# GEOGRAPHIC INFORMATION SYSTEM SPATIAL-TEMPORAL EVOLUTION OF MULTISCALAR PATTERNS AND DETERMINANTS OF FOREIGN DIRECT INVESTMENT IN CHINA

by

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# ABSTRACT

Three decades of economic reforms and open door policies have made China the second largest recipient of Foreign Direct Investment (FDI). China's FDI attraction strategies merit a closer look. To fully understand the significance of FDI attraction strategies in China, distributional patterns and locational determinants need to be investigated to explain the nature, dynamics, and mechanisms of FDI.

This dissertation models locational causes and regional effects of FDI in China. It examines the multiscalar spatial-temporal distribution of FDI, and analyzes locational determinants of FDI at interregional, intraregional, intercity, and intracity levels. The research also addresses dynamic processes of FDI, and assesses and evaluates the effectiveness of policy implementation strategies towards FDI locations. A case study of the Wuhan metropolitan area is conducted to explore the intrametropolitan pattern of FDI, highlighting locational factors and processes within an inland metropolitan area. Such econometrical, statistical, and GIS methods as Moran's $I$ and Getis-Ord $G$, space-time permutation model, geographically weighted regression (GWR), and logistical regression are used to investigate and analyze the dynamic processes in a hierarchical structure.

The results indicate that at the interregional level, the eastern/coastal region dominated FDI and FDI had spread from Guangdong to the Pan-Yangtze River Delta and the Bohai Rim Region. Institution is the most influential to Guangdong, transportation is the most influential to the Pan-YRD, and agglomeration influences the BRR the most. In

addition, the results at the intercity level indicate that relative gaps among the eastern/coastal region and another two regions, the central and western regions, are narrowing, though absolute gaps among them are widening. FDI clusters had a trend of spreading from eastern/coastal cities to central and western cites. The significance of market size and transportation infrastructure, and the increasing importance of agglomeration effects were identified in the regression model. Last, the results of the case study indicate that FDI in Wuhan is centralized on the Wuhan Economic and Technological Development Zone, a national development zone. FDI in Wuhan is a result of interaction among institution, urban structure, and accessibility. This study contributes to the literature on development theory, location theory, and globalization theory.

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# CHAPTER 1

# INTRODUCTION

## 1.1.Background

Foreign Direct Investment (FDI), as one of the most salient features of today's global economy, has grown at a faster rate than most other international transactions and, as a result of globalization and liberalization of economies, is likely to continue growing for the foreseeable future. Attracting FDI is an important element in strategies for national, regional, and local economic developments. FDI can promote the growth of economies, as a source of finance, technology, management, labor skills, and competition. However, the ability to both attract and to benefit from FDI vary a great deal depending on the host country since institutional and policy-related factors both enable and constrain host countries in their efforts to attract and appropriate beneficial spillovers from FDI. Three decades of economic reforms and open door policies have made China the second largest recipient of FDI after the United States; as such, China's FDI attraction strategies merit a closer look.

To fully understand the significance of FDI attraction strategies in China, distributional patterns and locational determinants need to be investigated to explain the nature, dynamics, and mechanisms of FDI (Coe et al., 2008). No general conclusions have been drawn about causes or determinants of FDI (Dunning, 2008); however, in the

developed world, the existing literature was based on the neoclassical development paradigm that focuses on the determination of comparative advantages in markets, such as market size, labor costs, union membership, and transportation infrastructures (Hymer, 1976), and new economic geography that emphasizes the determination of agglomeration effects (Krugman, 1991; Porter, 1998). They paid little attention to the content and quality of institutional infrastructure, incentive structures, and enforcement mechanisms of a country (Dicken, 2007; Ethier, 1998; Hennart, 1992). Those are significant determinants of the success by which developing countries are able to both attract and to benefit from FDI, especially China (Wei et al., 2010).

FDI location is a dynamic and continuing process consisting of two stages: initial entry and continuing expansion or allocation (Dunning, 1973, 2001; Grubaugh, 1987; McConnell, 1983). The search for the location of initial entry within a country is limited, and mainly based on a macrospatial framework, such as at the state or provincial level. As multinational enterprises (MNEs) become more familiar with the economic environments of host countries, locational options for FDI expand to cities. The intensification of globalization has reduced geographical and institutional barriers for FDI and made capital more mobile over space.

The hierarchical way that foreign firms seek location indicates that geographical scales matter in the study of FDI location. Yet the majority of existing research focuses on FDI location at the regional level, paying little attention to the intercity level and intrametropoliatan FDI location process. These studies examined the patterns and determinants of FDI at the provincial level in the 1980s and 1990s. During that time period, FDI was concentrated in coastal areas. Some research utilizes the ordinary least regression

model to examine locational determinants of FDI within China (Broadman & Sun, 1997; Chen, 1996, 1997) while others incorporate the spatial characteristics of the data into the regression analysis (Coughlin & Segev, 2000; Sun, 2002). Moreover, a panel framework was proposed to examine the economic properties of the panel data set and understand the temporal diversity of FDI location in China (Cheng & Kwan, 2000; Wei et al., 1999). These studies found similar results on the significance of comparative advantages and agglomeration effects in FDI location in China, as shown in the existing literature on the neoclassical economics and the new economic geography, but there are very few findings on institutional impacts on FDI location in China.

China's economic reforms and openness to foreign investment has been a gradually spatial varying process over the last three decades. Policies toward FDI have experienced three stages: limited opening of coastal areas in the 1980s, active promoting through preferential treatment in the 1990s, and further opening of western and central regions in the 2000s after China's entry into the World Trade Organization (WTO). Understanding the roles that the institution plays in investment decision processes made by foreign firms and assessing the effectiveness of these policies in attracting FDI have huge impacts on finding new strategies to attract investments and foster economic development.

Since China has been having explicit policies to encourage FDI in different regions over time, understanding the effects of these government policies is required to analyze the determinants of FDI distribution. However, most current FDI theories are based on capital market theory or economic geography, and thus, they are not able to providing explanations for the institutional dimension of FDI location (Wei et al., 2010). Although many efforts have been made to incorporate an institutional component in FDI (Leung, 1993; Liu &

Dicken, 2006), those institutional examinations are limited to the coastal area in the 1980s and 1990s, and do not systematically investigate the spatial and temporal diversity of institutional effects on FDI (Cheng & Kwan, 2000).

Because of different policies at all levels of government, the examination on spatial-temporal effects of institutions brings many research challenges for FDI: the Chinese dual-track system to market liberalization, varied policies and incentives at various levels of government, and complex relationship among different levels of government (Fan, 1994). China's market-oriented reform is an incrementalist reform. It has been characterized by gradual changes in its reform objectives and measures and therefore, the development of a new system always parallels the unreformed old one. Due to this dual-track system to market liberalization, institutions have a vast amount of temporal diversity in the reform. Current studies are not designed with the needed dynamic approach to examine the vast amount of diversity of institutional effects associated with FDI. Second, the decentralization grants decision-making powers to local governments, which is a dynamic mechanism for a variety of new forms of reform programs to emerge at various levels. For example, Special Economic Zones (SEZs) and Open Coastal Cities (OCCs) were established, various preferential treatments to different regions were given, and local initiatives were approved. These varied policies and incentives at various levels of government must be considered or presented for spatial diversity of institutional effects on FDI in China. Third, to consider these varied policies and incentives, complex relationships between different levels of governments need be understood to examine spatial and temporal diversity of institutional effects.

In addition to the research challenges stated above, there is an urgent need to

develop analytical methods for institutional effects on FDI. The neoclassical approach widely applied in the developed world deployed single equilibrium models. It also tended to be monocausal and unidimensional. The core model in new economic geography (Krugman, 1991) explains spatial distributions of economic activities from parametric changes. Therefore, these traditional methods that are based on stable equilibria are not applicable for the Chinese dual-track system. Moreover, traditional analytical methods are comparative static and the researchers need to determine stable equilibrium outcomes. Therefore, traditional (spatial) analytical methods cannot deal with "dynamical" and thus account for the evolution of institutional effects, such as emergence, clustering, dispersion, and other patterns and trajectories that are rooted in historical time. A major challenge is to develop models and techniques to describe, analyze, and visualize such institutional effects to extract meaningful patterns, trends, and relationships.

Conceptual and technological frameworks have been developed to address useful patterns, trends, and relationships within dynamical institutional settings, including the dual-track system. These are referred to as the cluster literature and the institutional economics: they are two major research fields that are associated with institutional effects on FDI. Although their approaches to institutional effects are different from each other, their primary goal is to understand the evolutionary process of the investment landscape and the role of institutions in shaping this landscape. The difference is that the cluster literature relies upon a proximity framework whereas the institutional economics is based on the regulation approach. However, methods of the cluster analysis and the institutional economics both require linking microlevel behavior to macrolevel processes. Neither a cluster analysis nor an institutional analysis at a single level is helpful to systematically

and completely find patterns, trends, and relationships embedded in institutions – multilevel application of the methods, from the microlevel of firms to the macrolevel of markets and institutions, are required.

There are several research challenges in the cluster literature and the institutional economics to handle institutional effects in FDI. One of the major research challenges is the integration of the cluster analysis and institutional approach: the cluster literature emphasizes the importance of institutional evolutions in the analysis of the birth, growth and decline of clusters, although institutional effect is just one of factors contributing to spatial clustering, compared to traditional cost factors and agglomeration effects. Another research challenge is to incorporate institutions in a more quantitative (evolutionary) framework. Although the cluster analysis relies upon a proximity framework and thus is based on spatial statistics and computational methods, many institutional analyses employ qualitative, descriptive case-studies. Efficient institutional approaches that can quantify institutions and strive for generalizations beyond the unique are required. In addition, institutional linkages between different levels of governments are also a research challenge in the cluster literature and the institutional economics – multiple-level linkages of institutional approaches are necessary to better understand institutional effects on FDI.

There have been many efforts in the cluster literature and institutional research to solve the problems stated above. Some studies linked different levels of institutions together. Other research proposed quantitative methods of institutional evaluation. Moreover, a microperspective was combined with a dynamic macroview on institutions for the analysis of cluster evolution (Malmberg & Maskell, 2010). This research expanded the capabilities of cluster analysis and institutional economics to examine and explain the

institutional effects, including the dual-track system.

In addition to the grand challenges in the cluster literature and institutional economics for institutional effects, some research problems describing the evolution of clusters and institutions have been proposed. They are as follows: First, clusters may evolve very differently. However, clusters are usually treated as static, rather than dynamic entities (Martin & Sunley, 2003). The origins, dynamics, and consequences of variation in clusters should be estimated in the cluster literature. Second, to treat clusters as dynamic entities, evolutionary approaches to spatial clustering are needed. Third, due to the limited availability of the longitudinal data on institutions, it is difficult to perform the analysis with the data of the same granularity. Since data may have different temporal dimensions, data compatibility should be discussed and solved to incorporate the data from different data sources. Fourth, institutions can be considered at different levels of aggregation (Boschma & Martin, 2010). Institutional approaches often associate institutions with territories at various spatial levels. If institutional effects are examined at different aggregation levels, different patterns, trends, and relationships of foreign investment can be detected. Therefore, aggregation methods should be developed. Fifth, institutions are usually regarded as factors that determine, instead of condition, the investment (Boschma & Martin, 2010). Institutional change is required not only to drive the emergence of new investment clusters, but also to revive the existing ones. So, the problem of how to make the role of institutions endogenous needs be added as an unsolved challenge. It is not just that these five challenges remain unsolved, but that they are the tasks that can be applied to any investment research – a more spatial-temporal framework that overcomes these problems should be developed.

## 1.2. Research Objectives

This dissertation proposes a spatial-temporal framework to uncover patterns, dynamics, and trends of foreign direct investment under the Chinese dual track system. This gradual approach to market liberalization enables us to develop economic geography theories from an evolutionary perspective instead of an equilibrium-based approach, which is the preoccupation of traditional mainstream economics when time series data were scarce and methodological state of dynamic analysis of the economic landscape were embryonic.

An evolutionary perspective focuses on irreversible changes in patterns, dynamics, and relationships of investment activities in space and time (Boschma & Martin, 2010). Institutional changes at all levels have increased the mobility of capital due to globalization, market liberalization, and decentralization, especially in China. In addition, urbanization, industrialization, and postindustrialization have been altering the nature of investment capital flows in space and time. An equilibrium-based approach is not well-suited in the era of massive institutional changes that contains dynamic spatial, temporal, and attribute information of capitals.

As stated previously, there is an imperative need to develop methods that can deal with institutional effects. Since institutional effects are not constant, evolutionary analysis rather than stable equilibrium analysis is appropriate to discover underlying patterns, dynamics, and processes of investment behaviors. Therefore, evolutionary analysis, such as path dependence and space-time model, plays a key role.

This dissertation proposes a space-time model as a means of evolutionary analysis for foreign direct investment, which leads to research at a more detailed and deeper level,

such as hypothesis creation of economic geography theories, and assessment of space-time models that have not been discovered or developed. Insights from evolutionary analysis have great potential in understanding dynamical processes of foreign investment, evaluating institutional effects on it, and developing future economic policies.

The space-time model in this dissertation also provides institutional components to overcome research problems for the cluster, integration of the cluster analysis and the institutional approach, dealing with the longitudinal data, enhancing quantification of institutions, institutional linkages between different levels of government, and aggregation and endogeneity of institutions. The research objectives are as follows: (1) to build a space-time model for analyzing patterns, dynamics, and trends of foreign direct investment; (2) to develop evolutionary approach to examine institutional effects on the evolution of clusters using longitudinal data; (3) to propose methods for quantification, aggregation, and endogeneity of institutions for better understanding the role of institutions in foreign direct investment; and (4) to provide policy implications on future economic policies on foreign capital.

An evolutionary approach enables this research to explore the process of foreign investment from historical perspectives. The spatial-temporal data are used to examine the spatial, temporal, economic, and institutional components of foreign capital, which is explained in detail in Chapter 3. The ability to deal with the "history" part of economic data has been one of the major research challenges in evolutionary economic geography. Moreover, aggregation and endogeneity of institutions enhance quantification of institutional effects in the location decision of foreign investment and provide new insights in the institutional component. Also, the integration of cluster analysis and institutional

approach is accomplished by incorporating different levels of governmental policies in the space-time model. This space-time model consists of novel competencies for patterns and processes of foreign capital towards the evolution of clusters and institutions.

### 1.3. Structure of This Dissertation

This dissertation consists of six chapters. Chapter 1 introduces the research background, summarizes current research challenges, and proposes research goals and objectives of this dissertation. Chapter 2 reviews literature of related research fields that contributed to economic geography research for FDI: neoclassical location theory, new economic geography, institutional economics, spatial interdependence, and evolutionary analysis. Since this research focuses on discovering the evolution of FDI patterns and institutional effects, a large portion of the literature review is dedicated to research fields of institutional economics, cluster analysis, and evolutionary analysis. Chapter 3 describes data and methods that are utilized to build the space-time model: geographically weighted regressions, space-time statistics, and spatial econometrics. Model components and variables are presented in this chapter. Chapter 4 presents the results of the space-time model of FDI at the provincial and regional levels, which examines patterns and factors of FDI location, paying special attention to the dynamic changes in FDI clusters at the regional level. Chapter 5 presents the results from intercity competition for FDI, showing spatial-temporal patterns and dynamics of FDI among all prefecture-level cities. Chapter 6 presents a case study of Wuhan metropolitan area to explain the evolutionary processes of FDI patterns and trajectories at an intrametropolitan level, emphasizing the spatial-temporal variation in institutional effects. Chapter 7 summarizes and discusses the results.

Then it concludes and provides policy implications for future economic policies on foreign capital and proposes the future agenda that this research suggests.

# CHAPTER 2

# LITERATURE REVIEW

Extensive research has been accomplished on the topics of FDI location and its patterns and determinants in institutional and geographic spaces, as well as the application of geography and evolutionary economics theory to generate a better understanding of activities of FDI location. This section includes an overview of location theory, neoclassical theory and new economic geography, institutional economics, evolutionary economic geography, spatial issues pertaining to the FDI, and FDI location characteristics in China.

The first section of this chapter presents a review of location theory pertaining to the core notion of rationalism: two principles of maximization and equilibrium upon which traditional location theories are based. The second and third sections of this chapter provide a literature review of neoclassical theory and new economic geography, which are based on two principles of maximization and equilibrium. Compared to traditional location theories, the fourth section reviews institutional economics focusing on understanding the role of institutions in FDI location. The fifth and sixth sections review spatial issues pertaining to FDI location: spatial interdependency, and scale and scale effects. The seventh section reviews temporal issues pertaining to FDI, which provides a dynamical analysis of FDI patterns and trajectories derived from "history," from an evolutionary perspective. The

final section of this chapter discusses the characteristics of FDI in China.

## 2.1. Location Theory

Location theory is the study of the geographic location of economic activity, addressing questions of what economic activities are located where and why. It was inaugurated by von Thunen in 1826 (von Thunen, 1966) and had a history of over 175 years, but it was originally introduced to the English-speaking world by Isard in 1940 (Isard, 1956). Traditional location theory mainly rests on rationalism rather than local knowledge (Barnes, 2003). Rationalism defines two schools of locational analysis: neoclassical location theory and new economic theory.

