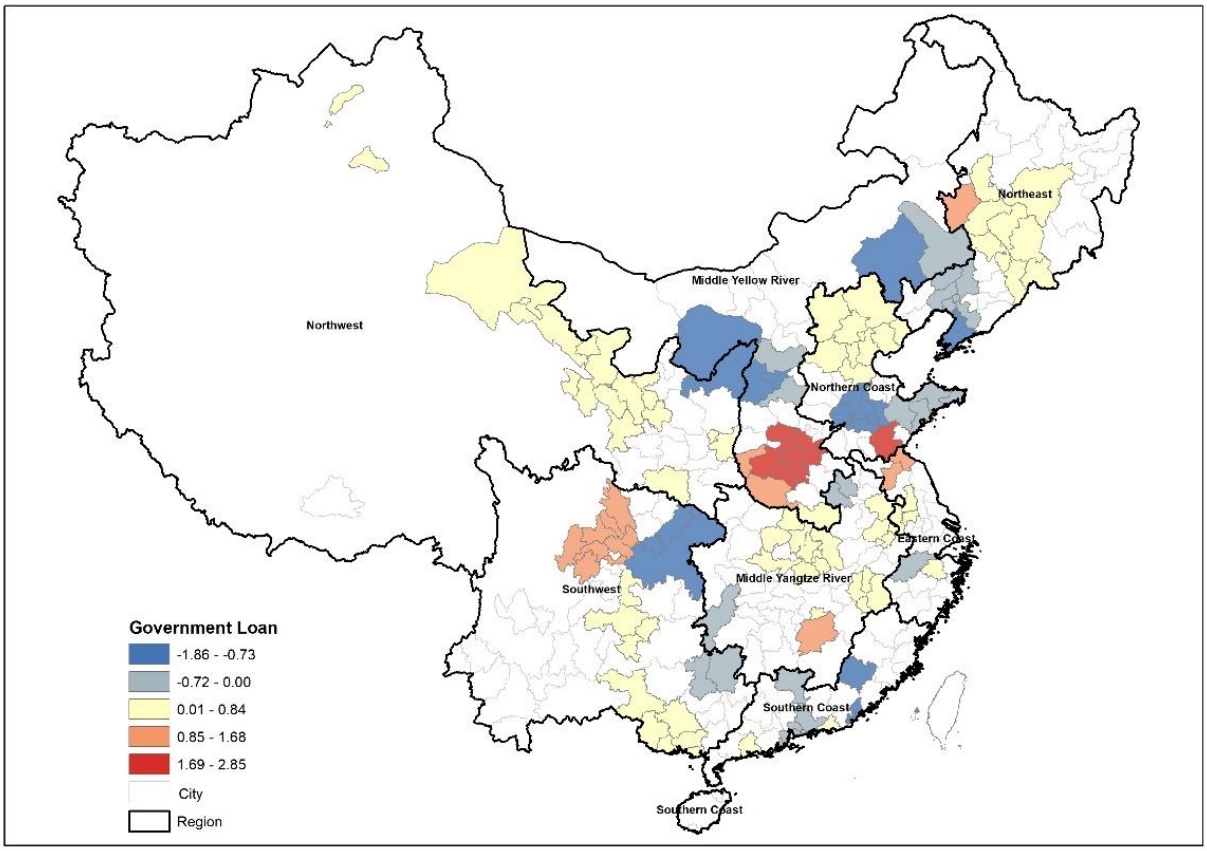

Figure 18 Spatially Varied Coefficients of Government Loan from GWPR 2006-2014

Data Source: Wind Financial Data 2006-2014; China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

Inter-city competition is directly measured by competition through bond issuance in Figure 19. The competition effect is strong to drive local borrowing in the East (three coastal regions) and part of the southwest and Middle Yangtze River region. Cities in these regions will positively respond to their neighbors' bond issuance, by issuing more urban investment bonds to compete. In this sense, bonds are issued as a competition tool rather than a development tool. 1 RMB increase of issuance from neighbors will stimulate the targeted city to issue almost 2.12 billion RMB more bonds. In contrast, some other cities may choose to react differently to reduce the issuance when they observe the rising issuance of neighbors. This can be understood from the

perspective of local capacity that when neighboring cities increase the issuance, it indicates the lower competitiveness and attractiveness of the targeted locality to issue bonds. They also may not have the capacity to compete in the bond market. Therefore, in more developed coastal regions, cities tend to respond to this competition with positive reaction functions to neighbor's bond issuance, while in the less developed inland regions, there is less competition as illustrated by a negative relation to neighboring bonds.

