



## Space, scale, and regional inequality in provincial China: A spatial filtering approach



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### ABSTRACT

This paper investigates regional inequality and development in China's Guangdong province by employing the multi-scale and multi-mechanism framework. The study further examines the relationship between space, scale, and regional inequality by applying a spatial filtering method that eliminates spatial dependence of the data and quantifies the extent to which spatial effects have contributed to regional inequality at multiple scales. The results suggest that over 90% of the divide between the core of the Pearl River Delta (PRD) and the periphery areas of Guangdong province can be explained by the effect of strengthening spatial dependence. By incorporating spatial filters in space-time models, we also reveal the space-time and core-periphery heterogeneities of development mechanisms. Our study confirms that the integration of a multi-scale and multi-mechanism framework and rigorous spatial analysis methods, such as spatial filtering and space-time modeling, helps better understand the complexity of regional development in China.

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### Introduction

Since the early 1990s, driven by the theoretical advances in new economic geography, new endogenous growth, and new convergence (Barro & Sala-i-Martin, 1997; Krugman, 1991; Martin & Sunley, 1998; Scott & Storper, 2003), regional inequality has received renewed interdisciplinary interests. Regional inequality also attracts considerable interests from policy makers and governments because the growing interregional inequality is often associated with political and ethnic tensions and becomes a potential threat to national unity and social cohesion (Kanbur & Venables, 2005; Wei, 2000). Cross-country analysis has found that globalization and trade liberalization may bring wealth to poor regions in developed countries (Ezcurra & Rodríguez-Pose, 2013a; Ezcurra & Rodríguez-Pose, 2013b). In contrast, inequalities in many developing countries tend to persist, and new forms of uneven regional development are emerging (Ezcurra & Rodríguez-Pose, 2013a; Lessmann, 2013).

The rapid economic growth of China in the era of reform is undoubtedly associated with a spatially uneven development,

attracting considerable attention from both scholars and policy makers. Although the majority of studies have been focused on the evolution of regional inequality among Chinese provinces and groups of provinces (e.g., Fan & Sun, 2008; Li & Fang, 2014; Li & Wei, 2010; Lu & Wang, 2002; Wei, 2002), the research frontier on the regional inequality in China has recently extended to intra-provincial analysis of inequalities using finer-scale data (Li & Wei, 2014; Wei & Ye, 2009; Yu & Wei, 2008). Case studies in Zhejiang, Jiangsu, and Guangdong have documented the spatial and temporal complexity of regional inequality under Chinese provinces (e.g., Liao & Wei, 2012; Wei & Ye, 2009; Wei, Yu, & Chen, 2011). Notably, this strand of literature has been particularly fueled by recent developments in GIS spatial analysis methods and has supplied more detailed evidence about the role played by space and scale in shaping the unevenness of development in China (e.g. Wei & Ye, 2009).

This paper examines regional inequality and development in China's Guangdong province, known for the geographical concentration of development in the core region of the Pearl River Delta (PRD). In doing so, the study aims to further examine the relationship between space, scale, and regional inequality in provincial China based on the multi-scale and multi-mechanism framework. Specifically, it applies an alternative approach, namely, spatial filtering, to handle spatial dependence. Although previous studies

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have addressed the same issue using exploratory spatial data analysis (ESDA) and geographically weighted regression (GWR), the application of a spatial filtering approach has its own advantages: on the one hand, this method is rather straightforward and allows us to quantitatively clarify the relationship between spatial dependence and regional inequality; on the other hand, as argued by [Thayn and Simanis \(2013\)](#), spatial filtering offers a highly powerful and flexible way to reduce misspecification errors in linear regression models. Therefore, by incorporating spatial filters in a set of space–time modeling specifications, we can more accurately probe the space–time heterogeneities of development mechanisms, uncovering the varying effects of the same mechanism on regional development over space and time.

## Literature review

Regional inequality has generated lasting debates among adherents of various schools of development (e.g., convergence, divergence, and inverted-U). [Kuznets \(1955\)](#) and [Williamson \(1965\)](#) argued that when countries develop from agricultural economies to industrial economies, spatial inequality tends to initially increase, and then it peaks and decreases, following an inverted-U trajectory ([Lessmann, 2013, 2014](#)). Since the early 1990s, new convergence theory has become more influential in the literature. Drawing from two important notions, namely, the  $\beta$  and  $\sigma$  convergences, [Barro and Sala-i-Martin \(1991\)](#) identified that poorer states or regions in the US and Western Europe grew faster, resulting in convergence over the long run.