The core notion of rationalism is two principles of maximization and equilibrium upon which theories are based. Based on the rational choice theory, firms tend to make location decisions in their own best interests. They seek benefits from maximizing profits. In other words, firms make location decisions about how they should choose by comparing the costs and benefits of different locations. As a result, patterns of location will develop resulting from these choices.

In addition to maximization, equilibrium has been the central concept in traditional location theory. It is a state where economic forces are balanced and this state will not change without external influences. Its quintessential feature is a movement towards a predefined equilibrium outcome. The aim is to demonstrate how economic activities tend towards a unique and invariant equilibrium state. It is conceptualized as an equilibrium process being depicted as (Harris, 2004):

Equilibrium process: $x(t+1) = F_x^e(x(t)), -\infty \leqslant t \leqslant +\infty;$

$x^e$ = equilibrium point

where $x$ is the economic state or outcome of interest, and the function $F_x^e$, governing the change over time of the system, generates a unique and stable equilibrium $x^e$. Equilibrium is not an outcome of real historical processes, but an abstract state based on assumptions, equations, and exogenous parameters and variables.

Traditional location theories, including neoclassical theory and new economic geography, are based on these two principles of maximization and equilibrium. Based on these two principles, neoclassical theory develops multiple strategies of valid scientific inquiry on location, such as statistics and correlation analysis. Comparatively, the presentation of these two principles in any formal mathematical model is considered as a solid basis for integrating spatial issues into economics within mainstream new economic geography (Krugman, 1995).

Compared to traditional location theory, institutional economics focuses on understanding the role of institutions in firm location decisions. It originated from Veblen's (1898) instinct-oriented dichotomy between technology on the one side and the society on the other, emphasizing the importance of habits, conventions, and norms in economic activities.

## 2.2. Neoclassical Theory

The neoclassical theory, including industrial organization theory and industrial location theory, is based on profit maximization in terms of costs and market access, and

focuses on comparative advantages. The industrial organization theory, pioneered by Hymer (1976), states that the characteristics of multinational corporations and the market structures in which they operate are important determinants of the firms that engage in FDI. The theory uses firm-specific advantages, such as a firm's market position, product differentiation, and expertise in organizational and management skills, to explain MNC's international investment. The advantages that certain firms have over competitors in the home country can be extended into foreign markets through international direct investment.

In terms of the efficient use of factors of production, a firm split off some of its activity from an otherwise integrated production process in the home country. Depending on how the overall activities of the firm are split, FDI is classified into *horizontal investment* and *vertical investment.* A firm splits its activity by duplicating a subset of its activities for some part of the production process, which is referred to *horizontal foreign direct investment* (HFDI). The main costs of HFDI are plant-level economies of scale foregone while the main benefits of HFDI are market access and competition. So market size and growth is argued to have a positive effect on FDI location. A large market will attract firms that have outgrown their own domestic market and are looking to expand into other markets to gain greater sales or market share (Jones & Wren, 2006).

A firm split its activity by function is called *vertical foreign direct investment* (VFDI), referring to the breaking of the value-added chain. The costs of VFDI are economies of integration foregone while the main benefits of VFDI are access to low factor costs. So the labor market is expected to have an effect on FDI location. The availability of labor positively affects FDI location, as a large amount of available labor provides the firm with a pool of workers from which it can choose its labor force. However, there are a

number of other considerations. The cost of labor will have an inverse effect on investment while more-productive labor will yield productivity gains (Mudambi, 1995). The cost of labor and the level of productivity are often used in studies of FDI location to test the effect of the labor market (Hill & Munday, 1991). Overall, the tradeoff between costs and benefits of different types of investment determines which firms are more likely to become MNE and which are the areas they are more likely to invest in.

Neoclassical location theory advances a core-periphery pattern. This pattern is largely attributed to the significance of accessibility since easy access to the central business district, transportation, and infrastructure can reduce the investment costs (Alonso, 1964). Neoclassical location theories explain FDI activities in terms of conditions in locations where FDI activities operate (Santiago 1987). Traditionally, location theory indicates the significance of accessibility to the central business district (CBD) (Alonso 1964). Location theory also shows the significance of transportation infrastructure, such as airports and highways (Guimera et al. 2005; Knox & Taylor 1995; Wu 1999).

However, the neoclassical theory assumes perfect competition, zero transaction costs, and perfect information and fails to fully account for investors' motivations and behavior (how, where, and why FDI occurs). While large market size and cheap labor costs are important drivers for MNEs to invest in China, after the WTO, MNEs are changing from export-oriented investments to market-oriented investments, and market size is increasingly playing more important roles in attracting FDI. Existing studies, however, have not examined the temporal change of effects of different comparative advantages on FDI yet.

## 2.3. New Economic Geography

New economic geography, pioneered by Krugman (1991), identifies agglomeration economies as one of the driving forces for FDI. It provides a new explanation on the high concentration of firms through agglomeration effects of investment (Krugman, 1991). This strand of literature investigates how agglomeration influences MNE's location choices and FDI distribution due to increasing returns at the level of the individual firms (Chung & Alcacer, 2002; Coughlin & Segev, 2000; Head et al., 2004). It, therefore, provides a framework that potentially considers different types of forces influencing FDI distribution, either concentration or dispersion. Agglomeration economies refer to the self-reinforcing phenomenon of FDI. It indicates that the existing firms in an area can bring more firms to invest in this area, which causes a process of circular causation. Through this process, a growing concentration of firms will emerge and continue. The theoretical literature has identified different factors generating positive feedback loops (Storper, 2000), which makes FDI concentrated in particular places and lead to agglomeration of industries (Coughlin et al., 1991; Shaver & Flyer, 2000). It has identified and modeled four different mechanisms that lead to localization of industry: specialized labor (Audretschand Feldman, 1996), specialized intermediate suppliers of regional economies (Storper, 2000), knowledge flows (Henderson, 1997; Liefner & Zeng, 2008), and scale economies. These factors can generate positive feedback loops (Storper, 2000), which leads to the concentration of foreign ventures in particular locations (Krugman, 1991).

Recent studies focus on the knowledge spillover of FDI. They investigated the accumulation and sharing of knowledge among firms in an industry or those across

industries, which stimulate the geographic concentration of FDI at urban or larger scales (Head et al., 1999; Henderson, 1997; Jacob, 1969; Kogut & Chang, 1996; Smith & Florida, 1994; Urata & Kawai, 2000). In addition, technological externalities arising from personal interactions, such as informal conversations, matter most for small-scale agglomerations, such as intraurban level, especially between small, high tech firms (Saxenian, 1994) or between firms and nearby universities (Jaffe, 1989). They find that these geographic knowledge spillovers cause spatial clustering. Porter (1998) developed the cluster theory and maintained that the geographic scope of a cluster can range from a zone, single city, or state to a country or even a group of neighboring countries.

On the other hand, the underlying idea of expecting positive spillovers is that foreign firms bring in more advanced technological know-how, marketing and managing practices, and distribution networks. These intangible assets related to FDI are viewed as an engine of a plant's productivity growth. These benefits may not be restricted to affiliates of MNCs, but spill over to other firms operating in the same region or sector. The literature identifies four potential FDI spillover channels: imitation (related to products and technology, export, and managerial skills), acquisition of human capital, exports, and competitive effects (Abraham et al., 2006). Such spillovers have the potential to raise productivity and their exploitation might be related to the structural characteristics of the local economy. Despite the theory predicted regarding the positive spillover effects, the empirical literature finds no or even negative effects on the productivity of domestic firms in transition and developing economies (Aitken & Harrison, 1999; Konings, 2001; Smarzynska-Javorcik, 2004).

Agglomeration economies help to reduce transaction costs for different types of

investors, such as greenfield investors (Guimaraes et al., 2000). However, when a city or region's FDI concentration reaches a certain level, the city or region may exhibit agglomeration diseconomies and lost comparative advantages due to serious problems, such as rising labor costs, congestion, pollution, transportation bottles necks, crime, and so on. Then FDI moves to cities or regions with comparative advantages (Fan & Scott, 2003). Thus, concentration ceases or dispersion replaces with it (Henderson, 1974). Therefore, research on the intercity level and interregion level is important to understand the dynamics and processes of FDI location decisions among cities. However, the existing research on China focuses on the intraurban agglomeration of FDI in emerging global cities, such as Beijing and Shanghai (Wu & Radbone, 2005; Zhou & Tong, 2003), paying little attention to FDI agglomeration at the intercity level and interregion level. Also, since institutions play an important role in creating agglomeration economies, a series of critics have argued that institutional factors, such as local governments, are taken less into account; therefore, the field has been unable to model a system of cities in which cities are of different institutional environments (Henderson, 1996).

### 2.4. Institutional Economics

Institutional economics focuses on institutional impacts on foreign investments, including transaction or internalization theory (Williamson, 1973), and new regionalism (Ethier, 1998). Transaction or internalization theory interprets how institutional market imperfection and transaction costs may be internalized by MNCs through FDI to minimize transaction costs, such as tariffs or subsidies, foreign exchange controls, import quotas, and income taxes (Hennart, 1992; Rugman, 1986). New regionalism (Ethier, 1998) revealed

the importance of regional integration schemes, such as the North American Free Trade Agreement, the European Union, and the Association of South East Asian Nations, which often combines a small, developing economy with one or more large developed economies. Developing economies can significantly increase their attractiveness to foreign investors by entering into agreements that share major features of the regional integration (Ethier, 1998; Waldkirch, 2003).

There has been an increasing use of institutional analysis in FDI research. More recent works on institutional theory have uncovered the significance of nation-states (Dicken, 2007; Liu & Dicken, 2006) and local institutions (Wei et al., 2008; Wei et al., 2010) in firm location and business organization. Good institutions have positive influence on attracting foreign investment in general, through reducing vulnerability to any form of uncertainty and thus lowering additional costs (Benassy-Quere et al., 2007). Furthermore, local institutions are an important factor of local embeddedness. Amin and Thrift (1994, 14) use the concept of "institutional thickness" and suggest that a "strong institutional presence" and "high levels of interaction amongst the institutions in a local area" may generate strong local embeddedness (Yeung & Li, 2000). In developing countries, many factors, such as quality and quantity of local suppliers, the role of export platforms, and lack of intellectual property protection, inhibit development of networks of linkages between MNCs and domestic enterprises.

These existing theories are mostly developed, adopted, and based on developed economies. They are insufficient to explain multimechanisms reflecting the interactions among society, economics, and institutions, which influence the FDI locations in China. The role of institutions has not been well explored (Wei et al., 2008). Also, they are often

based on case studies and qualitative approaches (Leung, 1993; Sit & Liu, 2000; Yang, 2006), which show that place promotion and local institutions influence locational decisions of MNEs and intensify spatial competition for FDI (Wei et al., 2010). These studies indicate institutions play an important role in the tradeoff between comparative advantages and agglomeration. However, few efforts have been made to quantify nontraditional factors, such as state policy, preferential policy treatment, and local promotion (Taylor & Thrift, 1982; Wei et al., 2010; Wu & Radbone, 2005).

The institutional approach emphasizes the evolution of institutions and investments since institutions are characterized by "path dependence" (Martin, 2000). Also, institutional-economic path dependence is itself place-dependent (Martin, 2000). Some literature has drawn attention to the emergence of new regional and local economies as nodes of institutional entities within this new globalized capitalism (Scott, 1998; Storper, 1997). They indicate that differences in institutional capacities of these economies play an important role in attracting FDI when many nation-states are decentralizing and devolving their institutional structures (Martin, 2000). In China, FDI policies are location-specific and vary across regions and cities (Wei et al., 2010). Early research on FDI agglomeration in China focuses on the PRD and YRD. With a shifting policy focus, the BRR has become a new center of FDI and globalization. However, changes in roles and effects of institutions on FDI growth and distribution at the intercity level in China have not been thoroughly studied.

## 2.5. Spatial Interdependency

The tradeoff among comparative advantages, agglomeration, and institutions determines which firms are more likely to become MNCs and which areas they are more likely to invest in. However, these theories fail to consider FDI as a dynamic and continuing process consisting of two stages: initial entry and continuing expansion or allocation (Dunning, 1973, 2001; Grubaugh, 1987b; McConnell, 1983). The search for the location of initial entry within a country is limited and mainly based on a macrospatial framework such as states and provinces. As MNCs become more familiar with the economic environment of host countries, the locational options for continuing expansion or allocation are increased. Therefore, locational factors are sensitive to the spatial scale during the dynamic processes of perception and evaluation of location choices.

Theoretical modeling of such MNC decisions will clearly be affected by having more than two areas, which involves host market interdependency. A number of recent papers apply spatial econometric techniques to allow for interdependence of FDI activity across host countries (Baltagi et al., 2007; Blonigen et al., 2004; Coughlin & Segev, 2000). These studies show that spatial interdependence matters for FDI patterns, but that the sample chosen in geographic space to estimate these relationships can substantially affect the estimated interdependencies.

## 2.6. Scale and Scale Effects

Scale and scale effects are one of the important considerations for the studies regarding the global economy. An examination of the global economy must incorporate multiple scales of economic, political, cultural, and social relations. Usually a local or a

global-local geographical scale of analysis is used, which preclude alternatives and obscure the variations within different scales. Also, interconnections between scales become difficult or even impossible. The selection of a particular scale involves the automatic privileging of that scale over others, which becomes an obstacle to understand developmental strategies, and their implementation and impacts. Thus, in order to avoid the privileging of a particular scale, it is necessary to incorporate multiple scales in understanding the global economic activities (Dicken et al., 2001).

FDI research has been increasingly conducted in understanding the global economy. The scale effect on the FDI has not received adequate attention, despite the fact that scale may significantly affect the results of these studies. Although scale is a fundamental issue that need be dealt with, its effect on FDI has seldom been addressed. The current studies have generally analyzed the following types of agents: firms, industrial sectors, cities, and provinces. Other agents, such as states, nongovernment organizations, and global regulatory bodies have been neglected.

The characteristics of FDI present unique challenges to scale studies. The goal of this research is to incorporate multiple scales in understanding FDI location by examining spatial patterns, dynamics, and processes of FDI under the multiscale institutional frameworks at interregion, intercity, and intrametropolitan levels. Specifically, this dissertation examines (1) how locational determinants change in response to the change in scale and (2) what the effective ranges of scale are for responding to the change in scale. This dissertation provides a perspective for selecting appropriate scales for FDI studies.

## 2.7. Evolutionary Economic Geography

Recent decades witnessed a new paradigm in economic geography: evolutionary economic geography. Through evolutionary economic geography, which focuses on change in the economic landscape and emphasizes the importance of history, an evolutionary perspective on the economic landscape started receiving attention as a method to overcome the shortcomings of conventional location analysis – stationary states or equilibrium movements. Stationary states or equilibrium movements is the preoccupation of traditional mainstream economics based on rationalist, indicating that traditional mainstream economics conducts static or comparative-static analysis and does not treat economic agents and their behaviors as dynamical. From an evolutionary perspective, "dynamical" refers to emergence, convergence, divergence, and other patterns and trajectories derived from "history," which have not been dealt with in the conventional locational analysis. Although the conventional location analysis has been widely accepted and used, the major drawback of the traditional paradigms is the lack of "dynamical" processes and mechanisms in the locational analysis (Boschma & Martin, 2010).

Evolutionary economic geography exploits characteristics of real historical information. It receives attention as an approach to overcome shortcomings in the conventional location approach toward better prediction for location choices. First, the evolutionary approach focuses on irreversible processes: the past cannot be recovered and it conditions the location choices of firms in the present and the future. There is a real history in this approach (Boschma and Martin, 2010). Second, an evolutionary perspective is essential to a fuller understanding of such issues as the geographies of firms, dynamic processes of location choice by multinational firms, and economic growth.

## 2.8. Foreign Direct Investment Location in China

These theories were developed primarily to explain FDI location in Western capitalist cities. Though these theories have influenced the policies and research on China's FDI, they are limited in explaining FDI location within Chinese cities, which have different urban spatial structure and are experiencing the transition to a socialist market economy.

The literature on FDI location within Chinese cities is very limited due to the limitation of data availability and the regional constraint of open cities, but they have displayed their own characteristics. First, different from the neoclassical location theory, accessibility have varied effects on the location of FDI within Chinese cities due to different urban spatial structure. Some scholars find the positive influence of proximity to the central business district (CBD), airports, and supporting services on FDI location in major coastal cities, such as Guangzhou (Wu, 1999) and Shanghai (Wu & Radbones, 2005), while Wei et al. (2010) find that proximity to the railway station is a negative factor for FDI, which is unexpected. They explain that because the railway station in Nanjing is used mainly for residential and commercial activities. Second, the research on intracity level agglomeration effects within Chinese cities are mainly based on qualitative approaches and case studies in certain industries, such as auto industry and chemical industry in Shanghai (Bathelt & Zeng, 2012; Liu & Dicken, 2006) and information and communications technology industry in Beijing (Wei et al., 2012; Zhou & Xin, 2003). Only one study quantifies agglomeration effects in Shanghai using aggregated data. Wu and Radbone (2005) use density of economic output as an indicator to confirm the agglomeration effects of FDI: the degree of FDI concentration in an area has an influence on the location choice of FDI.