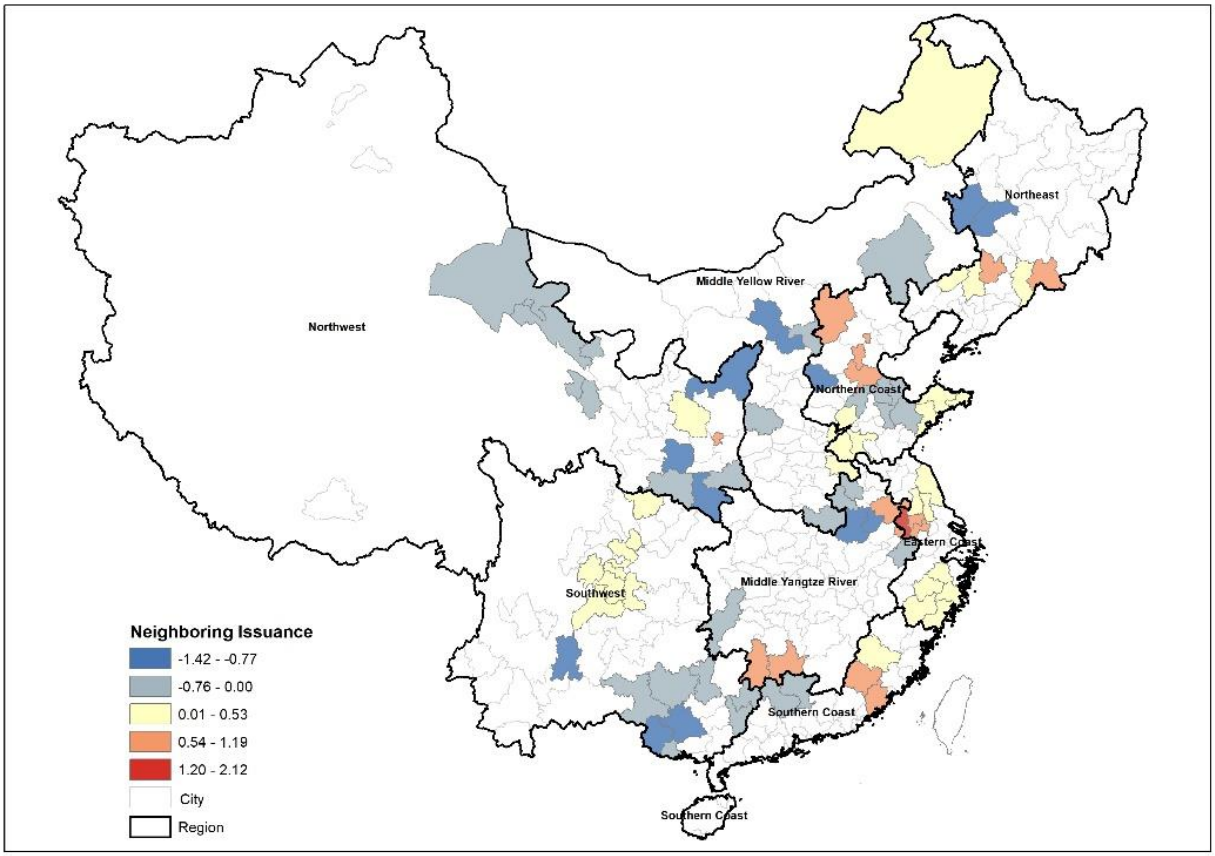

Figure 19 Spatially Varied Coefficients of Neighboring Issuance from GWPR 2006-2014

Data Source: Wind Financial Data 2006-2014; China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

The different roles of state funds are demonstrated in Figure 20. State funds play a substitutive role to reduce local issuance in cities of blue but function as a complementary tool to promote more local bond issuing efforts in cities of yellow, orange and red.

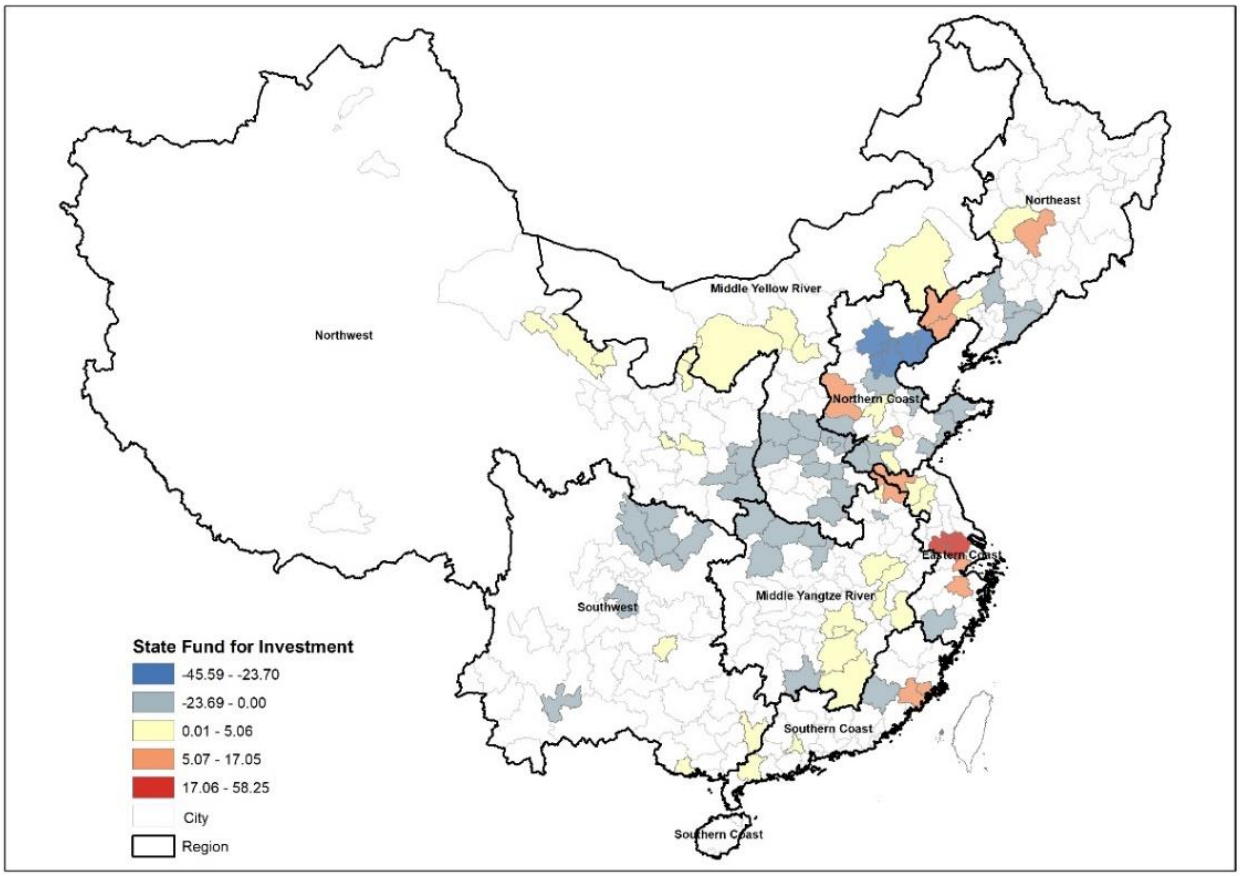

Figure 20 Spatially Varied Coefficients of State Fund for Urban Investment from GWPR 2006-2014

Data Source: Wind Financial Data 2006-2014; China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Year Book 2007-2015

In general, more complementary roles of state funds are found in the East, especially the coastal regions, and the North, compared to Central and West China where the substitutive function of state policy is dominant. For example, in the Eastern Coast region, the places privileged by state for development, a 10% increase of state funds in local finance will encourage and support more

local bond issuances by 1.71 billion RMB - 5.83 billion RMB. For less developed and privileged regions, such as the Central North and the Southwest, a 10% increase of state funds in local finance resource will relieve the local borrowing stress and debt accumulation by 2.37 billion RMB - 4.56 billion RMB.

The indirect or spillover effects of state funds are decomposed in Figure 21. The dominant spillover effect is positive that the increase of neighbors' state funds will promote more efforts in the targeted locality and further encourage more competition for state funds. Most cities respond to neighboring state funds in this pattern to compete with peers for being selected by state funds, especially for cities close to Beijing and Shanghai. When the state funds increase by 10% in neighboring urban finance structure, the targeted cities will demonstrate their efforts to the state with 5.13 billion RMB - 10.08 billion RMB more in local bond issuance. In contrast, there are several cities in less developed regions, e.g. the Northeast, the Northwest, and the Middle Yangtze River region, which choose to decrease their effort of debt-financed investment when neighboring state funds rise. They try to compete for redistributive state support and rely more on the state for local finance when they notice more funds are flowing into their regions and neighbors that lack capacity and are in high need. If the redistributive and substitutive state funds increase by 10% in neighboring cities, the target city will reduce its own finance effort by maximum 1.37 billion RMB, hoping to get more aid and rely more on the state.