Growing concerns about the spatial influences of economic globalization and political or fiscal decentralization have been witnessed in the recent years (e.g., [Ezcurra & Rodríguez-Pose, 2013a, 2013b](#); [Lessmann, 2013, 2014](#)). For instance, [Lessmann \(2014\)](#) presented new evidence that supports the inverted-U hypothesis using a panel data of 56 countries over the period 1980–2009. The study also showed that within a group of very high-income countries, regional inequality actually increases again, and this increase may be related to the countries' shift from manufacturing industries to service sectors. Reforms in former socialist countries and transitional economies have drawn even more attention to the spatial influences of reforms. In this context, the role of space and scale in shaping the evolution of regional inequality is emphasized by scholars, challenging the traditional convergence, divergence or inverted-U hypotheses (e.g., [Wei, 1999](#); [Wei & Ye, 2009](#)).

China's market reform and spectacular economic growth have generated considerable scholarly attention on the issue of regional inequality, deepening our understanding of the evolution of regional inequality in a transitional economy (e.g., [Fan & Sun, 2008](#); [Li & Gibson, 2013](#); [Lu & Wang, 2002](#); [Wei, 1999](#)). More specifically, the multi-scale and multi-mechanism framework has been proved as a valuable framework. On the one hand, regional inequality is sensitive to geographical scales. Ignoring scales may result in controversial findings on regional inequality ([Wei, 2002](#)). For instance, [Li and Wei \(2010\)](#) clarified that although the divide between coastal and inland provinces has risen, the interprovincial inequality in China has actually fluctuated significantly since the late 1990s (p. 3). Recent efforts have further “scaled down” the research on regional inequality in China by examining regional inequality within individual provinces. These efforts argue that within provinces, regional inequality in China can also be differentiated on interregional (between-region), intermunicipality (between-city) and intercounty (between-county) scales.

On the other hand, major drivers of regional development in China can be conceptualized into a triple process of economic transition, namely, globalization, marketization, and

decentralization, acting as structural forces behind regional inequality in China at multiple scales ([Wei, 2000, 2002](#)). First, during the reform era, the central government has granted more decision-making power to local governments (decentralization), providing local states with more incentives to promote economic growth ([Wang, 2010](#)). Second, under market reform, the state-owned sector has exerted less control over the economy in China, whereas the private sector has become an important driver and a new growth momentum (marketization) ([Wei, 2004](#)). Together with decentralization and marketization, globalization is the process in which China has been increasingly integrated with the world economy, making the country one of the largest recipients of foreign direct investment (FDI) in the world. Lastly, under the triple process of economic transition, coastal localities have developed at a fast pace based on the growth of non-state-owned enterprises (SOE) and the agglomeration of external capital. In contrast, those provinces or regions favored by socialist planning and dominated by state-owned enterprises have fallen behind, resulting in widening gaps between coastal and inland regions and localities ([Hao & Wei, 2010](#); [Wei et al., 2011](#)).

Notably, recent studies of regional inequality in China have greatly benefited from the applications of newly developed GIS spatial analysis methods. First, using GIS spatial analysis techniques has been useful in identifying the emerging regions and clusters and in examining their contribution to changing patterns of regional inequality ([Ye & Wei, 2005](#)). Using ESDA, studies in Zhejiang demonstrated that the rising inter-county inequality could be attributed to the spatial clustering of development in areas centered on Hangzhou and Wenzhou ([Wei & Ye, 2009](#); [Yue, Zhang, Ye, Cheng, & Leipnik, 2014](#)). Second, consistent with the broad literature on the pervasive force of agglomeration, the application of rigorous spatial analysis techniques has found strong evidence for spatial dependence and agglomeration, which has intensified regional inequality at both the interprovincial and intra-provincial levels in China. For instance, applying spatial Markov chains, researchers demonstrate that neighboring counties matter for a county's development status, and then self-reinforcing spatial dependence has strengthened the north-south divide in Jiangsu and the core-periphery disparity in Guangdong ([Liao & Wei, 2012](#); [Wei et al., 2011](#)).

Additional research is still necessary as found by the literature review. First, in the existing literature, the relationship between spatial dependence and regional inequality in provincial China tends to be self-evident. Limited quantitative investigation has been performed on the extent of contribution of spatial dependence to regional inequality at different geographical scales. Second, the triple process of economic transition has been proven as a fundamental cause of the inland-coastal income inequality during the reform era (e.g., [Hao & Wei, 2010](#)). Nevertheless, the different effects of these mechanisms on the regional development within provinces have not been thoroughly examined. Third, with a few exceptions (e.g. [Liao & Wei, 2012](#); [Lu & Wei, 2007](#); [Yuan & Wu, 2013](#)), studies on regional inequality in Guangdong mainly dealt with the regional development in the 1990s ([Gu, Shen, Wong, & Zhen, 2001](#)). Changes in the development mechanisms since the 2000s deserve more research efforts. By integrating a spatial filtering approach and the multi-scale and multi-mechanism framework, this paper emphasizes the exact relationships among spatial dependence, scale, and regional inequality. The case of Guangdong, a province known for being “one step ahead” in China's economic transition, also sheds further light on the spatial-temporal heterogeneities of development mechanisms in different stages of the reform.

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