Third, the important role of institutions in foreign investment is highlighted (Wei & Liefner, 2012). Research on institutional effects mainly focuses on significance of economic and technological development zones (ETDZs) in FDI location. ETDZs are widely found to be the major areas of FDI. Wei et al. (2008) and Wei et al. (2010) find that development zone authorities are a significant force influencing the intramunicipal location decisions of multinational enterprises (MNEs) in Hangzhou and Nanjing, respectively. They argue that the important roles of these development zones lie first in modulating MNE risks with financial incentives, second in supporting FIE operations with industrial infrastructures, and third in enhancing investment environments with quality administration (Wei et al., 2008). Similarly, Wu (1999), and Wu and Radbones (2005), find the positive impacts of ETDZs in Guangzhou and Shanghai, respectively. However, little is done on assessing and evaluating the effectiveness of certain national development strategies and policies in attracting FDI in a city. Fourth, though Chinese cities' urban spatial structure is quite distinct from Western capitalist cities due to differences in their history, socio-economic structure, and population, its roles in FDI location have not identified in Chinese cities yet and its interaction with agglomeration and institution in FDI have been unexplored.

Based on the above review, three areas deserve more research efforts. First, effects of accessibility on FDI location should be further studied in inland cities. Current studies have shown that varied effects of accessibility may be due to the complexity of urban structure and local institutions. In addition, these studies are context-specific and fail to produce generalisable results because of unique regional and local context in coastal areas. Second, Chinese cities' urban spatial structure is experiencing significant changes resulting

from rapid urbanization, and consequently, the influence of urban spatial structure on FDI location should be examined. Third, the effectiveness of the policies toward inland areas in attracting FDI should be examined. Although there has been extensive research on the success of open policies in coastal cities, little is known about the effectiveness of national policies in inland cities.

The objectives of this research are to map the shifts in patterns of FDI at interregion, intercity, and intrametropolitan levels since 1990 and therefore assess the effectiveness of relevant policies, to examine the influence of comparative advantages and urban spatial structure and their interaction with agglomeration and institution in FDI, and to evaluate the effects of different comparative advantages and accessibility. This research is conducted under the framework of institution, agglomeration, and comparative advantages.

## 2.9. Analytical Framework

Based on the above review, neoclassical location theory, new economic geography, and institutional economics provide the basis for building a framework for understanding multiscalar FDI patterns and determinants (Figure 2.1). Factors representing comparative advantages, agglomeration effects, and institutions will be examined. This research examines spatial-temporal patterns and determinants of FDI at four spatial scales during the time period between 1990 and 2010 (Figure 2.2). These four spatial scales are interregion, interprovince, intercity, and intrametropolitan.

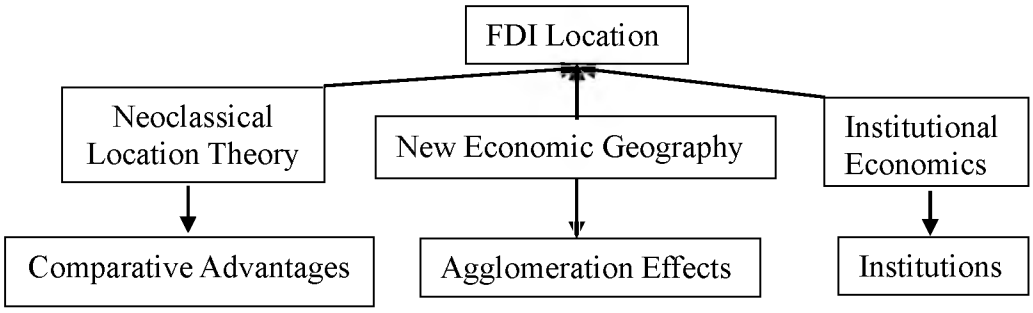


Figure 2.1. Theoretical and analytical framework of FDI location

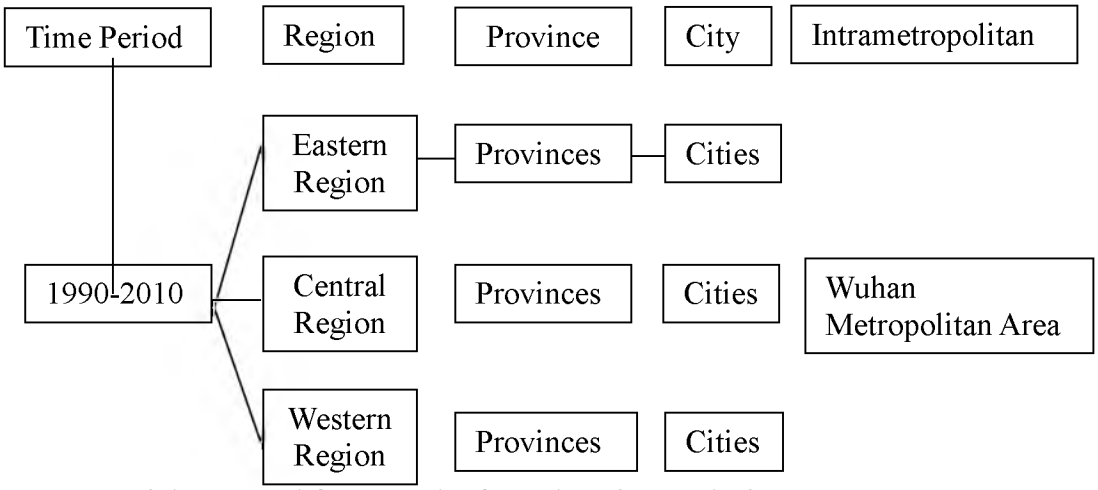


Figure 2.2. Spatial-temporal framework of FDI location analysis

## 2.10. Summary

Research fields introduced in this chapter have significant roles in understanding spatial patterns, dynamics, and processes of FDI. Location theory provides basic assumptions used in current research. Neoclassical location theory, new economic geography, and institutional economics can provide a useful framework for conceptualizing and analyzing FDI. Spatial interdependency, scale and scale effects, and evolutionary economic geography provide methods to uncover patterns and determinants of FDI in both

exploratory and confirmatory manners. Based on the literature review, spatial-temporal theoretical and analytical frameworks of FDI location are established. The next chapter introduces the methods and data employed in this dissertation.

# CHAPTER 3

# METHODOLOGY

## 3.1. Overview

This chapter describes the methodology of this dissertation. The dissertation consists of four sections that explain the research setting, data, and methods employed in this research: 1) research settings; 2) data; 3) spatial and temporal indicators: global and local statistics; 4) location determinants: regression model and geographically weighted regression. This dissertation examined spatial patters and locational determinants at three spatial scales in China, including interprovince, intercity, and intrametropolitan levels. It employed spatial statistics to detect global and local spatial and temporal clusters of FDI at three levels. A variety of regression models were used to examine the locational determinants of FDI at each spatial level.

First, the research settings section describes the nature and characteristics of study areas, and reviews the policies related to FDI in these areas. Second, the data section describes the nature, characteristics, sources, and quality of data at three spatial levels. Third, the spatial and temporal indicators section describes the methods of global and local statistics to assess and detect FDI distribution patterns, including Moran's $I$ index, Getis-Ord $G$, and space-time scan statistics. Last, in the location determinants section, regression model specifications are introduced, including forms, variables and

their justification, and spatial dependence tests.

## 3.2. Research Settings

### 3.2.1. China

China includes the 27 provinces and four municipalities. 27 Provinces are Liaoning, Hebei, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan, Guangxi, Heilongjiang, Jining, Inner Mongolia, Shanxi, Henan, Hubei, Hunan, Jiangxi, Anhui, Shaanxi, Ningxia, Gansu, Qinghai, Yunnan, Guizhou, Sichuan, Xinjiang, and Tibet. The four municipalities are Beijing, Shanghai, Tianjin, and Chongqing. They are divided into three regions in terms of geographical, socioeconomic, cultural, and demographic characteristics: eastern, central, and western regions (see Figure 3.1). Taiwan is not considered in this study because the data are not available and also because Taiwan's economic activity has effectively been outside PRC control. In order to keep the consistency of the study area, Chongqing is taken as a municipality in the whole study period, though this city has been separated from the Sichuan Province since 1997. Hainan is also considered as a province in this study though it was separated from Guangdong after 1988.

The "three economic belts" scheme based on the Seventh Five-Year Plan (1986-1990) is commonly used to analyze FDI determinants in China. Six metropolitan economic regions, the Pearl River Delta region (PRD), the Yangtze River Delta region (YRD), the Bohai Rim region (BRR), the Strait Economic region in the eastern costal region, the Greater Wuhan Economic region in the central region, and the Chengyu Economic region in the western region, are also used to analyze FDI distribution and


Figure 3.1. Regions and provinces in China

patterns in China. Until 2008, 56 national high technology development zones, and 54 national economic and technology development zones are established to attract FDI.

### 3.2.2. Wuhan Metropolitan Area

#### *3.2.2.1. Institution*

The central government initiated the *Rise of Central China Plan* in 2004, which proposed the idea of the Greater Wuhan Megalopolis, consisting of Wuhan and eight surrounding cities, in order to create a competitive economic region in Central China. In 2005, Wuhan became a strategic pillar city and played a leading role in the *Rise of Central*

*China Plan*, and specific policies were implemented later. In December 2005, the Ministry of Commerce issued *Opinions Regarding Attracting Foreign Investment and Promoting the Rise of Central China*. The following year, the State Council issued *Opinions Regarding Promoting the Rise of Central China*, and in 2007, the General Office of the State Council issued a notice that 26 cities in Central China were given the same preferential policies as those implemented in the *Great Western Development Strategy* and the *Northeast China Revitalization*. Wuhan is one of these 26 cities. One of the aims of these opinions and notices is to strengthen modern equipment manufacturing bases, including auto and auto parts, and promote rapid development of development zones through the encouragement of investment by private enterprises and foreign enterprises. Incentives were provided to achieve this aim in terms of capital and land. They included fiscal and tax incentives, which increased the fiscal transfer payment to help undertake industrial transfer projects. Also, China Development Bank provided a discounted loan of 15 billion Yuan to basic infrastructure projects in national development zones in Central China. For encouraged projects in the categories of foreign investment, the imported equipment for their own use was duty free. There were also land incentives, which increased the quota of land for urban development and gave higher priority to land use in the industrial parks.

Wuhan has experienced a series of institutional changes since being opened as one of the five open cities along the Yangtze River by the central government in May 1992. Two national development zones, the Wuhan East Lake High-Tech Zone (Wuhan ELHTZ) and the Wuhan Economic and Technological Development Zone (Wuhan ETDZ), were established in 1988 and 1991, respectively. The Wuhan ELHTZ, referred to as "Optics

Valley of China," focuses on the optical electronics, telecommunication, information, and biology sectors, while the Wuhan ETDZ is a manufacturing base for auto and auto parts. Additionally, each district in Wuhan established its own local development zone in the 1990s. Compared to the national development zones, these local development zones are considered to be local economic development tools and are more related to local interest within a metropolitan area. In 2010, the Wujiashan Economic and Technological Development Zone (Wujiashan ETDZ) was approved by the State Council to become the third national development zone in Wuhan, which is a food industry base. This research examines the effectiveness and influence of these specific policies on FDI location.

*3.2.2.2. Urban Structure*

Wuhan consists of 13 districts: seven districts are in the city center, and another six districts are in the suburbs (see Figure 3.2). The suburb has more available land for FDI than the city center, while the suburb has a lower population than the city center. The suburb has a total area of 7606 square kilometers, more than eight times as much as the city center has. The suburb has a population of 3.34 million while the city center has a population of 5.76 million (Wuhan Statistics Yearbook, 2010). Wuhan is divided into three parts: Hankou, Hanyang, and Wuchang. In terms of urban functions and land use characteristics, Hankou is the commercial and financial center where the majority of commercial and financial land use is concentrated, Hanyang is the industrial center with the highest percentage of industrial land use, and Wuchang is the educational and cultural center where the majority of educational and cultural land use is concentrated. Each part has a long history of serving its function and has its own centers. Effects of different

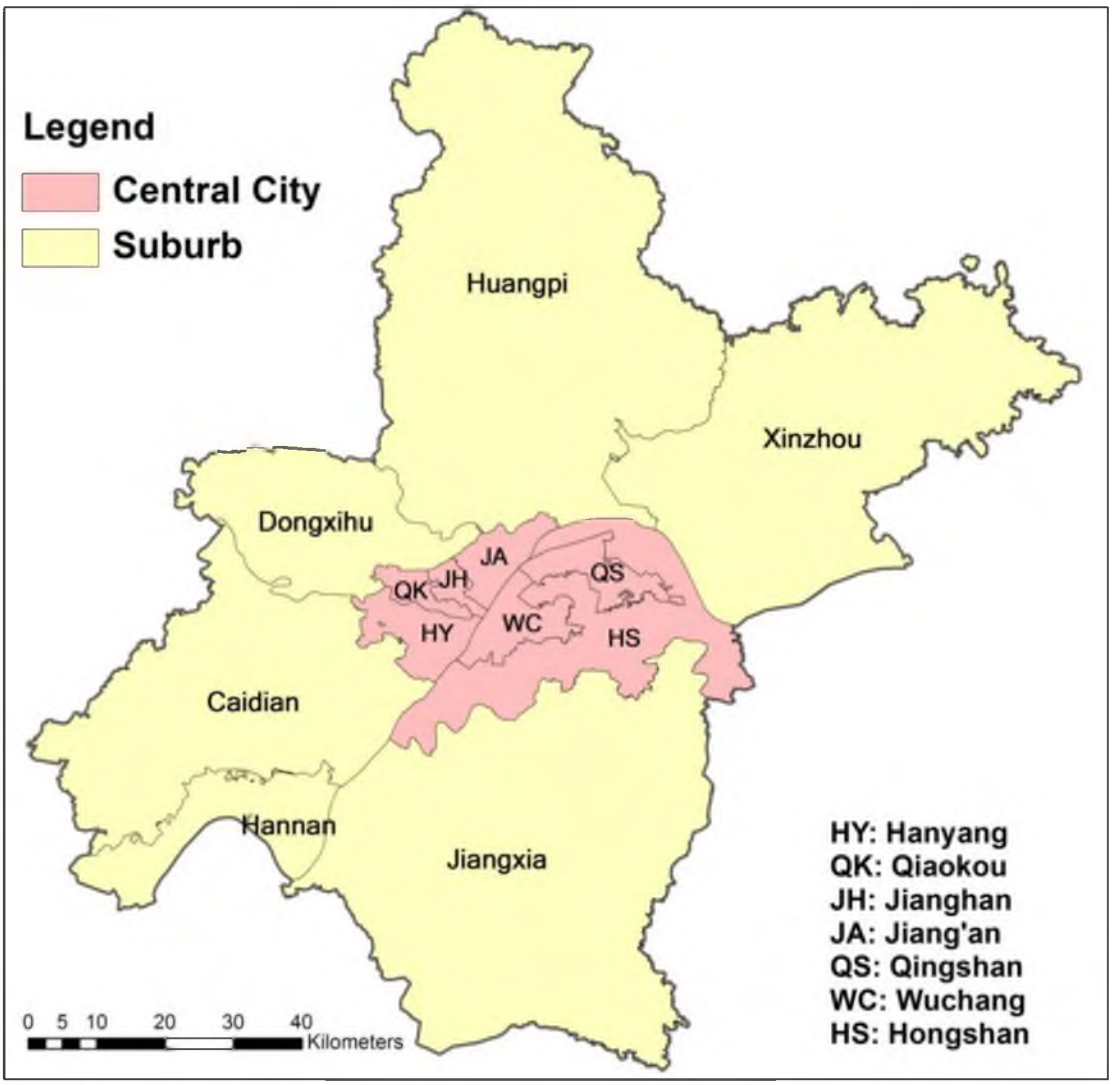


Figure 3.2. Central city, suburb, and districts of Wuhan metropolitan area

urban functions and landscapes are identified to examine the role of urban spatial structure in FDI location.