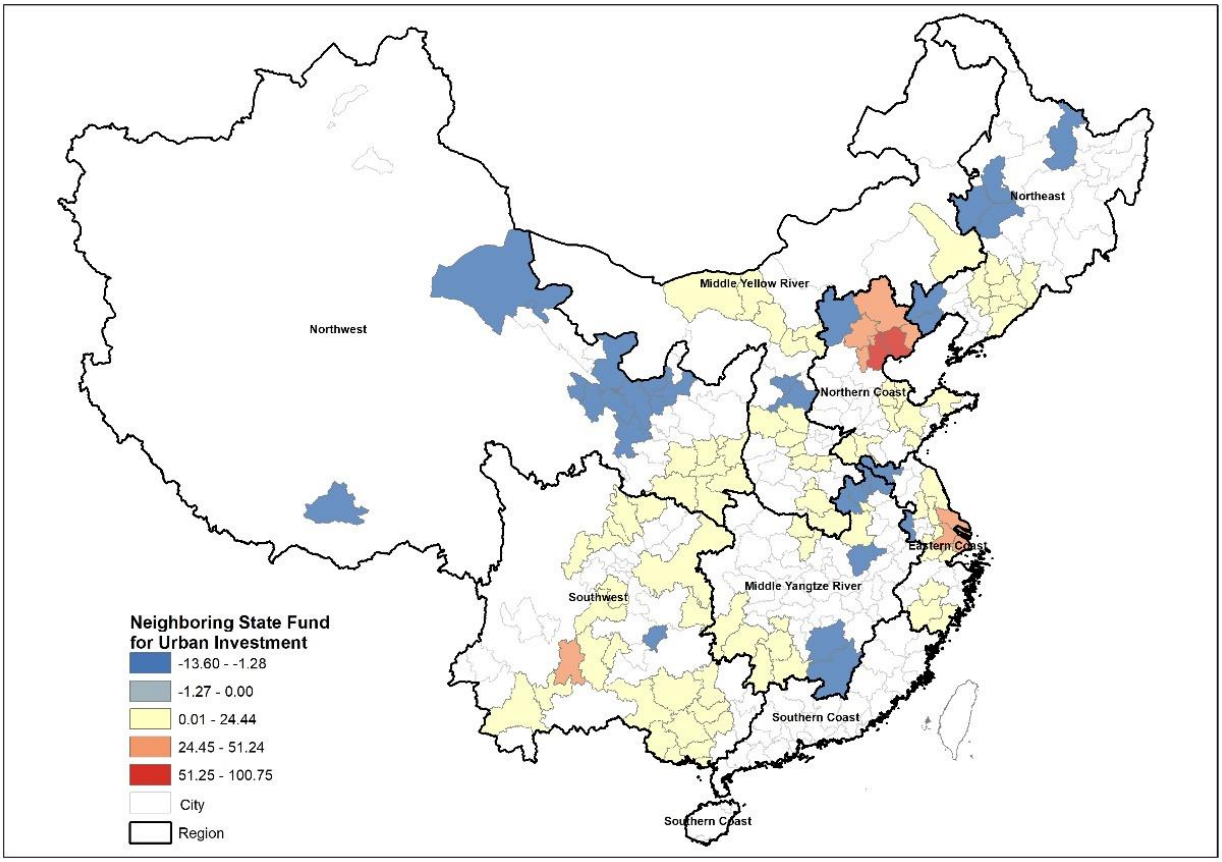

Figure 21 Spatially Varied Coefficients of Neighboring State Fund for Investment from GWPR 2006-2014

Data Source: Wind Financial Data 2006-2014; China Land and Resource Statistical Yearbook 2006-2014; China Urban Construction Yearbook 2006-2014; China City Statistical Yearbook 2007-2015

To sum up the GWPR results, we find the capacity and effort of local debt-financed investment is highly dependent on the land premiums for cities in the North and West. The issuance of cities in Central China is likely to be driven by the financial purpose for debt-servicing, through using the less restrictive urban investment bonds via LGFPs. Cities in more developed regions, such as coastal regions in the East, tend to issue bonds for the purpose of inter-city competition. They often have the economic capacity to compete for more state funds and perceive themselves to be favored by state funds. Cities in less developed regions, such as the Central, the North and

the West are relying on state funds to replace their own effort for urban investment and development. As declining areas, they usually lack the capacity to compete and expect more redistributive state policy and substitutive roles of state funds to help relieve their local finance pressures.

Conclusion

This study has explored different motivations behind the prevalent local debt-financed investment and urbanization in China. Through the understanding of different institutional contexts of China, our model measures those critical institutional incentives from fiscal, financial, economic and political aspects. We examine their impacts on local debt-financing. It has enriched the stories of local borrowing. Besides the "developing by borrowing" (Pan et al., 2017), our models find "fiscal stress relief by borrowing", "debt/financial management by borrowing", "land-driven borrowing", "peer-competition by borrowing", "state-promoted borrowing" and "competition for state fund by borrowing". Urban investment bonds, as the major finance tool in China's urbanization, are pursued by local governments for different purposes across regions. Specifically, our model shows budgetary fiscal gap, existing loans, land premiums, neighboring issuances, and state funds have influenced local issuance for different reasons rather than for development only. This raises planning and governance concerns on the risk of government debt, draws attention to the efficiency and accountability of local finance and investment, questions the sustainability of the current land reliance and debt-based urbanization model, and highlights the roles of state policy in a multilevel structure.

Moreover, the spatial model has contributions both theoretically and methodologically. The new methods developed in this paper can be applied to any studies that deal with panel data and geographic diversity issues. I have made two improvements for modeling. On one hand, based

on the Spatial Durbin Model, I have explored the spatial diversity of the impacts of the spatial lag terms. This not only enables me to capture local reaction functions to neighbors' activities (spatial lag term), but also allows spatial heterogeneity for these reaction functions. On the other hand, the GWPR model provides a methodological possibility for studies aiming to tackle spatial non-stationarity and heterogeneity issues using panel data. The GWPR estimate that is developed in this paper advances the GWR (Fotheringham et al., 2002) from cross-sectional to panel studies, as well as GTWR (Fotheringham, 2015) by combining the nonparametric technique for optimal subsampling with classic econometric methods of fixed effects model. It allows customized local panel regressions for each locality and locational-specific stories. This new GWPR methods will enable future panel studies to empirically model spatial diversity in many topics, such as the diversity of impacts of state rescaling in this paper.

Theoretically, it first shows the spatially variegated mechanisms for local debt-financed investment with the visualization of regional-specific explanations and implications. In general, borrowing in the less developed regions, e.g. the North, the West, and the Central, tends to be driven by fiscal and debt-servicing concerns, while cities in the more developed coastal regions are found to issue bonds for competition purposes. Second, it also demonstrates how different institutional incentives can be generated under rescaling and further affect local government planning and financing activities. Third, it extends the scope of state rescaling theory by including both vertical (e.g. fiscal decentralization, state funds) and horizontal (e.g., inter-city competition on debt-financing and state funds) dimensions, to capture both direct and indirect (or spillover) effects of state policy within a multilevel governance structure. Fourth, this study has empirically identified the different spatial logic of state policy in urbanization funds by demonstrating how cities respond differently to state policy across regions. Cities in the more developed East, have

the capacity to compete with peers and actively show their increased effort to compete for state funds, while cities in the declining West and North rely more on state funds as a substitute for their own effort. This highlights the significant role of state policy to either exacerbate or ameliorate regional disparity in rescaling and urbanization process.

Discussion

Hunger Game - First, it's important for state to monitor local fiscal situations and be alerted with localities under fiscal stresses since the budgetary gap is an important indicator for cities to issue debt. Cities in less developed regions are more hunger to transfer land into financial resources of bond issuances. These cities are playing a hunger game to issue bonds to repay the previous debt. They feed debt with debt through financialization of land.

Competition Game - Second, for cities in more developed coastal regions, bond issuance is facilitating inter-city competition both economically and politically to invest more for economic achievements and leave the debts to the successors. Local governments in these eastern coastal regions have capacities to play this competition game since they are more attractive to the bond market for investment. In addition, most cities play such competition game for future state fund.

Game Facilitator or Breaker – Third, state could be either game facilitator or game breaker. It can aid to reduce local fiscal gap by prioritizing cities in less developed regions with more targeted state funds or intergovernmental transfers, to break and end the hunger game. However, some hunger cities view state funds as complementary resources to facilitate more local debts. To avoid the spillover effects to encourage inter-jurisdictional competition, state funds need to be designed by linking with more state scrutiny of local issuance. The financial instrument of LGFPs needs to be more regulated in terms of their existing debts and future issuances purposes. The spatial or regional planning from the state may help form inter-city collaborations through more

designations and allocations in functions and plans, e.g. the recent Guangdong, Hong Kong and Macau Bay Area Planning.

The state-led urbanization in China should consider these aspects above to manage and reduce financialization risks of current rising local debts. It needs to break the debt-financed hunger and competition games to ensure issuance are compatible with real urbanization demand.

References

Brennan, G. & Buchanan, J. (1980). *The Power to Tax: Analytical Foundations of a Fiscal Constitution.* Cambridge: Cambridge University Press.

Brenner, N. (2004) *New State Spaces: Urban Governance and the Rescaling of Statehood*. Oxford: Oxford University Press.

Brenner, N. (2009). Open questions on state rescaling. *Cambridge Journal of Regions, Economy and Society,* 2(1): 123–139.

Brunsdon, C., Fotheringham, A. S. & Charlton, M. (1998). Spatial nonstationarity and autoregressive models. *Environment & Planning A*, 30 (6): 957–973.

Brunsdon, C., Fotheringham, A. S. & Charlton, M. (1996). Geographically weighted regression: a method for exploring spatial nonstationarity. *Geographical Analysis*, 28 (4): 281–298.

Chen, Z., He, Z. & Liu, C. (2017). The Financing of Local Government in China: Stimulus Loan Wanes and Shadow Banking Waxes. *NBER Working Paper o. 23598,* Issued in July 2017. http://www.nber.org/papers/w23598

Chien S-S. (2008). The isomorphism of local development policy: A case study of the formation and transformation of national development zones in post-Mao Jiangsu, China. *Urban Studies*, 45(2): 273–294.

Chung, J. H. (1994). Beijing confronting the provinces: The 1994 tax-sharing reform and its implications for central-provincial relations in China. *China Information*, 9 (3): 1–23.

Congleton, Roger D. (2006). *Asymmetric Federalism and the Political Economy of Decentralization*. Virginia: George Mason University.

Cox, K. R. (2009). 'Rescaling the state' in question. Cambridge Journal of Regions, Economy and Society, 2 (1): 107–121.

Davidson, M., & Ward, K. (2014). 'Picking Up the Pieces': Austerity Urbanism, California and Fiscal Crisis. *Cambridge Journal of Regions, Economy and Society, 7*(1), 81-97.

Feng, X. (2013). Local government debt and municipal bonds in China: Problems and a framework of rules. *The Copenhagen Journal of Asian Studies,* 31: 23–53.

Fotheringham, A. S., Brunsdon, C. & Charlton, M. E. (2002). Geographically Weighted Regression: The Analysis of Spatially Varying Relationships. Chichester: Wiley.

Fotheringham, S., Crespo, R. and Yao, J. (2015). Geographical and Temporal Weighted Regression (GTWR). *Geographical Analysis*, 47: 431-452.

Glaeser, E. (2011). *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier.* New York: Penguin Press.

Guo, G. (2009). China's local political budget cycles. *American Journal of Political Science*, 53: 621–632.

He, C., Zhou, Y. & Huang, Z. (2015). Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geography*, 37 (3): 436–457.

Inman, R. P. (2003). Transfers and bailouts: Enforcing local fiscal discipline with lessons from U.S. Federalism, In J. Rodden et al.(eds.), *Fiscal Decentralization and the Challenge of Hard Budget Constraints*. Cambridge, MA: MIT Press, pp. 35–83.

Inman, R. P. & Rubinfeld, D. L. (1997). Rethinking Federalism. *Journal of Economic Perspectives*, 11, 43–64.

Jessop, B. (2002) *The Future of the Capitalist State. Cambridge:* Blackwell, Cambridge.

Johnson, K. M., Pelissero, J. P., Holian, D. B. & Maly, M. T. (1995). Local Government Fiscal Burden in Nonmetropolitan America. *Rural Sociology, 60*(3), 381-398.

Knight, J. & Shi, L. (1999). Fiscal decentralization: Incentives, redistribution and reform in China. *Oxford Development Studies*, 27(1): 5–32.

Kornai, J. (1986). The soft budget constraint. *Kyklos*, 39: 3–30.

Ladd, H. F. & Yinger, J. (1994). The case for equalizing aid. *National Tax Journal*, 47(1): 211–224.

Li, H. & Zhou, L-A. (2005). Political turnover and economic performance: The incentive role of personnel control in China. *Journal of Public Economics,* 89: 1743–1762.