*3.2.2.3. Accessibility*

Wuhan has unique locational advantages. Usually referred to as the "thoroughfare to nine provinces," the Wuhan metropolitan area is China's largest inland rail and road transportation hub. Wuhan is located within 1,200 km of China's six major metropolises - Beijing, Tianjin, Shanghai, Guangzhou, Xi'an, and Chongqing (see Figure 3.3). China's two transportation arteries, the Yangtze River that runs from west to east and the Jing-Guang Railway from north (Beijing) to south (Guangzhou), meet in Wuhan. Five major

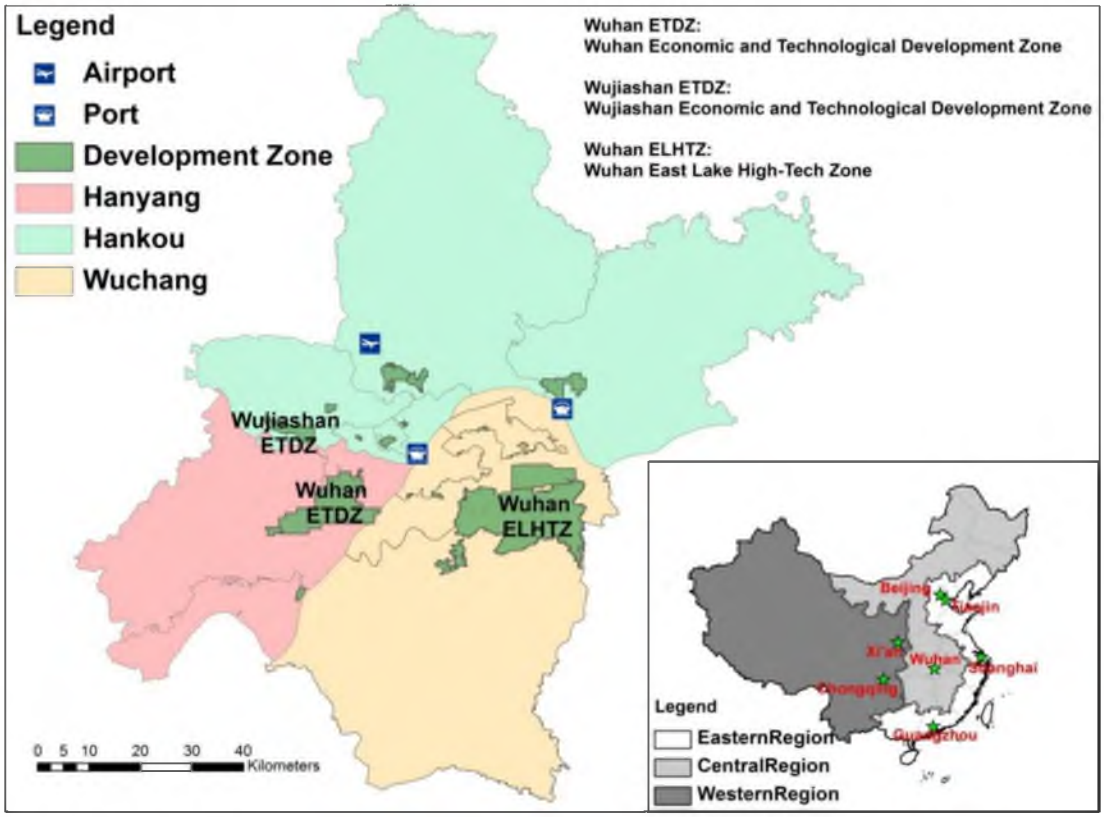


Figure 3.3. Location and spatial organization of Wuhan metropolitan area

country-network railways all meet at Wuhan, forming a hub with spokes leading to northern, southwestern, mid-southern, and eastern parts of China (Yangtze Council, 2008). Wuhan is a polycentric metropolitan area with one hub airport and two hub ports. Wuhan Tianhe International Airport is the busiest (and only) hub airport in Central China because of its geographically central location. Wuhan has two ports, Wuhan Port and Wuhan International Container Port. Wuhan Port is the largest inland hub port in Central China. Wuhan International Container Port is a deep water regional container hub port at the midstream of the Yangtze River. It plays a key role in the water transportation through connecting Wuhan with areas along the Yangtze River corridor, including the upstream areas of Chongqing and the downstream areas of Shanghai. This research examines effects of these transportation infrastructures in FDI location in terms of their accessibility.

## 3.3. Data

### 3.3.1. Provinces

Data at the provincial level include locational characteristics -- socioeconomic data, and GIS spatial files (shapefiles). Locational socioeconomic data cover the following variables for each province: FDI per capita, FDI, GDP per capita, GDP, average annual wage cost, railway length, and land area. GIS shapefiles refer to provincial boundary files of China. The national FDI data of China are from China Statistics Yearbook (SSB, 2009) released by the State Statistics Bureau, and provincial data are from China Data Online (http://chinadataonline.org/) with provincial socioeconomic data from 1989 to 2007. The shapefile source is China Data Center (http://chinadatacenter.org), from which the GIS boundaries for provinces are downloaded.

This research analyzed determinants of FDI in 27 Chinese provinces and four

municipalities between 1989 and 2007. In addition, in order to keep the consistency of the study area, Chongqing is integrated into Sichuan Province in the whole study period for calculating Moran's *I* and Geits-Ord *G*, though it has been separated from the Sichuan Province since 1997. Hainan is also treated as a province in this study since it was separated from Guangdong after 1988.

The State Statistics Bureau has collected foreign investment data since 1985, representing a long history of FDI data, which makes data consistent and reliable in general. However, a small share of the FDI in China is due to "round-tripping" by mainland Chinese firms, who take advantage of tax incentives through phony FDI transactions (Henley et al., 1999). However, its effect on FDI patterns should be limited.

### 3.3.2. Prefecture-level Cities

Data for all prefecture-level cities come from two major sources. The first is the China City Statistical Yearbooks, which provide social and economic data for all prefecture-level cities from 1990 to 2010 (the number of prefecture-level cities increased from 188 in 1990 to 287 in 2010), including FDI, GDP, average annual wage, volume of road passenger traffic, road area, and population. The second is the China Data Center website (http://chinadatacenter.org) where GIS boundary and point files for prefecture-level cities are downloaded.

Statistics in the China City Statistical Yearbooks are generated from the *hukou* registration statistics, one of two systems for the collection and reporting of statistical data (Chan, 2007). Compared to the other system of surveys, a major strength of this source is the variety of annual data on social and economic characteristics for us to examine the

change in spatial patterns and determinants in FDI location. However, its major shortcoming is that it is based on the *hukou* registration system and thus excludes unregistered migrants and thus underestimates a city's population, especially for the most dynamic and rapidly growing cities (Chan, 2007; Zhou & Ma, 2005).

#### 3.3.3. Wuhan Metropolitan Area

Data for Wuhan metropolitan area cover firm characteristics data from the 2008 economic census officially released by the National Bureau of Statistics and locational characteristics data from GIS spatial files. The 2008 economic census includes 1220 foreign firms. The firm level data do not include affiliates. Locational characteristics data of firms include distance to railways, distance to major roads, distance to the airport, distance to ports, distance to central business districts, density of firms, density of foreign firms.

### 3.4. Spatial and Temporal Indicators: Global and Local Statistics

This research uses global statistics and retrospective analysis to explore the spatial and temporal patterns of FDI distribution. Global statistics, including global Moran's $I$ index and global Getis-Ord $G$ statistics, are carried out to assess the degree to which the FDI distribution pattern deviates from the null hypothesis of spatial randomness. Moran's $I$ is commonly used to reveal spatial agglomeration by analyzing spatial autocorrelation among regions (Anselin, 1988), which can detect the spatial clusters and agglomeration of FDI. Global Moran's $I$ measures the degree of overall clustering tendency over the whole study area. Local Moran's $I$, called Local Indicators of Spatial Association (LISA), assesses

significant local spatial clustering around an individual location (Anselin, 1995). In addition, Getis and Ord's *G* statistics is to measure globally or locally spatial concentration of high or low values (Getis & Ord, 1992, 1996). Space-time scan statistics are used to test whether clusters existed over space and time for a predefined geographical region during a predetermined time period (Kulldorff et al. 1998). A space-time permutation model is applied to detect local concentrations over certain time periods (Kulldorff et al. 2005).

### 3.4.1. Province Level

First, this research uses the global Moran's *I* index to analyze whether spatial autocorrelation exist in the patterns of FDI for China. The Moran's *I* index is used to summarize the degree to which FDI tends to locate near each other. It is used to test the clustering of similar value of FDI. An index close to 1 indicates clustering and an index close to 0 indicates randomness. Global Moran's *I* of each year is calculated in ArcGIS for the period between 1989 and 2007 so that the change of spatial distribution of FDI can be explored. Moreover, LISA (Local Indicators of Spatial Association) statistics, such as the local Moran's *I* is used to identify local spatial autocorrelation in provinces. This is because global Moran's *I* only detects spatial association averaged over the entire study area, it cannot identify localized occurrence of spatial autocorrelation. Local Moran's *I* statistic is used to identify local patterns of spatial autocorrelation. Local Moran's *I* of FDI in each year from 1989 to 2007 is mapped in ArcGIS. Second, in order to detect concentrations of high or low values of FDI, the global and local Getis and Ord's *G* statistics are used to detect hot or cold spots of FDI. These hot or cold spots in each year are mapped in ArcGIS. Third, retrospective analysis is applied to determine whether FDI distribution is close in

space and also close in time. Spatial, temporal, and space-time scan statistics are used to detect clusters in spatial, temporal, and space-time dimensions. The normal model is used to find temporal and spatial clusters of FDI. This model is carried out in SaTScan.

### 3.4.2. Intercity Level

Global Moran's *I* index is calculated in ArcGIS to indicate the change in spatial autocorrelation of FDI in each year between 1990 and 2010. If Moran's *I* index is close to 1, it indicates clustering, while if it is close to 0, it indicates randomness. Local Moran LISA (Local Indicators of Spatial Association) statistics are used to identify local spatial autocorrelation of cities with similar values of FDI. In addition, in order to examine the concentrations of high or low values of FDI, local Getis-Ord *G* statistic is used to identify hot or cold spot cities for FDI. Results of LISA and local Getis-Ord *G* are visualized and mapped through ArcGIS to show the spatial clusters, and hot or cold spots of FDI in 1990, 2000, and 2010.

### 3.4.3. Intrametropolitan Level

Global Moran's *I* index is calculated in ArcGIS between 1992 and 2008 to investigate the temporal change of spatial autocorrelation of FDI. Moran's *I* index close to 1 indicates clustering and close to 0 indicates randomness. Local Moran's *I*, LISA (Local Indicators of Spatial Association) statistics are used to indicate local spatial autocorrelation and identify local FDI clusters within Wuhan in 1995, 2000, and 2005-2008, respectively. In addition, local Getis-Ord *G* statistics are used to identify hot or cold spot areas for FDI within Wuhan in 1995, 2000, and 2005-2008, respectively. ArcGIS is used to calculate and

visualize results of LISA and local Getis-Ord $G$ statistics.

## 3.5. Location Determinants: Regression Model and Geographically Weighted Regression

A regression model is used to examine which factors significantly affect locational decisions of FDI at three different spatial levels. GWR was developed to deal with nonstationary data by allowing regression model parameters to change over space (Fotheringham et al., 2002).

### 3.5.1. Province Level

This research uses the regression model to examine the variance of the relative importance of factors determining FDI in different provinces, using FDI per capita (FDIPC) in a province as the dependent variable. Within the framework of GWR, the traditional linear model is expressed as

$$Y_i=\beta_0+\beta_1 X_i+\varepsilon_i$$

In the above expression, the subscript $i$ represents specific geographical locations. Instead of being fixed, the values of $\beta_0$ *and* $\beta_1$ are now spatially varying. $X_i$ consists of three groups of determinants of FDI: comparative advantage, agglomeration, and institution. Comparative advantage includes three variables that are usually used to measure a region's comparative advantage in attracting foreign investors. They are GDP per capita (GDPPC), average annual wage (WAGE), and railway length per square kilometer (RPSK). GDP per capita measures the relative strength of market demand of a province. Average annual wage indicates the cost of labor. Railway length per square kilometer measures the railway

density, which indicates the extensiveness of transportation infrastructure. The FDI stock, the amount of existing FDI per capita (FDISTOCKPC), is measured as agglomeration. We measure the institution as the area percentage of national economic and technological development zones and high-tech development zones (DZPERCENT).

### 3.5.2. Intercity Level

In order to test spatial dependence, we calculated Moran's *I* for residual spatial autocorrelation and five Lagrange Multiplier test statistics. The results from these tests show that the Moran's *I* index for the residuals are 0.007, 0.030, and -0.008, for regression models run in 1990, 2000, and 2010, respectively. Moran's *I* for the residuals, the Lagrange Multiplier Lag (LM-Lag) statistic, and the Lagrange Multiplier Error (LM-Error) statistic are not significant in 1990 and 2010, but Moran's *I* for the residuals and the LM-Error statistic are significant in 2000 (see Table 3.1). So we used the ordinary least squares (OLS) regression model to examine which factors significantly affect locational decisions of FDI in 1990 and 2010, and used the spatial error model (SEM) to examine factors influencing FDI location in 2000.

For both OLS and SEM models, we control for residual unmeasured region-scale

Table 3.1. Diagnostics for spatial dependence

| | 1990 | | 2000 | | 2010 | |
|---|---|---|---|---|---|---|
| Test | Value | Prob | Value | Prob | Value | Prob |
| Moran's I (error) | 1.01 | 0.31 | 2.10 | 0.03 | -0.15 | 0.88 |
| Lagrange Multiplier (lag) | 0.09 | 0.77 | 0.49 | 0.48 | 0.17 | 0.68 |
| Robust LM (lag) | 0.37 | 0.54 | 2.60 | 0.11 | 0.02 | 0.90 |
| Lagrange Multiplier (error) | 0.04 | 0.83 | 1.48 | 0.22 | 0.48 | 0.49 |
| Robust LM (error) | 0.33 | 0.57 | 3.60 | 0.06 | 0.33 | 0.56 |
| Lagrange Multiplier (SARMA) | 0.41 | 0.81 | 4.09 | 0.13 | 0.50 | 0.78 |

variables by estimating region-level effects (O'Loughlin et al., 2012). These region-level effects are included as fixed instead of random effects. The OLS model has the following function form as the equation 1 and the SEM model has the following function form as the equation 2:

$$Y_i=\beta_0+\beta_1 X_i+Region_i+\varepsilon_i \quad [1]$$

$$Y_i=\beta_0+\beta_1 X_i+Region_i+\varepsilon_i+\lambda w_i\xi_i \quad [2]$$

As Table 3.2 shows, we consider FDI per capita as the dependent variable $Y_i$. *Region* is a fixed effect term. $X_i$ consists of three groups of determinants of FDI based on the literature review: comparative advantage, agglomeration, and institution. Comparative advantage includes four variables that measure a city's market size, labor cost, and transportation. They are gross domestic product per capita (GDPPC), average wage per year (WAGE), volume of public road passenger traffic (ROADPT), and road area per capita (ROADAPC).

Table 3.2. Definitions of dependent and independent variables at the intercity level

| Dependent Variables: FDI per capita | | |
|---|---|---|
| Independent | Variable | Definition |
| Comparative Advantages | GDPPC | Gross domestic product per capita |
| | WAGE | Average wage per year |
| | ROADPT | Volume of public road passenger |
| | ROADAPC | Road area per capita |
| Institution | NDZ | Whether a city has national economic and technological development zones or high-tech development zones |
| | PRD | Whether a city is located in the Pearl River Delta |
| | YRD | Whether a city is located in the Yangtze River Delta |
| | BRR | Whether a city is located in the Bohai Rim Region |
| | SEZOCC | Whether a city is designated as a Special Economic Zone or Open Coastal City |
| | CAPITAL | Whether a city is a provincial capital |
| Agglomeration | FDISTOCK | The amount of existing FDI |

GDPPC is considered an indicator of a city's standard of living, so it is used to measure the relative strength of the market demand of a city. The average wage per year indicates the cost of labor because generally, higher wages deter foreign investment (Coughlin & Segev, 2000; Friedman et al., 1992). In addition to market size and labor cost, transportation infrastructure is an important force determining FDI location. More developed and advanced transportation infrastructure helps cities attract more investment (Broadman & Sun, 1997; Coughlin et al., 1991; Head & Ries, 1996). However, due to the unavailability of data, we cannot find consistent data to use the same variable to measure a city's transportation ability in different time periods. The volume of public road passenger traffic measures a city's transportation ability in 1990, and road area per capita measures a city's transportation ability in 2000 and 2010. Besides the above, the FDI stock (FDISTOCK), meaning the amount of existing FDI, is used to measure agglomeration because a larger pool of existing foreign investment makes a city more attractive to investors and thereby generates strong self-reinforcing effects of FDI (Cheng & Kwan, 2000; Head & Ries, 1996;).

We use several dummy variables to measure the impact of the different institutions, including NDZ, PRD, YRD, BRR, SEZOCC, and CAPITAL. These variables are used to measure the effects of changing institutional policies and reforms on FDI locations. They include foreign capital policies, national and regional development policies, and decentralization policies. As mentioned in the literature review, in order to examine the changing effects of national foreign capital policy and investigate the debatable issue on the national development zones' continual contributions to FDI attraction, the variable national development zones (NDZ) is used to indicate whether a city has a national

development zone. The variable SEZOCC is used to indicate whether a city is a SEZ or OCC, which examines the effect of national and local open policy on FDI. Three dummy variables, PRD, YRD, and BRR, are used to indicate whether a city is located in the Pearl River Delta, the Yangtze River Delta, or the Bohai Rim Region, respectively; these variables examine the changing effects of national and regional development policies on FDI in these three regions in the 1990s and 2000s. Also, the central government devolved its authority and responsibility to provincial-capital governments in order to increase their autonomy in developing strategies to attract FDI, so the variable CAPITAL, which examines the effect of the decentralization policy on FDI, is used to indicate whether a city is a national or provincial capital.