Lin, G. C. S. (2009). Scaling-up regional development in globalizing China: Local capital accumulation, land-centered politics, and reproduction of space. *Regional Studies*, 43 (3): 429–447.

Lin, G. C., Li, X., Yang, F. F. & Hu, Z. Y. (2014). Strategizing urbanism in the era of neoliberalization: State power reshuffling, land development and municipal finance in urbanizing China. *Urban Studies*, 52(11): 1962–1982.

Lin, G. C. S. & Yi, F. (2011). Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geography*, 32 (1): 50–79.

Lin, G. C. & Zhang, A. Y. (2014). Emerging spaces of neoliberal urbanism in China: Land commodification, municipal finance and local economic growth in prefecture-level cities. *Urban Studies*, 52 (15): 2774–2798.

Liu, T. & Lin, G. (2014). New geography of land commodification in Chinese cities: Uneven landscape of urban land development under market reforms and globalization. *Applied Geography*, 51: 118–130.

Lobao, L. M. & Adua, L. (2011). State Rescaling and Local Governments' Austerity Policies Across the USA, 2001-2008. *Cambridge Journal of Regions, Economy and Society, 4*(3), 419-435.

Lu, Y. & Sun, T. (2013). Local government financing platforms in China: A fortune or misfortune? IMF Working Paper, No. 13/243. http://ssrn.com/abstract=2375564

National Audit Office (NAO) (2011) Quanguodifang zhengfuxing zhaiwu shengji jieguo (Results from the Nationwide Audit of Local Government Debts), No. 35. http://www.gov.cn/zwgk/2011-06/27/content_1893782.htm [in Chinese]

Oates, W. E. (2005). Toward a second-generation theory of fiscal federalism. *International Tax and Public Finance, 12* (4), 349-373.

Oates, W. E. (1999). An essay on fiscal federalism. *Journal of Economic Literature Journal of Economic Literature, 37* (3), 1120-1149.

Oates, W. E. (1972). *Fiscal Federalism.* NY: Harcourt Brace Jovanovich.

Pagano, M. A. & Perry, D. (2008). Financing infrastructure in the 21st century city. *Public Works Management and Policy*, 13: 22–38.

Pan, F., Zhang, F., Zhu, S. & Wojcik, D. (2017). Developing by borrowing? Inter-jurisdictional competition, land finance and local debt accumulation. *Urban Studies*, 54 (4): 897-916.

Peck, J. & Tickell, A. (1994) Searching for a new institutional fix: The after-Fordist crisis and the global-local disorder, in post-Fordism: A Reader (ed Amin A.), Blackwell Publishers Ltd, Oxford, UK.

Peck, J. & Zhang, J. (2013). A variety of capitalism with Chinese characteristics? *Journal of Economic Geography*, 13: 357–396.

Sassen, S. (2005). The Global city: Introducing a concept. *The Brown Journal of World Affairs*, XI (2): 27-43.

Scott, A. J. (2001). *Global City-regions: Trends, Theory, Policy.* Oxford: Oxford University Press.

Siemiatycki, M. (2007). What's the secret? Confidentiality in planning infrastructure using public/private partnerships. *Journal of the American Planning Association*, 73 (4), 388–403.

State Council. (2010). Notification on Strengthening the Regulation of Local Financing Platforms. 13 June. Available at: http://www.gov.cn/zwgk/2010-06/13/content_1627195.htm [In Chinese].

Storper, M (2013). *Keys to the city: how economics, institutions, social interactions, and politics shape development*. Princeton: Princeton University Press.

Tao, R., Su, F., Liu M. & Cao, G. (2010). Land leasing and local public finance in China's regional development: Evidence from prefecture-level cities. *Urban Studies*, 47: 2217–2236.

Tsui, K. Y. (2011). China's infrastructure investment boom and local debt crisis. *Eurasian Geography and Economics*, 52: 686–711.

Wang, E. (2010). Fiscal decentralization and revenue/expenditure disparities in China. *Eurasian Geography and Economics*, 51: 744–766.

Warner, M. E. (2001). State Policy Under Devolution: Redistribution and Centralization. *National Tax Journal*, *54*(3), 541.

Warner, M. E., & Pratt, J. E. (2005). Spatial Diversity in Local Government Revenue Effort Under Decentralization: A Neural-Network Approach. *Environment and Planning C, Government & Policy.*, *23*(5), 657-678.

Weber, R. (2010) Selling City Futures: The Financialization of Urban Redevelopment Policy, *Economic Geography* 86(3): 251-274.

Wong, C. P. W. (2000). Central-local relations revisited: The 1994 tax sharing reform and public expenditure management in China. *China Perspectives*, 31: 52–63.

World Bank (2014). Urban China: Toward efficient, inclusive, and sustainable urbanization. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/18865

World Bank (2009) The Urban Development Investment Corporations in Chongqing China. Technical Assistance Report. http://documents.worldbank.org/curated/en/2010/01/12648119/urban-development-investmentcorporations-udics-chongqing-china

Wu, W. (2010). Urban infrastructure financing and economic performance in China. *Urban Geography*,31: 648–667.

Xu, Y. & Warner, M. E. (2016). Does devolution crowd out development? A spatial analysis of US local government fiscal effort. *Environment and Planning A: Economy and Space*, 48(5): 871-890.

Xu, Y. & Warner, M. E. (2015). Understanding employment growth in the recession: The geographic diversity of state rescaling. *Cambridge Journal of Regions, Economy and Society*, 8 (2): 359-377.

CHAPTER 6

CONCLUSION

This study provides an institutional understanding of local planning and urban policy by highlighting the importance of different fiscal, political and economic incentives within a multilevel system, and the spatiotemporal diversity of the state rescaling process. To explore the complexity of state rescaling, this study has elaborated a multilevel framework to analyze local planning and policy making and how it links to different development outcomes. This section will discuss the contribution of this study in theory, methodology and policy implications for planning and urban studies.

Asymmetric state rescaling framework

This study contributes to the theory of state rescaling (Brenner 2004 and 2009) by showing the importance of an asymmetric rescaling process on state policy and local responses. First, asymmetric rescaling can occur in different policy dimensions, more than just the fiscal dimension described by Xu and Warner (2015 and 2016). It is critical to examine these processes in fiscal, economic (land use), political and financial aspects and how they affect each other. Based on the second generation theory of fiscal federalism (Oates, 2005; Weingast, 2007 and 2009), the institutional incentives need to be given attention, especially in how they may not align with rational and sustainable local development. In this thesis, the framework of second generation theory of fiscal federalism in China has been extended beyond the fiscal dimension by involving land as the critical component in rescaling.