### 3.5.3. Intrametropolitan Level

In a discrete urban space, logistic models are usually used for predicting discrete outcomes, especially for firm-level data. It can reflect the heterogeneity of locational determinants of FDI by overcoming the assumption that the relationships between FDI and locational determinants are homogenous across all firms. Thus, a logistic model is appropriate to analyze the locational determinants of foreign investment at a firm level. However, due to limitation of data availability and appropriate models, the existing studies use aggregated data and ordinary least squares (OLS) linear regression to examine factors influencing FDI location. They assume normal distribution and ignore the heterogeneity of FDI location determinants, which may cause a downwards-biased estimate of the slope coefficient and an upwards-biased estimation of the intercept. Based on the 2008 economic census, our study uses firm-level data to establish the logistic model to examine locational

determinants of FDI. We also develop the geographically weighted regressions (GWR) to examine the variation of the relative significance of factors determining FDI across the metropolitan area.

The logistic model is specified in terms of the probability of the firm being a foreign firm location as follows:

$$P = exp\ (\beta_0+\beta_1 X_i)/(1+exp(\beta_0+\beta_1 X_i)) + f_i$$

where, as Table 3.3 shows, $P$ is the probability of a firm being a foreign firm investment, and $X_i$ is a vector describing the site characteristics. $X_i$ consists of four groups of independent variables: accessibility, agglomeration, urban structure, and institution.

Table 3.3. Definitions of independent variables at the intrametropolitan level

| Type | Independent Variable | Definition |
|---|---|---|
| Accessibility | DistanceCBD | Distance to CBDs |
| | DistanceAirport | Distance to airport |
| | DistanceRoad | Distance to major roads |
| | DistanceRail | Distance to railway stations |
| | DistancePort | Distance to ports |
| Agglomeration | FirmDensity | Density of firms |
| | FDIDensity | Density of foreign firms |
| Urban Structure | Suburb | Whether a foreign firm is located in the suburb area (dummy variable: 1 for Yes and 0 for No) |
| | Hankou | Whether a foreign firm is located in Hankou (dummy variable: 1 for Yes and 0 for No) |
| | Hanyang | Whether a foreign firm is located in Hanyang (dummy variable: 1 for Yes and 0 for No) |
| Institution | NationalETDZ | Whether a foreign firm is located in one of national ETDZs (dummy variable: 1 for Yes and 0 for No) |
| | LocalETDZ | Whether a foreign firm is located in one of provincial level ETDZs (dummy variable: 1 for Yes and 0 for No) |

Accessibility variables include DistanceCBD, DistanceAirport, DistanceRoad, DistanceRail, and DistancePort, representing distances to the CBDs, airport, major roads, rails, and ports, respectively. Distances to the CBDs, airport, roads, major roads, rails, and ports indicate the accessibility to the CBD and different transportation infrastructures. All distances are straight-line calculated in ArcGIS and do not consider accessible time based on road network. The positive effect of easy access to the CBD and transportation infrastructures is shown in the studies of industrial locations influenced by neoclassical economics (e.g., Harrington & Warf, 2002; Knox & Taylor, 1995). Agglomeration variables include FDIDensity and FirmDensity, respectively representing the density of foreign firms and density of firms surrounding a foreign firm. These two variables are used to measure agglomeration effects because the existing firms can bring more firms to locate in the area, which causes a process of circular causation (Krugman, 1991; Storper, 2000; Wu & Radbone, 2005).

Urban structure variables include three dummy variables to measure the impacts of urban spatial structure on the FDI location. They are Suburb, Hankou, and Hanyang. Suburb is used to indicate whether a foreign firm is located in a suburban district because subdistricts are typically classified into two types in China: central city and suburb. Usually suburbs can provide more flexible institutional arrangements and financial policies for FDI than the central city (Wei et al., 2010). In addition, the three parts of Wuhan, Hankou, Hanyang, and Wuchang, serve different urban functions of commercial and financial center, industrial center, and educational and cultural center, respectively. In terms of its urban function, each part has corresponding land use characteristics. Therefore, Hankou is used to indicate whether a foreign firm is located in Hankou. Hanyang is used to indicate

whether a foreign firm is located in Hanyang. Institution variables include two dummy variables, NationalDZ and LocalDZ, measuring the effects of development zones on the FDI location, because development zone authorities significantly influence location decisions of FDI within a metropolitan area (Wei et al., 2008; Wu, 1999; Wu & Radbone, 2005). In order to distinguish the effects of different levels of development zones, NationalDZ is used to indicate whether a foreign firm is located within one of national ETDZs, while LocalDZ is used to indicate whether a foreign firm is located within one of provincial level ETDZs.

### 3.6. Summary

This chapter introduced the data and methods used to assess spatial-temporal patterns of FDI and examine its locational determinants. Global statistics enables an assessment of FDI distribution across the whole study area while local statistics provides detection of local clusters and outliers, and hotspots and coldspots. A variety of regression models examine spatial and temporal variation of locational determinants of FDI at interprovince level, intercity level, and intrametropolitan level. The next chapter of this dissertation presents the results derived from these data and methods.

# CHAPTER 4

# FOREIGN DIRECT INVESTMENT BY PROVINCE AND REGION

## 4.1. Overview

This chapter presents the results of analyzing the spatial-temporal distribution and locational determinants of FDI at the provincial level. The results identify spatial- temporal clusters of FDI and spatial-temporal variation of factors influencing FDI location across different regions and provinces. This chapter will explore results using spatial statistics and geographically weighted regression models described in the Methodology chapter. This chapter will focus on the differences in FDI patterns and determinants among three developed economic areas within the eastern region, including the Pan-Yangtze River Delta (Pan-YRD), the Guangdong province, and the Bohai Rim Region (BRR). These differences are indicating the different relationships among provinces within three economic areas: cooperative, competitive, or mixed. The roles of metropolitan areas of Shanghai, Beijing, and Tianjin in these relationships are identified and emphasized.

## 4.2. FDI Growth and Distribution in China

Since the launch of reforms in the late 1970s, China has dramatically restructured Mao's policy of self-reliance and has favored opening up its domestic economy to the outside world. FDI has since grown drastically in China, especially in the early and mid-

1990s when China deepened its economic reforms and in the early 2000s after China joined the WTO (Figure 4.1). The primary sources of FDI in China are Greater China (Hong Kong and Taiwan), East Asia (Japan and South Korea), and the United States, followed by European countries.

Whereas all of the provinces in China have attracted foreign investment, the coastal region has captured the lion's share of FDI (Table 4.1 and Figure 4.2). As Figure 4.2 shows, a large amount of FDI has been located in China's eastern/coastal region, without any significant equalizing with the interior. China's eastern region generally attracted about 90% of the regional FDI. From 1983 to 2000, the central region's share of

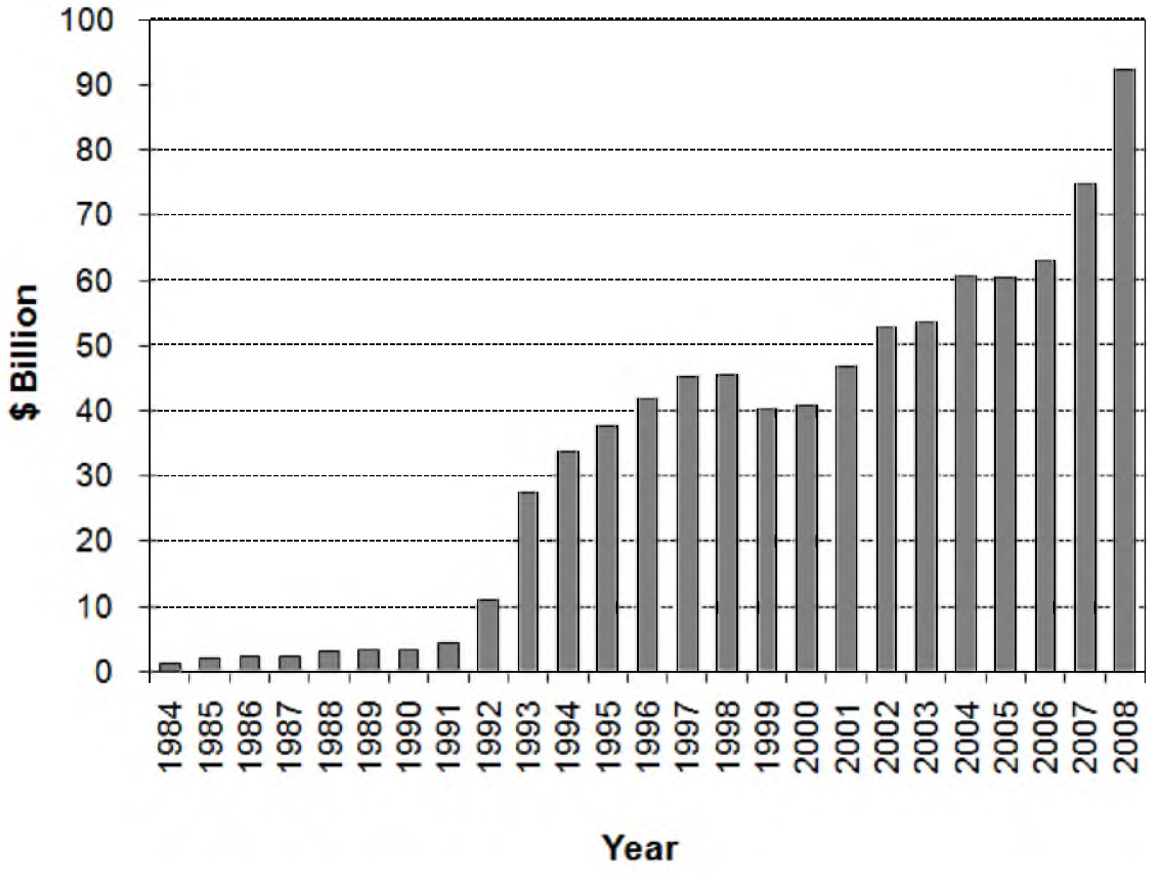


Figure 4.1. The growth of FDI in China (1984-2008)

Table 4.1. Regional distribution of FDI in China.

| | Eastern Region | | Central Region | | Western Region | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Total | Percent | Total | Percent | Total | Percent | Total | Percent |
| 1985 | 827 | 92.4 | 36 | 4.0 | 32 | 3.6 | 895 | 100 |
| 1990 | 3045 | 94.2 | 111 | 3.4 | 76 | 2.4 | 3232 | 100 |
| 1995 | 32949 | 87.2 | 3380 | 8.9 | 1442 | 3.8 | 37771 | 100 |
| 2000 | 35412 | 87.6 | 3700 | 9.1 | 1330 | 3.3 | 40442 | 100 |
| 2007 | 96038 | 78.3 | 21664 | 17.7 | 4922 | 4.0 | 122624 | 100 |

Unit: US$ Million. Source: China Data Online

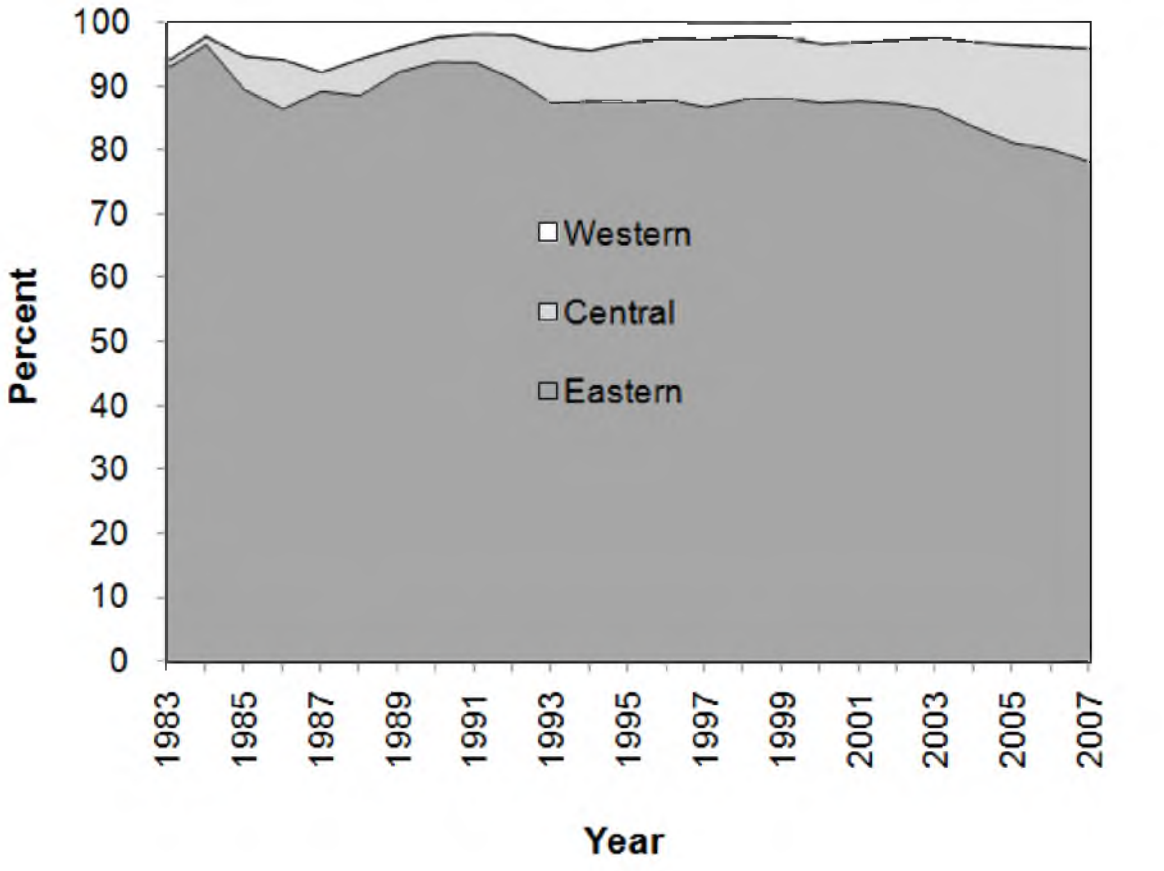


Figure 4.2. Share of FDI in western, central, and eastern regions (1983-2007)

FDI increased from 1.1% to 9.1%, while the western region's share stagnated. In 2007, these two regions as a whole attracted only 21.7% of China's regional FDI. However, the FDI share in the eastern region decreased by 14% from 1985 to 2007 while the FDI share in the central region increased by 14%.

Among China's provinces, Guangdong attracted the earlier infusion of FDI, with the opening up of Special Economic Zones in south China (Table 4.2 and Figure 4.3). In the1980s, Guangdong captured about half of the FDI. With the opening up of the Pan-YRD, FDI in this region increased rapidly, which has become one of the largest hosts of FDI and emerging global city-regions in the world. Jiangsu gradually surpassed Guangdong to become the largest destination of FDI in China (Table 4.1 and Figure 4.3). By 1995, although Guangdong remained dominant, the share of FDI in Guangdong declined to 27%,

Table 4.2. Distribution of FDI in the BRR, Pan-YRD, and Guangdong.

| | 1990 | | 1995 | | 2000 | | 2007 | |
|---|---|---|---|---|---|---|---|---|
| | FDI | % | FDI | % | FDI | % | FDI | % |
| Bohai Rim Region | 798 | 24.8 | 7716 | 20.4 | 8544 | 21.12 | 32869 | 26.8 |
| Beijing | 277 | 8.6 | 1403 | 3.7 | 1684 | 4.2 | 5066 | 4.1 |
| Tianjin | 83 | 2.6 | 1521 | 4.0 | 1166 | 2.9 | 5278 | 4.3 |
| Hebei | 39 | 1.2 | 781 | 2.1 | 679 | 1.7 | 2416 | 2.0 |
| Liaoning | 248 | 7.7 | 1404 | 3.7 | 2044 | 5.1 | 9097 | 7.4 |
| Shandong | 151 | 4.7 | 2607 | 6.9 | 2971 | 7.3 | 11012 | 9.0 |
| Pan-Yangtze River Delta | 366 | 11.4 | 9289 | 24.6 | 11199 | 27.7 | 40178 | 32.9 |
| Shanghai | 177 | 5.5 | 3250 | 8.6 | 3160 | 7.8 | 7920 | 6.5 |
| Jiangsu | 141 | 4.4 | 4781 | 12.7 | 6426 | 15.9 | 21892 | 17.9 |
| Zhejiang | 48 | 1.5 | 1258 | 3.3 | 1613 | 4.0 | 10366 | 8.5 |
| Guangdong | 1460 | 45.2 | 10180 | 27.0 | 11281 | 27.9 | 17126 | 14.0 |

Unit: US$ Million. Source: China Data Online

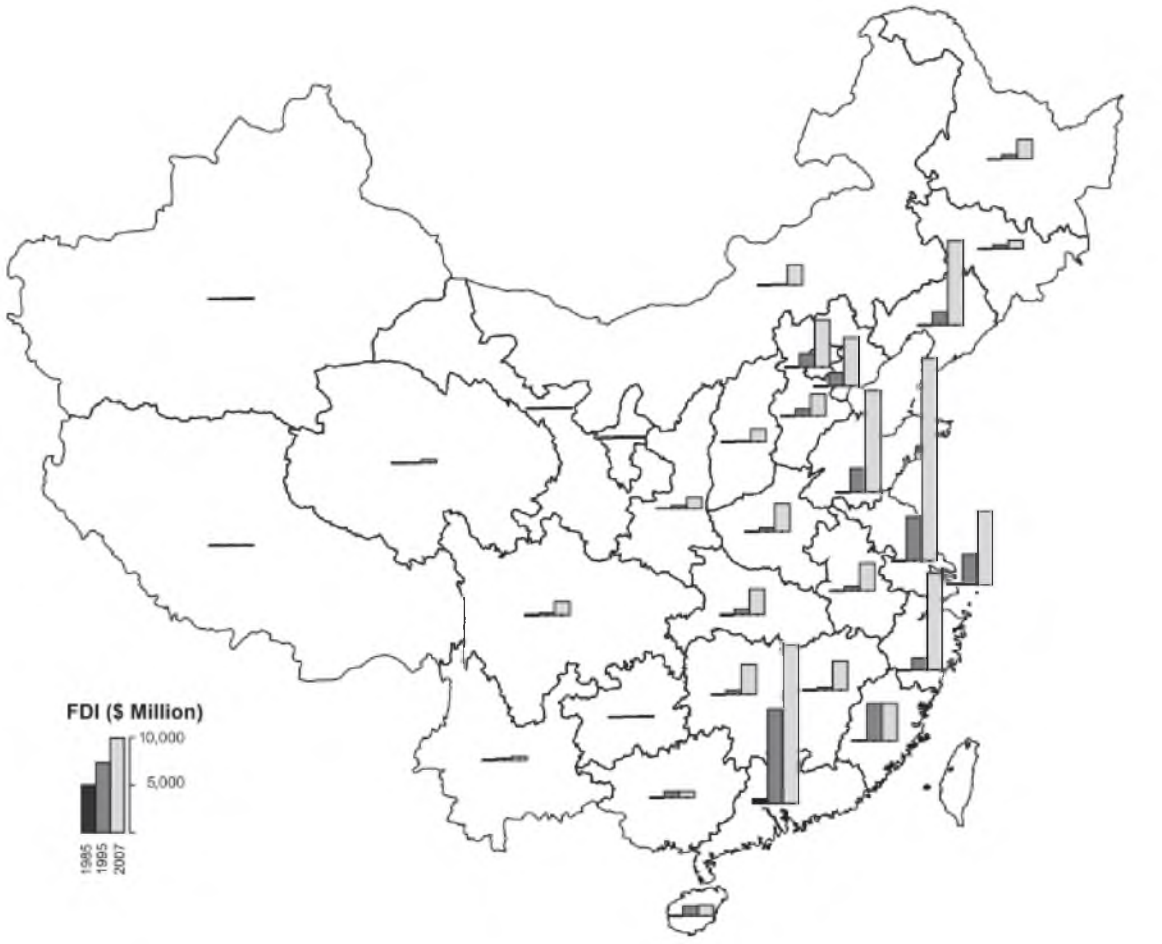


Figure 4.3. Provincial distribution of FDI between 1985 and 2007

while shares of FDI in other southern and eastern coastal provinces, including Jiangsu, Fujian, Shanghai, and Shandong, increased. In 2007, Jiangsu had FDI of US$21.9 billion, larger than that of Guangdong (US$17.1 billion). In terms of FDI per capita, in 2007, centrally administrated municipalities of Tianjin, Shanghai, and Beijing were all among the top destinations of FDI, while Jiangsu led the nation's provinces (Figures 4.4 and 4.5).

Within the eastern region, FDI in the BRR, Pan-YRD, and Guangdong are presented in Table 4.2. FDI share in Guangdong drastically decreased from 45.2% to 14%

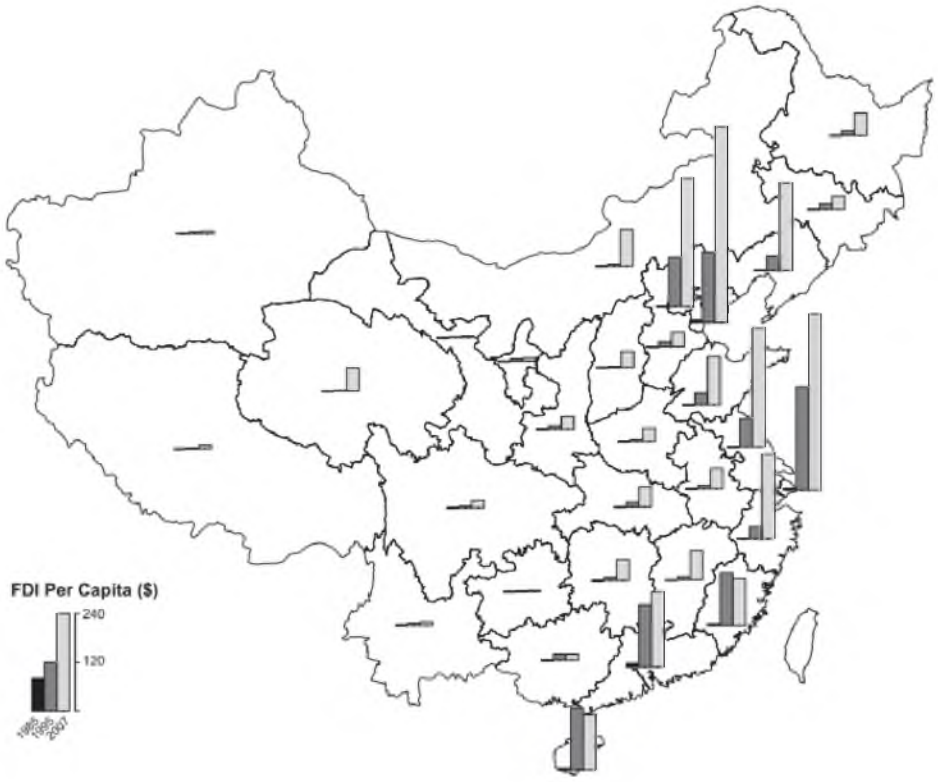


Figure 4.4. Provincial distribution of FDI per capita in 1985, 1995, and 2007

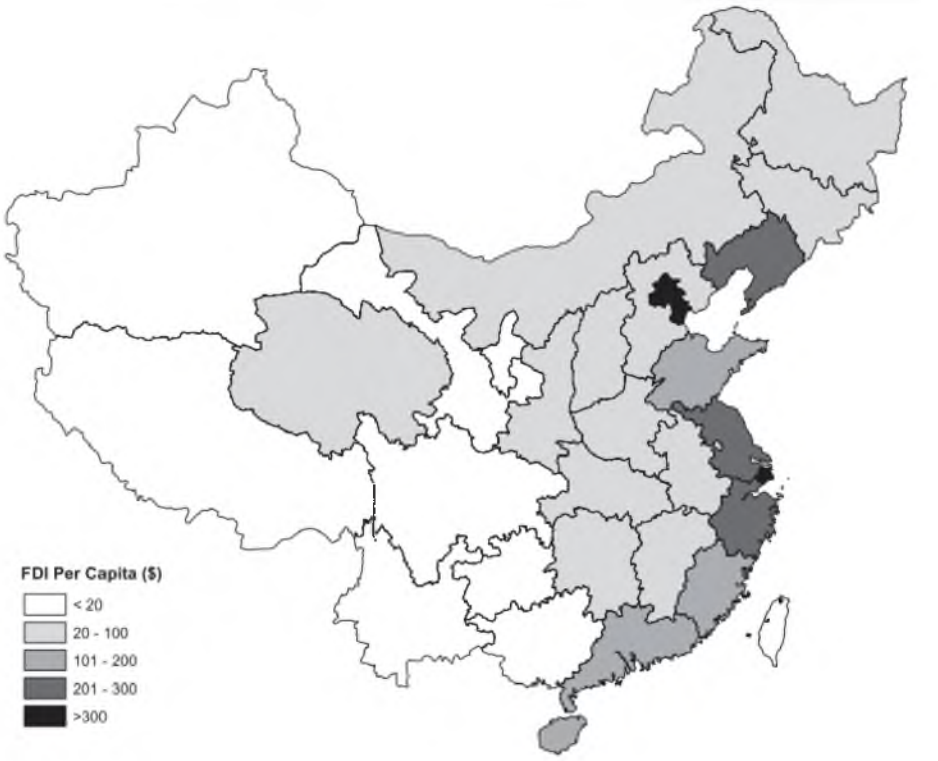


Figure 4.5. Provincial FDI per capita in 2007

over the period from 1990 to 2007. At the same time, FDI share in the Pan-YRD dramatically increased from 11.4% to 32.9%. Also, FDI per capita in these three areas is presented in Table 4.3. FDI per capita of the Pan-YRD dramatically increased from $3 to $276.3. Within the Pan-YRD, Shanghai's FDI per capita increased the most. From 1990 to 2007, FDI per capita also increased significantly in the BRR. Tianjin led the FDI per capita increase over the entire country in 2007.

Figure 4.6 shows the change of global Moran's *I* index for FDI per capita at the provincial level. It shows that global Moran's *I* for provincial FDI per capita has been greater than or equal to 0.15 and the Z-score for Moran's *I* has been greater than 1.96 since 2002. It indicates that at the provincial level FDI has shown the apparent pattern of positive spatial autocorrelation since 2002. Figure 4.7 shows similar changing patterns of the global Getis-Ord *G* index for provincial FDI per capita.

Table 4.3. Distribution of FDI per capita in the BRR, Pan-YRD, and Guangdong

| FDI Per Capita | 1990 | 1995 | 2000 | 2005 | 2007 |
|---|---|---|---|---|---|
| Bohai Rim Region | 3.9 | 36.0 | 38.3 | 93.1 | 140.7 |
| Beijing | 25.5 | 112.1 | 121.8 | 229.3 | 310.2 |
| Tianjin | 9.4 | 161.5 | 116.5 | 319.2 | 473.3 |
| Hebei | 0.6 | 12.1 | 10.2 | 27.9 | 34.8 |
| Liaoning | 6.3 | 34.3 | 48.2 | 85.1 | 211.7 |
| Shandong | 1.8 | 30.0 | 33.0 | 97.0 | 117.6 |
| Pan-Yangtze River Delta | 3.0 | 72.6 | 81.9 | 196.1 | 276.3 |
| Shanghai | 13.3 | 229.7 | 188.8 | 385.3 | 426.3 |
| Jiangsu | 2.1 | 67.7 | 87.7 | 176.4 | 287.1 |
| Zhejiang | 1.1 | 29.1 | 34.5 | 157.6 | 204.9 |
| Guangdong | 23.0 | 148.2 | 130.5 | 134.5 | 181.2 |

Unit: US$ per capita. Source: China Data Online

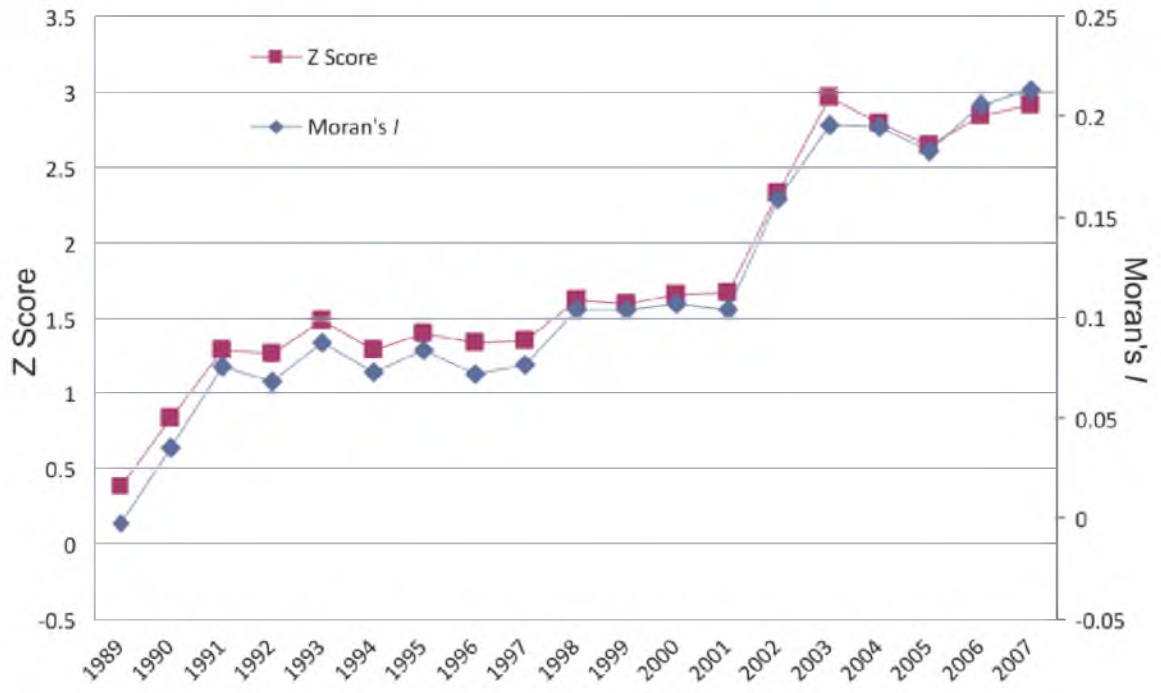


Figure 4.6. Global Moran's *I* index for provincial FDI per capita

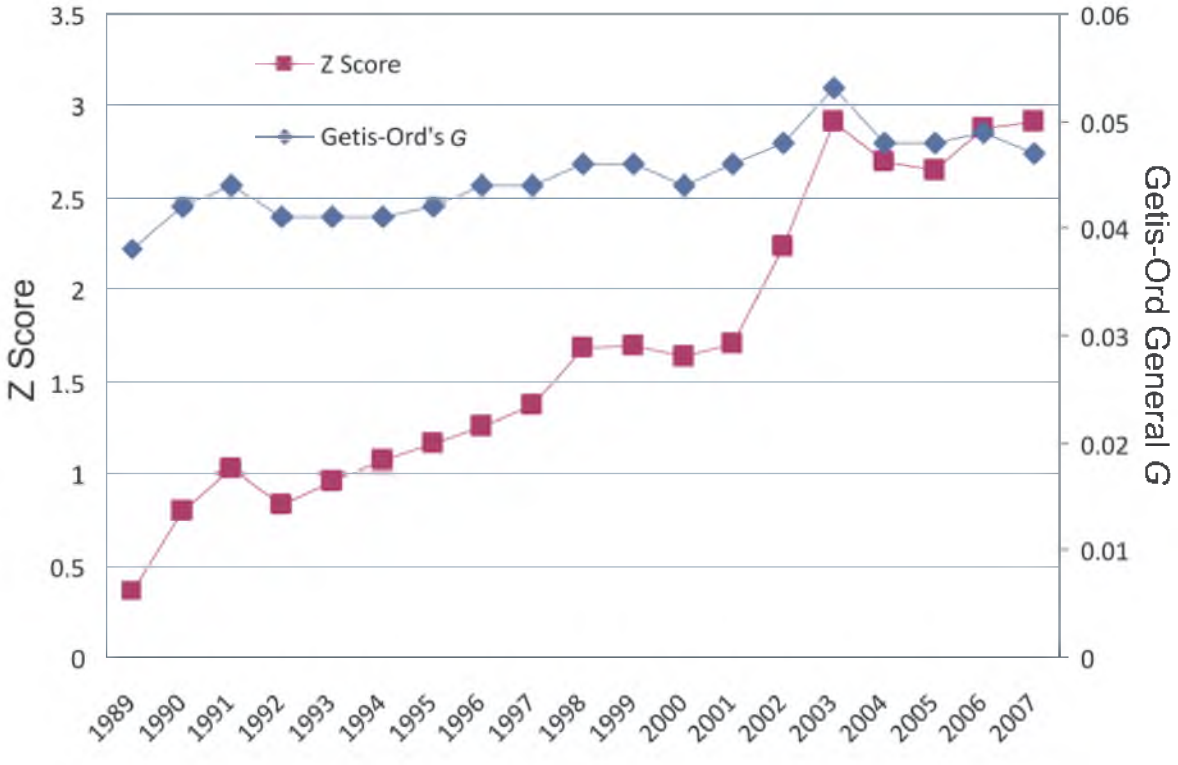


Figure 4.7. Global Getis-Ord *G* index for provincial FDI per capita

Three major features can be summarized in terms of FDI location in China: (1) the coastal region dominated FDI; (2) the spread mainly took place from Guangdong to the Pan-YRD and the BRR; (3) the share of FDI in the interior region only increased slightly, with larger increases often taking place in provinces near the coastal region.

### 4.3. Regional Clusters and Dynamic Processes of FDI

LISA results indicate that, at the provincial level between 1989 and 1997, except for 1991, there were not any local spatial autocorrelation of FDI. In 1991, only Hainan province showed the negative spatial autocorrelation of FDI at 5% significance level.