Specifically, Chapter 4 shows that political power is centralized while fiscal responsibilities and economic power to use land have been decentralized. This complexity of

asymmetrical rescaling across different policy domains has resulted in the imbalance of authority and responsibility, which has further created the fiscal, political and economic incentives in local planning to fiscally and financially use land (e.g., Lin, 2009; He et al., 2015).

Chapter 5 argues that incentives of competition are more easily generated in the context that fits the principal-agent model (e.g., China). Several reasons have been discussed in Chapter 5 to explain why incentives are strong in a second-generation theory of fiscal federalism (SGTFF) context. First, in the principal-agent model, local governments are responsible for the higher-level government instead of their direct constituencies. Political conformity creates both political and economic incentives that drive local planning policies to meet the decentralized benchmarks and show the development achievements and efforts to higher-level government. Second, the soft-budget constraint in SGTFF generates an irresistible incentive for agents/local government to expand their programs and spend beyond their capacities to show their maximum effort and how well they achieve the benchmarks. They have "expectations" that they will be bailed out by the central government through more transfers. Third, the principal-agent model also indicates possible policy imitations. To compete, agents are likely to copy each other's successful experience and adopt similar concepts and strategies. Last, besides the economic-based evaluation system, China's principal-agent model has a quick turnover for local officials to stimulate more short-term strategies and even destructive competition to "polish" their resumes for promotions. They leave the debt burden to future administrations.

Second, the asymmetric notion may refer to the territorial (Laboa and Adual, 2011; Xu and Warner, 2016) and sequential diversity of state selectivity. On the one hand, the rescaling from the state has its spatial logic. For example, Chapter 3 discussed the fewer state designated special zones in northern shrinking cities (e.g., resource-based) with slow-growing economies, compared

to more developed coastal regions. On the other hand, the mechanisms or impacts of state policy are also territorially asymmetric. For example, cities may be affected by a certain state fund very differently across regions. In Chapter 4, state funds for urban maintenance are a complementary revenue source which encourages more land urbanization and competition in the southwest and the Middle Yellow River region but reduces local land reliance and land transactions in other regions because it serves as a substitute of local urban finance. State funds for investment also have spillover effects on neighboring cities, creating more competition in northern and western regions. Thus, the same state policy may have different impacts across regions and time based on the territorial features of localities.

Therefore, it's important to understand the complex notion of asymmetric rescaling across policy domains and territories and the incentives through this process that shape local planning. We also need to pay attention to the spatiotemporal diversity of both direct and indirect effects of state rescaling on local paths.

Shrinking city in developing countries

Through the chapters, this study links the complexity of state rescaling to various development outcomes. Thus, it fills the gap in shrinking city literature, which is dominated by studies in western countries (e.g., Oswalt, 2006; Oswalt and Rienitz, 2006; Reckien and Martinez-Fernandez, 2011; Wiechmann and Pallagst, 2012; Beauregard, 2009) by looking specifically at a developing country context. The "developing" character tends to divert the research focus to the growing and megacities, masking the parallel uneven development and the problem of shrinkage in other cities. In fact, the state-led urbanization in China has created different development trajectories for cities. However, studies on shrinking cities in China are just emerging and exploratory, such as general surveys, case studies and graphical analysis (Yang & Dunford 2017;

Li and Mykhnenko, 2018; Wu and Long, 2016). Theories on China's shrinking cities still need to be developed with more nuanced geographical understanding considering the large regional differences of China.

Chapter 3 uses the state rescaling framework to examine the divergent development results in China's state-led urbanization process. It highlights the importance of being selected by the state via fund transfers, local policy responses to rescaling, state-designated economic geographies and industrial restructuring in explaining various urban trend typologies. The north-south division of shrinking cities has been found in terms of their mechanism and features. In general, cities in northern China suffer from population loss and economic decline due to not being privileged by the state for development, higher local economic share in resource-based sectors, lower natural growth rate, less competitiveness and attractiveness to the market and developers. In contrast, shrinking cities in the south-central China can be attributed to their proximity to state-selected high-level large cities that have a gravitational pull of people and economic activities. Since these middle and smaller cities are not favored by the state policies, they are likely to rely on debt to sustain local economic growth.

Spatiotemporal Analytical Methods

Methodologically, this dissertation has made several contributions. It is the first study to introduce Dynamic Time Warping (DTW) algorithms for time-series clustering in planning and urban studies. This method originated from the field of computer science and data science and has never been used in the planning field. Rather than just picking up two-time points and calculating changes, this nonspatial method can delineate trend patterns for different socioeconomic variables and generate spatial clustering patterns. Thus, it has the potential to be applied in many longitudinal

planning studies, such as trajectories of housing prices, population, local economies, government spending etc. to provide spatial patterns of the trend in these features.

Second, I use the Geographical and Temporal Weighted Regression (GTWR) to unfold the spatiotemporal variation (Huang et al., 2010; Fotheringham et al., 2015) of impacts from institutional factors on local land urbanization. This model can provide location-specific explanations and context-specific policy implications since the models are run locally using customized, spatially and temporally weighted subsamples for each city in each year. The model results can allow us to empirically capture the diversity of state rescaling on the ground and how local responses are spatiotemporally varied. In Chapter 5, I have developed a new spatial econometric algorithm, Geographical Weighted Panel Regression (GWPR), to advance the GWR and GWTR. It combines both the nonparametric technique for optimal subsampling and the econometric methods of fixed effects models to generate a customized and weighted local panel regression estimator. In other words, the panel data in this approach is handled by traditional econometric models of either fixed effects or random effects with spatially weighted subsamples. GWPR can be applied to any studies aiming to tackle spatial heterogeneity using panel data. It advances the spatial econometrics by solving the spatial non-stationarity issue from cross-sectional data limits to panel structure and achieves a good balance between nonparametric techniques and classic econometric models. This will enable us to see new patterns of statistical relationships of many research topics in urban and regional studies.

Policy Implications

Attention to the shrinking cities or left-behind places in China is rising. More media coverage focuses on the shrinking phenomenon, rapid land urbanization problems, irrational

building and high debts of Chines cities. One recent article[23] argues that some Chines cities are facing the greatest pressure of shrinking. These shrinking cities have different patterns, including "those that are heavily dependent on natural resources, such as coal mining town of Hegang in Heilongjiang province" (northern shrinking cities), and also "diminishing cities 'in the process of transformation', such as Yiwu in Zhejiang province, once christened the 'largest small commodity wholesale market in the world' and famous for its sprawling networks of stalls selling counterfeit goods" (southern shrinking cities). This confirms the north-south division of findings regarding shrinking mechanisms in Chapter 3.