The FDI distribution has shown clustering tendency at both regional and provincial levels since 2002. Provincial patterns of spatial autocorrelation from 1989 to 2007 are presented in Table 4.4. Among the BRR, Tianjin and Beijing have shown statistically significant positive spatial autocorrelation during the same period. The time periods are 1998, 1999, and from 2004 to 2007. Since 2006, new patterns of negative spatial autocorrelation have emerged in Hebei. In 2007, Liaoning showed a pattern of positive spatial autocorrelation. Among the Pan-YRD, Shanghai, Jiangsu, and Zhejiang sequentially have shown statistically significant positive spatial autocorrelation since 1999, 2000, and 2003, respectively. In addition, within the central region, Anhui showed a pattern of negative spatial autocorrelation, which indicates that Anhui had low FDI and was surrounded by provinces with high FDI. Within the western region, Sichuan showed the pattern of positive spatial autocorrelation in 2006 and 2007, which indicates Sichuan and neighboring provinces, had similarly low FDI.

Table 4.4. Provincial clusters of spatial autocorrelation and hot spots, 1989-2007

| | Spatial Autocorrelation | | Hot spots | |
|---|---|---|---|---|
| Province | Sign | Period | Sign | Period |
| Beijing | Positive(HH) | 1998–1999, 2004–2007 | Hot | 1989–1991, 1998–2000, 2005–2007 |
| Tianjin | Positive(HH) | 1998–1999, 2004–2007 | Hot | 1995–2002, 2004–2007 |
| Liaoning | Positive(HH) | 2007 | – | – |
| Hebei | Negative(LH) | 2006–2007 | – | – |
| Shanghai | Positive(HH) | 1999–2007 | Hot | 1989, 1992–2007 |
| Jiangsu | Positive(HH) | 2000–2007 | – | - |
| Zhejiang | Positive(HH) | 2003–2007 | – | - |
| Guangdong | – | – | Hot | 1989–1995, 1998–2001 |
| Sichuan | Positive (LL) | 2006–2007 | – | – |
| Hainan | Positive(HH) | 1991 | Hot | 1990–1993, 1995 |
| Fujian | – | – | Hot | 1991 |
| Anhui | Negative(LH) | 2004 | – | – |

Hotspots maps of provincial FDI indicate that Shanghai has been a hot spot of FDI since 1992. During 1989 to 2001, except 1996 and 1997, Guangdong was a hot spot of FDI. However, after 2001, it was not a hot spot any more. Between 1995 and 2007, except 2003, Tianjin has been a hot spot of FDI. Beijing was found as a hot spot of FDI during the following periods: between 2005 and 2007, between 1998 and 2000, between 1989 and 1991. Between 1990 and 1995, except 1994, Hainan has been a hot spot of FDI.

### 4.4. Temporal Clusters and Changes of FDI

Space-time scan statistics find that the most likely cluster found in space-time model is Shanghai, Zhejiang, and Jiangsu from 2002 to 2008. The p-value for this cluster is 0.001. Shanghai, Zhejiang, and Jiangsu constitute the Pan-YRD. The secondary cluster is found in the model is Inner Mongolia, Liaoning, Beijing, and Tianjin during the period

between 2004 and 2008. The *p*-value for this cluster is 0.001. These four provinces constitute the Bohai Rim Region. The most likely cluster for the temporal model is during the period between 2004 and 2008.

### 4.5. Effects of Transportation, Agglomeration, and Institution on FDI

The adjusted R square of the regression model is 0.921, indicating that about 92.1% of the variation of FDI per capita is explained by the explanatory variables (see Table 4.5). Three variables are statistically significant. The area percentage of national development zones has a positive effect on FDI per capita at 5% significance level. Also, FDI stock per capita has a positive effect on FDI per capita at 10% significance level. The railway density has a positive effect on FDI per capita at 1% significant level.

Table 4.5. Regression model summary

| | Coefficients | *t*-value | Sig | VIF |
|---|---|---|---|---|
| Constant | -8.497 | -0.038 | 0.970 | - |
| FDISTOCKPC | 0.045 | 2.313 | 0.029 | 8.098 |
| WAGE | -0.005 | -0.512 | 0.613 | 2.552 |
| GDPPC | 0.006 | 0.587 | 0.562 | 10.605 |
| DZPERCENT | 685.706 | 2.213 | 0.036 | 5.253 |
| RPSK | 0.740 | 3.457 | 0.002 | 5.444 |
| Model Summary | | | | |
| Adjusted $R^2$ | 0.921 | | | |

The adjusted R square of the geographically weighted regression model is 0.979, indicating that about 97.9% of the variation of FDI per capita is explained by railway density, FDI stock per capita, and the area percentage of national development zones. FDI stock, railway density, and the area percentage of national development zones have statistically significant effects on FDI. The factors of wage costs and market size are not statistically significant. Figures 4.8-4.10 show the surfaces of GWR coefficients for the area percentage of national development zones, FDI stock per capita, and railway density.

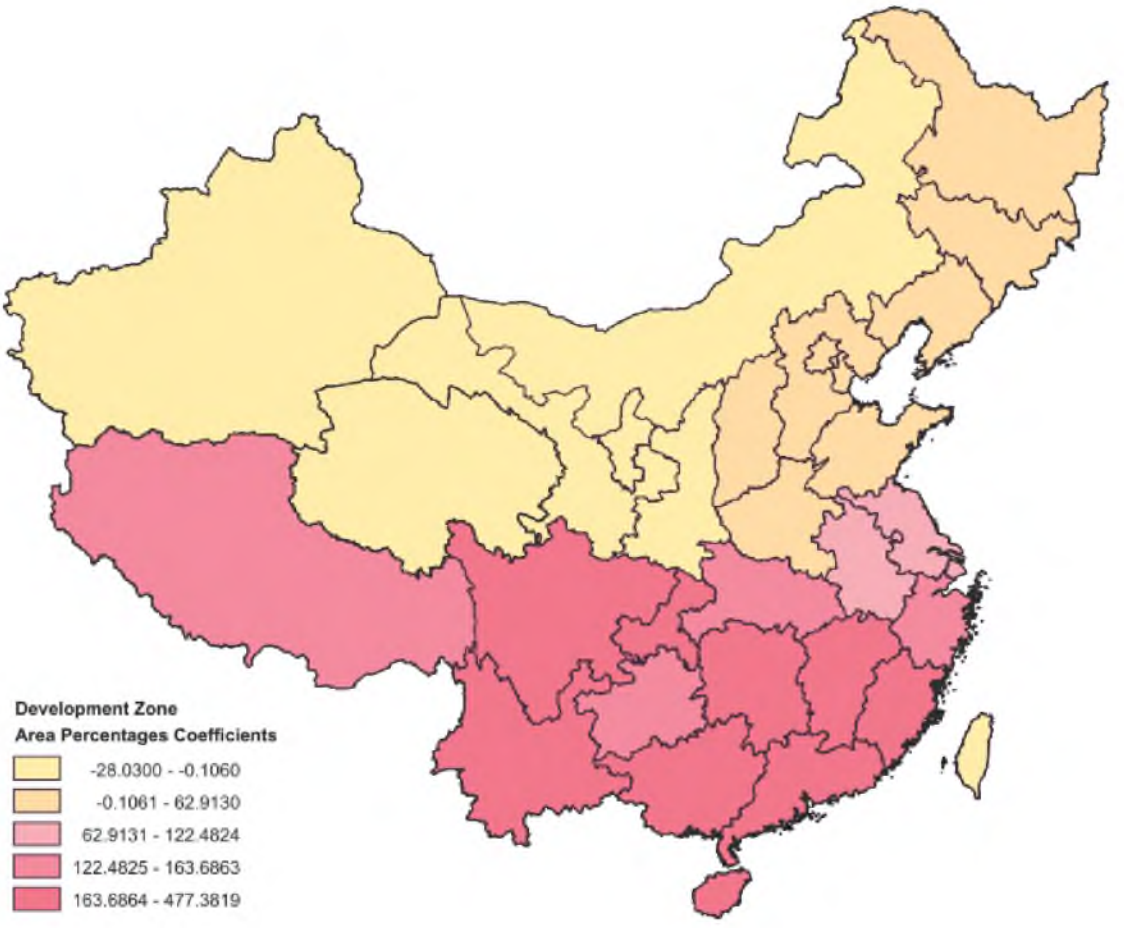


Figure 4.8. Surface of geographically weighted regression coefficients of national development zone area percentages in 2007

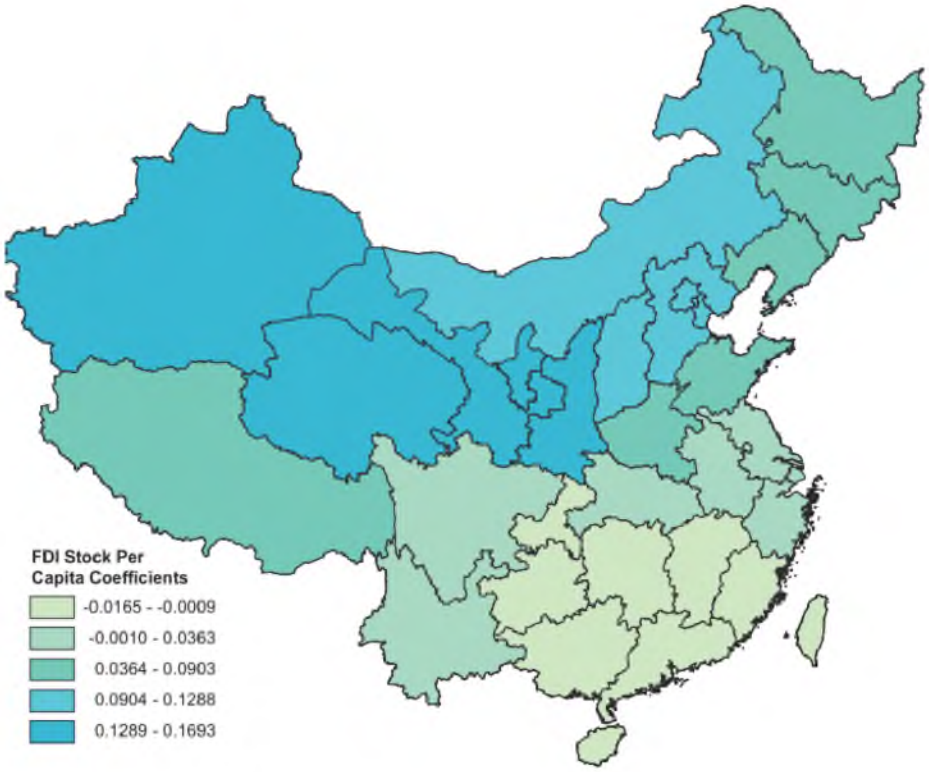


Figure 4.9. Surface for geographically weighted regression coefficients of FDI stock per capita in 2007

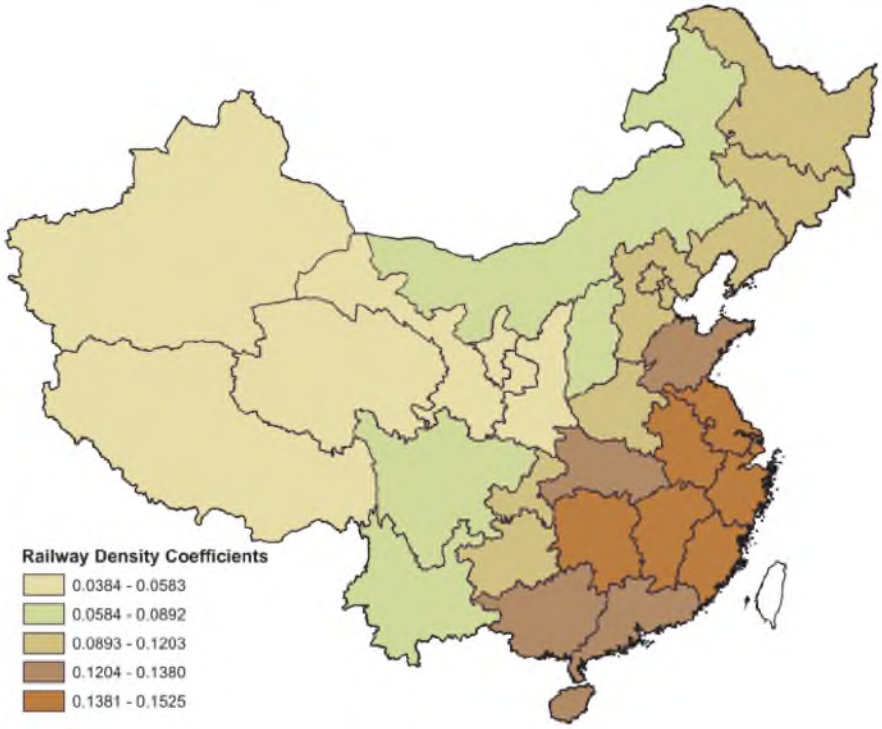


Figure 4.10. Surface for geographically weighted regression coefficients of railway density in 2007

It indicates that effects of the area percentage of national development zones, FDI stock per capita, and railway density on FDI per capita vary over space. GWR also shows that the area percentage of national development zones, FDI stock per capita, and railway density have positive relationships with FDI per capita. Coefficients for the national development zone area percentages, FDI stock per capita, and railway density are listed in Table 4.6. Among three regions, the BRR has the highest coefficient for the FDI stock per capita, the Pan-YRD has the highest railway density coefficient, and Guangdong has the highest coefficient for the area percentage of national development zones.

Table 4.6. Coefficients of geographically weighted regression in the BRR, Pan-YRD, and Guangdong

| Region | Province | FDIPC Stock | Railway Density | Development Zone Area% |
|---|---|---|---|---|
| BRR | Beijing | 0.0763 | 0.8778 | 167.8825 |
| | Tianjin | 0.0716 | 0.9129 | 209.6122 |
| | Hebei | 0.0758 | 0.8786 | 173.0134 |
| | Liaoning | 0.0616 | 0.9788 | 293.3191 |
| | Shandong | 0.0470 | 1.0562 | 451.3569 |
| Pan-YRD | Shanghai | 0.0171 | 1.1633 | 924.6792 |
| | Jiangsu | 0.0267 | 1.1507 | 723.6818 |
| | Zhejiang | 0.0049 | 1.1358 | 1272.3369 |
| Guangdong | Guangdong | -0.0220 | 1.0908 | 2247.4400 |

## 4.6. Summary

This chapter presents the results of FDI patterns and determinants with provincial-level data. The results indicate that while new concentrations of FDI have formed in the interior, the eastern region still dominates FDI distribution. Moreover, the concentration of FDI moves among provinces within eastern China, from Guangdong toward the Pan-YRD and the BRR, especially metropolitan areas of Shanghai, Beijing, and Tianjin. Institution, transportation, and agglomeration are major factors determining spatial distribution of FDI across provinces. However, Guangdong, the Pan-YRD, and BRR have different dominating factors determining the concentration. Institution is the most influential to Guangdong, transportation is the most influential to the Pan-YRD, and agglomeration influences the most to the BRR. Chapter 5 presents the results of spatial patterns and determinants of FDI across prefecture-level cities.

# CHAPTER 5

# INTERCITY COMPETITION FOR FOREIGN DIRECT INVESTMENT

## 5.1. Overview

This chapter presents the results of analyzing the spatial-temporal distribution and locational determinants of FDI at the intercity level. The results identify cities that are spatial- temporal clusters and outliers, and hotspots and coldspots of FDI. The results also reveals salient changes in spatial patterns and location determinants of FDI from 1990, shortly before China deepened its economic reforms, to 2010, when the most recent FDI data are available. They indicate the shift in the scale and nature of FDI at different stages. This chapter will explore results using spatial statistics and regression models described in the Methodology chapter. This chapter will focus on the disparity of FDI across prefecture cities and time, and emphasize the impacts of changing institutional frameworks and policies on this disparity, paying special attention to foreign capital policies and regional development policies.