What's worse, the article points out that "China's shrinking cities are still addicted to building despite a population slump". It is hard to expect local governments to set their goals in line with shrinking, especially in the current political and economic system in China. Another article[24] revealed a survey of 80 urban planners from those cities in the northeastern rust-belt region. It finds that over 50% of those planners make plans under the assumption of population growth and 90% of them draw blueprints with optimistic growth assumption since they face the pressures from local officials. These plans are often "key infrastructure projects and industrial, commercial and residential developments that may diverge significantly from demographic trends". This resonates with the findings in Chapter 4. In this sense, mots Chines city planning is detached from reality. Moreover, these plans and projects are debt-fueled and become the major contributors to economic growth, which confirms the results in Chapter 5. These results question

[23] *https://www.scmp.com/economy/china-economy/article/3004152/growing-pains-chinas-shrinking-cities-are-addicted-building*

[24] *https://www.scmp.com/economy/china-economy/article/3002219/almost-one-third-chinese-cities-are-shrinking-city-planners*

the efficiency and foresight of Chinese urban planning. However, under the current system, cities have to fight for resource and boost investment and economic growth.

What is this "system" to blame? It is the asymmetrical state rescaling system in China that lays out different degrees of rescaling in power, authority and responsibility across policy domains and geographic locations. This paper has revealed the problem of this "system" comprehensively and empirically by showing the institutional incentives and negative spillovers of asymmetric rescaling. Therefore, to make the "system" better, several policy recommendations are made here to shift the current physical-growth oriented planning paradigm to a people-oriented one, as well as reach a good balance between growth and maintenance for different contexts of urbanization.

The Importance of State Policy

First, the function of state policy matters. State fund or urban maintenance is found to be critical to retain population and reduce institutional incentives. On one hand, the support from the central state to improve local capacity in maintaining urban facilities and services is important to attract people as important as the economic opportunities. Hukou, the urban citizen registration, is not the only policy option to balance population and migration between large and small cities and coastal and inland regions. The State can use maintenance fund to divert population and help shrinking cities to build good quality of facilities and services as the foundation for future growth.

However, the State allocates more funds in supporting fixed assets investment. This type of state policy is linked to economic and physical growth rather than population growth. Following the philosophy "If you build it, they will come", cities are encouraged by such type of state funds to actively invest in fixed assets and expand the physical structure regardless of real demographic trends. This state fund also stimulates more local effort in debt-finance to boost the local economy.

Thus, it is urgent for the State to change its funding mechanisms from encouraging local physical expansion and economic growth to support the maintenance of urban facilities and service quality.

State spatial policy for development needs to pay attention to its spatial externalities on spurring inter-jurisdictional competition through land leases and debt issuance. Spatial modeling in this study provides a solution to detect these incentives and competition so that it can be designed based on a specific context. The State can connect its transfers, funding and preferential policies with certain regulation and scrutiny on local land transactions (quota) and debt issuance. This will also ensure localities do not use state resources as a complementary tool to fiscalize and financialize more urban resources to compete with peers. A spatial planning system[25] and other regional plans with a clear distribution of roles, functions and responsibilities of cities are also helpful to reduce these incentives and externalities on competition, such as the recent regional plan of Guangdong, Hong Kong and Macau Bay Area.

The Need of Local Fiscal Empowerment

At the local level, cities need to be fiscally empowered with more fiscal tools and wider taxing powers to handle the increasing responsibilities and challenges of urbanization. The budgetary gap under current decentralization thus can be reduced. Besides the diversity of fiscal tools, they also need stable fiscal resources, such as the property tax, to not only capitalize on the value of growth but also link the investment to help address maintenance cost. These connections are essentials for the urban growth machine. However, local taxes in China are mainly on the income and added values of corporations. This drives local fiscal effort to attract business instead

[25] *The central state is trying to establish a spatial planning system in China that not only improve the regulation and supervision of national land and resource, but also incorporate and coordinate plans from different departments and regions.*

of being people oriented. The current land-based and debt-financed system is also lack of sustainable fiscal streams to capture the value of improved physical structure and the cost of maintenance.

The political promotion system needs to be reformed as well. It should include more diversified objectives of local development, such as the concerns of environment protection, service quality, inequality reduction, and welfare enhancement etc. rather than just based on the economic achievement. Thus, the benchmarks that are passed down by the central state should involve more dimensions to reduce inter-city competition

Planning for shrinking context

Finally, cities need to learn how to conduct planning for a shrinking context. The current paradigm in policies and plans is growth driven and designed based on the past belief sets, which was set on growth, which exacerbates existing problems of shrinking, oversupply, overbuilding and high debt. In China's political and economic system, it is difficult to tell local officials that the population or economic activity of their cities is in "decline" or "decay". "Shrinking" is a more neutral word. These shrinking cities are much more challenging to manage and plan for compared to growing ones. These shrinking, declining or the left-behind places pose new political, economic and social problems we have never seen before, which also may vary across different regional contexts. Therefore, it is important to change our beliefs and accept the realities to orient planning to address the new problems, such as from smart growth to smart shrinking, from planning for growth to planning for maintenance, and from physical expansion in urbanization to the improvement of service quality etc.

Future Research

Future works need to combine qualitative research, such as case studies, with the quantitative models in this project. More grounded knowledge is needed to better understand why localities respond to state rescaling in certain planning strategies and why there is regional difference with respect to state spatial policies and development trajectories. This requires an understanding of the territorial and sequential nature of state rescaling policy as well as the local political, fiscal and economic rationality in response to both state policy and neighbors' actions. In addition, future studies need to look at the role of regional authorities, such as trans-provincial units, to explore a possible new governance scale that can reduce the institutional incentives and control the negative externalities of state rescaling. Moreover, it would be interesting to identify how many cities are close to the end of this game to run out of the land, and what they are going to do to respond to balance the rescaling challenges in maintenance, growth and competition. These cities at the cliff edge need to be identified urgently and given more attention. This could also be a different way of cutting the data for future analysis. Regarding future policy choices and impacts, simulation can be conducted to play out the debt crisis impact on China's economy. Lastly, scholars can apply some quantitative measures, such as decentralization, fiscal stress, state selectivity, inter-city competition etc. as well as the quantitative methods into other contexts, e.g., the US research. It will be worth comparing the responses of left-behind places (shrinking cities) between the US and China, such as the "revenge" through populism and voting for political rebellion in the US vs. the "work hard" to fiscalize and financialize urban resource for political conformity to attract state funds in China.

Multilevel institutional framework for planning

This study enriches the urbanization and urban planning literature by providing a multilevel perspective in an asymmetric state rescaling context. It challenges the productivity advantage notions of asymmetric decentralization from OECD (OECD, 2019) that such an institutional design is pursued for political tension alleviation across regions, economic efficiency and administrative capacity considerations. In contrast, this study reveals how asymmetric structure can generate different institutional incentives to shape local planning and policy to be irrational, inefficient, unsustainable and less accountable, and increase the spatial disparity of development.

By examining the institutional mechanisms behind China's land-based and debt-financed urban model, this paper offers a supply-side story of urbanization that uses fiscal decentralization, political centralization, inter-city competition, intergovernmental transfers etc. and the corresponding fiscal, political and economic incentives to explain rationales of local planning in land use and finance, and different urban development outcomes. This raises planning and governance concerns on the risk of local land use and bond issuance to generate possible "ghost cities" and high debt. Thus, it draws attention to the efficiency and accountability of land-based finance and investment, questions the sustainability of current land reliance and debt-based urbanization model, and highlights the critical roles of state policy in a multilevel structure.

More importantly, it shows the asymmetric state rescaling through state spatial selectivity contributes to the divergent paths of local development to create places of growth and shrinking. The left-behind places, shrinking localities and less developed regions under asymmetric rescaling are more responsive to the institutional incentives to shape their local planning and policies since they want to show their development effort to the central state and compete to be selected instead of being left behind. In other words, when the State allows places to be left behind via asymmetric

rescaling or spatial selectivity, it should expect the institutional incentives to play a role in those localities. Local governments, as agents, are responsive to the rescaling policies of the principal state, to either "work hard" to compete for political conformity in China or "revenge" to use voting and populism for political rebellion, as in the US or UK. The State needs to focus on the left behind places and how they act and respond to state policies. Therefore, the multilevel institutional framework from this study provides a lens to examine the interplays between state and local as well as dynamics among localities, and how they affect local planning, policy and development outcomes.

References

Beauregard, R. (2009). Urban population loss in historical perspective: United States, 1820–2000. *Environment and Planning A*, 41:514–528.

Brenner, N. (2009). Open questions on state rescaling. *Cambridge Journal of Regions, Economy and Society*, 2(1): 123–139.

Brenner, N. (2004) New State Spaces: Urban Governance and the Rescaling of Statehood. Oxford: Oxford University Press.

He, C., Zhou, Y. & Huang, Z. (2015). Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geography*, 37 (3): 436–457.

Huang, B., Wu, B. & Barry, M. (2010). Geographically and temporally weighted regression for modeling spatio-temporal variation in house prices. *International Journal of Geographical Information Science*, 24(3): 383-401

Inman, R. P. (2003). Transfers and bailouts: Enforcing local fiscal discipline with lessons from U.S. Federalism, In J. Rodden et al.(eds.), *Fiscal Decentralization and the Challenge of Hard Budget Constraints*. Cambridge, MA: MIT Press, pp. 35–83.

Inman, R. P. & Rubinfeld, D. L. (1997). Rethinking Federalism. *Journal of Economic Perspectives*, 11, 43–64.

Jessop, B. (1993). Towards a Schumpeterian Workfare State? Preliminary Remarks on Post Fordist Political Economy," Studies in Political Economy, 40: 7-39.

Jones, M. (2001). The rise of the regional state in economic governance: "Partnerships for Prosperity" or new scales of state power? *Environment and Planning A*, 33: 1185–212.

Katorobo, James. (2007). Decentralization and Local Autonomy for Participatory Democracy, in Public Administration and Democratic Governance, Governments serving Citizens: Economic & Social Affairs, United Nations, Januari, 2007.

Knight, J. & Shi, L. (1999). Fiscal decentralization: Incentives, redistribution and reform in China. *Oxford Development Studies*, 27(1): 5–32.

Kornai, J. (1986). The soft budget constraint. *Kyklos*, 39: 3–30.

Lessmann C. 2012. "Regional inequality and decentralization: An empirical analysis". *Environment and Planning A*, 44 (6) 1363-1388.

Lobao L M, Adua L. 2011. "State rescaling and local governments' Austerity Policies Across the USA, 2001-2008". *Cambridge Journal of Regions, Economy and Society*, 4 (3) 419-435.

Lin, G. C. S. (2009). Scaling-up regional development in globalizing China: Local capital accumulation, land-centered politics, and reproduction of space. *Regional Studies*, 43 (3): 429–447.

Long, Y. & Wu, K. (2016). Shrinking cities in rapidly urbanizing China. *Environment and Planning A*, 48 (2): 220–222.

Mykhnenko, V. & Li, H. (2018). Urban shrinkage with Chinese characteristics. *The Geographical Journal published by John Wiley & Sons Ltd on behalf of Royal Geographical Society (with the Institute of British Geographers)*, 184 (4):8, 398-412, DOI: 10.1111/geoj.12266

Oates, W. E. (2005). Toward a second-generation theory of fiscal federalism. *International Tax and Public Finance*, *12* (4), 349-373.

OECD (2019). Asymmetric decentralisation: Policy implications in Colombia. *OECD Multilevel Governance Studies*. http://www.oecd.org/countries/colombia/Asymmetric_decentralisation_Colombia.pdf

Oswalt, P. (ed.) (2006). *Shrinking Cities*, Volume 1, International research. Hatje Cantz Verlag, Ostfildern, Germany.

Oswalt, P. & Rieniets, T. (eds). (2006). *Atlas of Shrinking Cities* (Hatje Cantz, Ostfildern).

Pallagst, K., Wiechmann, T. & Martinez-Fernandez, C. (eds) (2013). *Shrinking Cities: International Perspectives and Policy Implications*. New York: Routledge.

Reckien, D. & Martinez-Fernandez, C. (2011). Why do cities shrink? *European Planning Studies*, 19: 1375–1397.

Weingast, B. R. (2009). Second generation fiscal federalism: The implications of fiscal incentives. *Journal of Urban Economics*, 65: 279 - 293.

Wiechmann, T. & Pallagst, K. M. (2012). Urban shrinkage in Germany and the USA: A comparison of transformation patterns and local strategies. *International Journal of Urban and Regional Research,* 36: 261–280.

Xu, Y, Warner, M E. 2015. "Understanding Employment Growth in the Recession: The Geographic Diversity of State Rescaling", *Cambridge Journal of Regions, Economy and Society,* 8 (2), 359-377. doi:10.1093/cjres/rsv001

Xu, Y, Warner, M E. 2016. "Does Devolution Crowd out Development? A Spatial Analysis of US Local Government Fiscal Effort", *Environment and Planning A,* 48 (5), 871-890. DOI: 10.1177/0308518X1562244

Yang, Z. & Dunford, M. (2018) City shrinkage in China: scalar processes of urban and hukou population losses. *Regional Studies,* 52:8, 1111-1121, DOI:10.1080/00343404.2017.1335865