## 5.2. Spatial and Temporal Distributions of FDI

FDI has grown drastically in China, especially in the early and mid-1990s when China deepened its economic reforms, and in the early 2000s after China joined the WTO (Figure 5.1). Institutional reforms played an important role in FDI growth since China

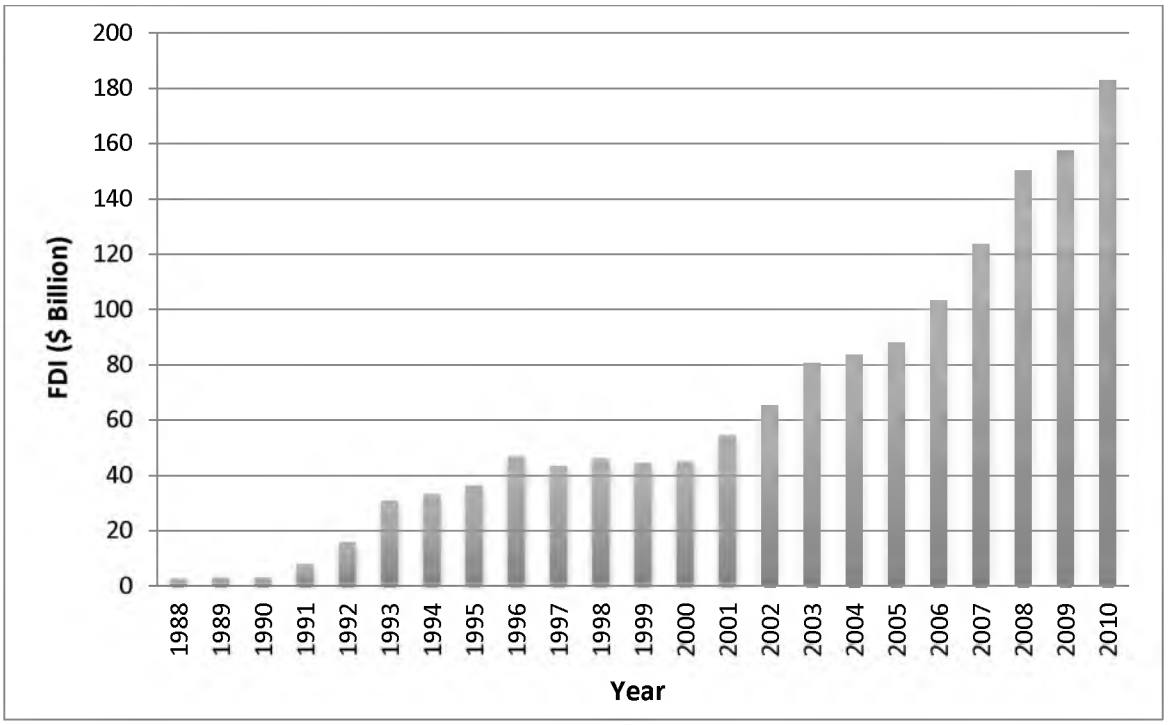


Figure 5.1. FDI at the city level in China, 1988-2010

started an open-door policy with SEZs in 1980 and OCCs in 1984, expanded to coastal deltas in the late 1980s, and selected interior cities and all provincial capitals in the 1990s (Gong, 1995; Wei, 2000).

FDI in China is unevenly distributed among eastern/coastal, central, and western regions. Absolute gaps among these regions are widening, while relative gaps among them are narrowing. As Table 5.1 and Figures 5.2-5.4 show, a large amount of FDI has been located in China's eastern/coastal region. In 2010, the eastern/coastal region still captured more than 70% of the total FDI; the central region's share of FDI was almost 20%, while the western region's share was less than 10%. These indicate the large absolute gap between the coastal area and the rest of China. Despite this widening gap, the relative gap between them was narrowing. The growth rates in the central and western regions were

Table 5.1. Regional distribution of FDI in China at city level (The whole city including counties) Unit: $ Million

| | Eastern Region | | | Central Region | | | Western Region | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Share (%) | Growth Rate (%) | Total | Share (%) | Growth Rate (%) | Total | Share (%) | Growth Rate (%) |
| 1990 | 3039 | 95.2 | - | 118 | 3.7 | - | 34 | 1.1 | - |
| 2000 | 39939 | 88.7 | 1214.2 | 3962 | 8.8 | 3257.6 | 1144 | 2.5 | 3264.7 |
| 2010 | 131029 | 71.6 | 228.1 | 36063 | 19.7 | 810.2 | 15796 | 8.6 | 1280.8 |

Source: China City Statistical Yearbooks, 1991, 2001, 2011

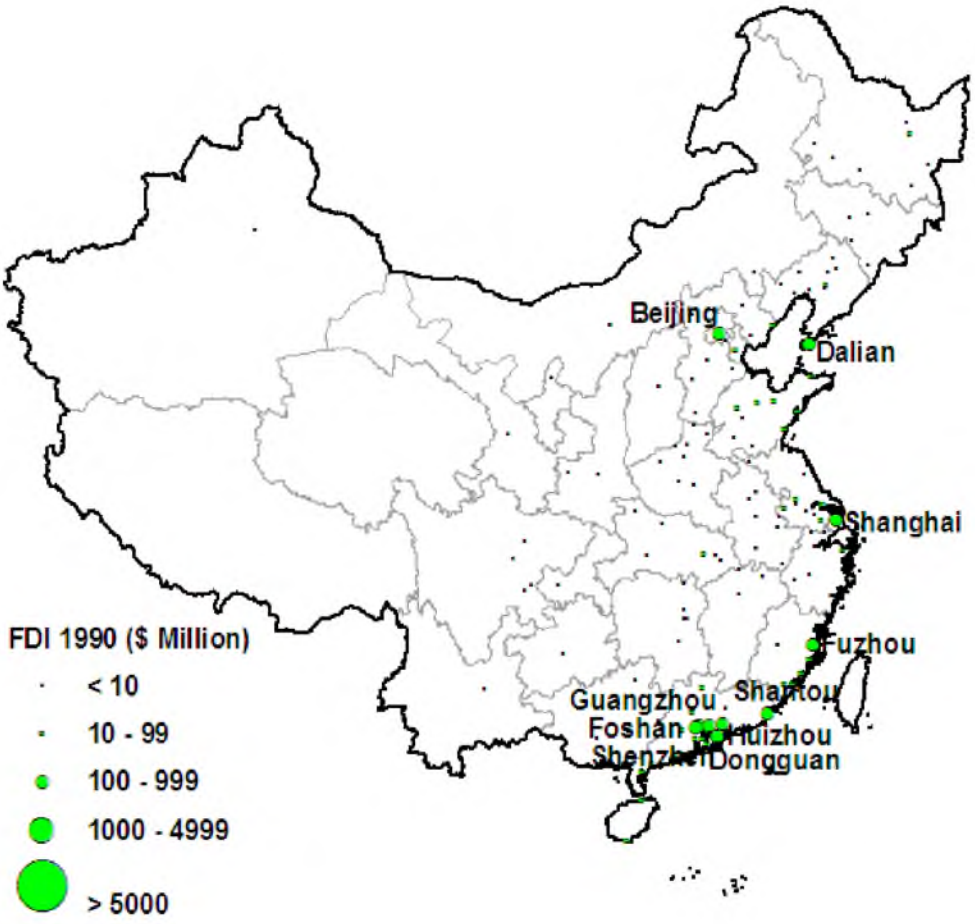


Figure 5.2. FDI in China's major cities in 1990

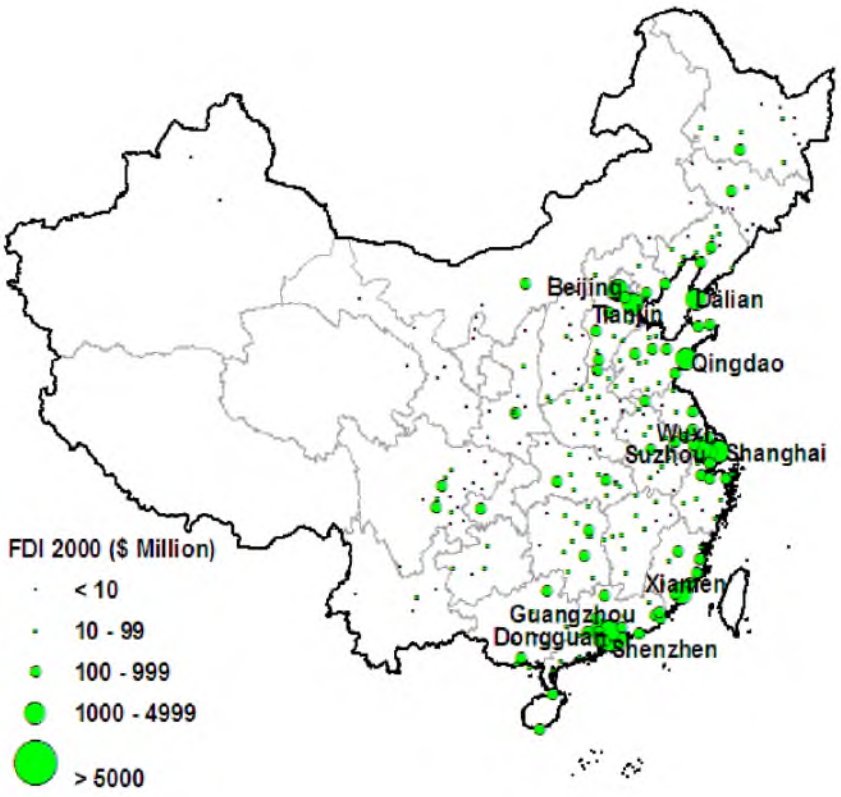


Figure 5.3. FDI in China's major cities in 2000

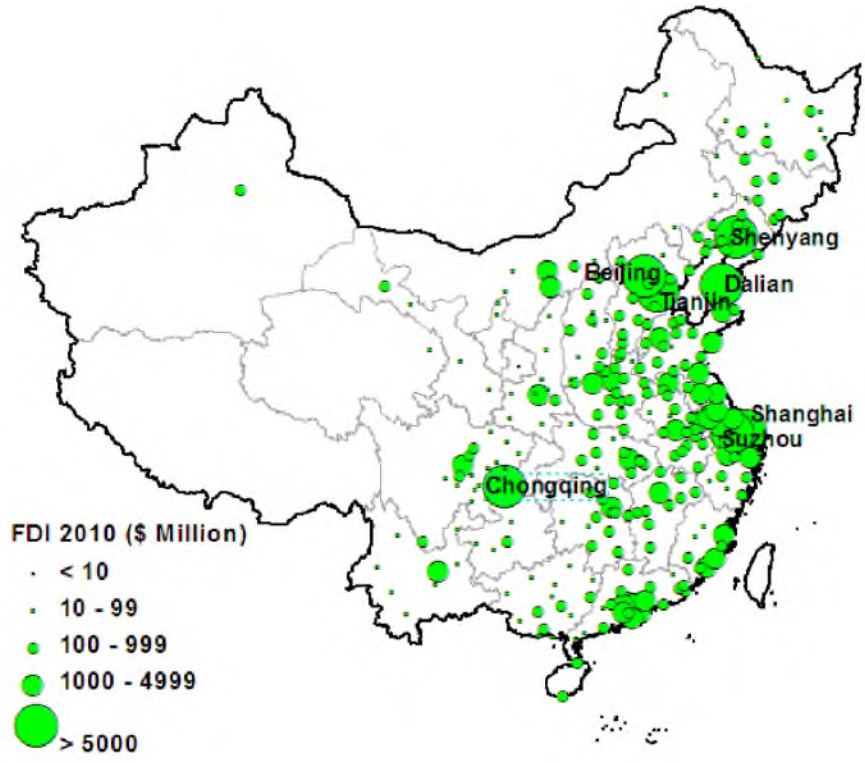


Figure 5.4. FDI in China's major cities in 2010.

much higher than those in the eastern/coastal region during the 1990s and 2000s. From 1990 to 2000, FDI in the central and western regions grew by a factor of 33, while FDI in the eastern region only grew by a factor of 12. From 2000 to 2010, FDI in the western region grew by a factor of 13, the fastest among the three regions, while FDI grew 800% in the central region and was only doubled in the eastern region (Table 5.1).

FDI in China is also unevenly distributed among cities. In general, cities in Guangdong, the Pan-YRD, and the BRR have dominated FDI. FDI tends to be concentrated in Special Economic Zones (SEZs), Open Coastal Cities (OCCs), other coastal cities, and provincial capitals. During the early 1980s, SEZs attracted half of the FDI. In 1984, when the 14 OCCs opened up, FDI in SEZs still accounted for 38.8% of the total, but the importance of OCCs increased as they attracted 25.4% of the FDI. The dominance of SEZs and OCCs in attracting FDI was not challenged during the 1980s, and only in the 1990s did the share of these cities' FDI decline somewhat, partially due to rising costs and the opening up of other areas for foreign investment. In 1990, SEZs and OCCs attracted US$1.55 billion FDI, which accounted for 47.7% of the regional FDI. In 2007, SEZs and OCCs attracted 5.0 % and 26.6 % of FDI, respectively. Besides SEZs and OCCs, FDI has been attracted to several other coastal cities and provincial capitals. In 2010, the leading cities of FDI included Shanghai, Tianjin, Dalian, Suzhou, Beijing, Chongqing, and Shenyang (Figure 5.4).

FDI shows a trend of spreading from the coastal cities to the interior cities adjacent to the coastal area, then to some western cities, such as Chengdu. Between 1990 and 2010, the coastal region's share of FDI decreased from 95.2% to 71.6%, while the central region's share of FDI increased significantly from 3.7% to 19.7%, and the western region's share

increased from 1.1% to 8.6% (Table 5.1). This further indicates the relative gaps among the eastern/coastal, and central and western regions were narrowing.

Three major features can be summarized in terms of the location of FDI in China: (1) The eastern/coastal region dominated FDI; (2) The spread took place from the eastern/coastal region to the central and western regions; (3) FDI tends to concentrate in Special Economic Zones, coastal cities, and provincial capitals.

### 5.3. Temporal Changes of Spatial Clusters of FDI

FDI distribution at the intercity level has shown statistically significant clustering trends since 1989. As Figure 5.5 shows, the global Moran's *I* statistics for each year from

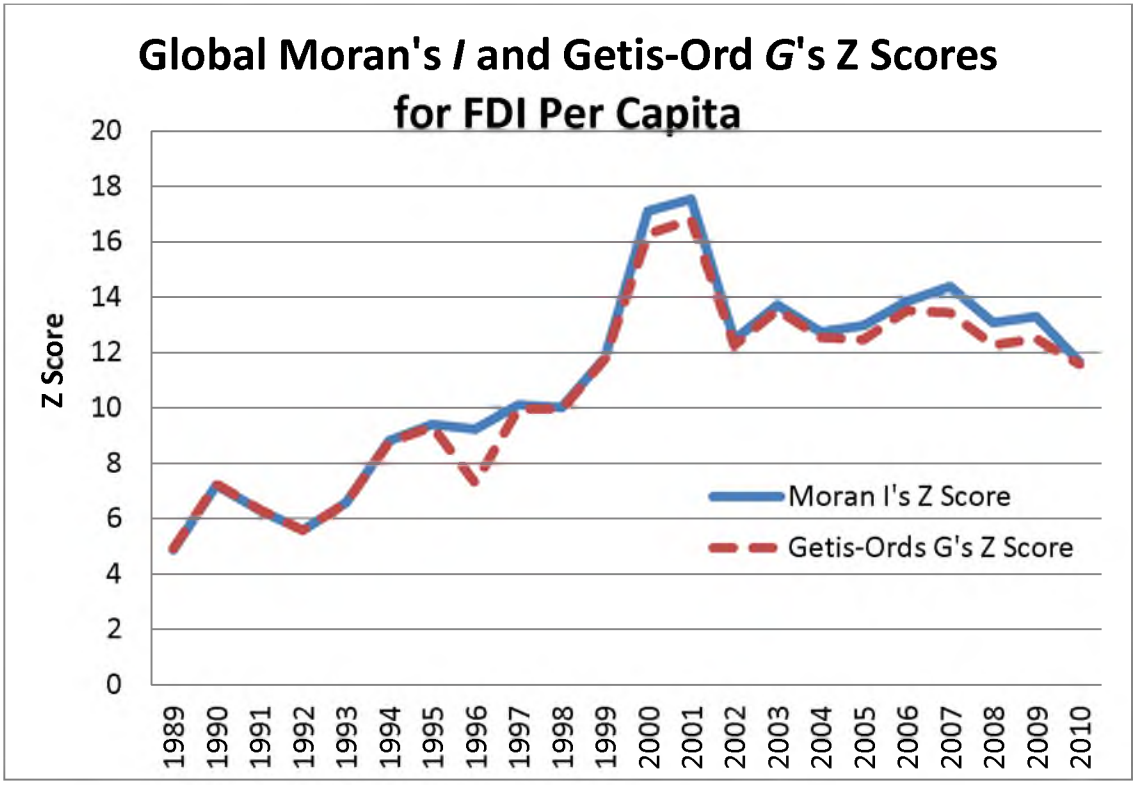


Figure 5.5. Z scores for global Moran's *I* and Getis-Ord *G* of FDI per capita

1989 to 2010 were greater than 0.1 at the 1% significance level, indicating that at the city level, FDI distribution has shown significant spatial clustering of similar values since 1989. There were very similar changing patterns of global Getis-Ord *G* index for FDI per capita, indicating the clustering patterns of high or low values.

FDI clusters had a trend of spreading from eastern/coastal cities to central and western cities. Table 5.2 lists LISA clusters of high value, LISA outliers, and hot spots of FDI in 1990, 2000, and 2010. Figures 5.6-5.8 show the maps of these clusters, outliers, and hot spots in 1990, 2000, and 2010, respectively. In 1990 and 2000, all the clusters of high value, outliers, and hot spots were concentrated in the eastern/coastal region. Within the eastern/coastal region, FDI clusters spread from the PRD to the YRD, then to the BRR.

In 1990, all the clusters of high FDIs and hot spots were concentrated in cities in the PRD and Hainan Province. Shenzhen and Zhuhai were the hot spots of FDI in the PRD. Haikou was the hot spot in Hainan Province. In 2000, in addition to Shenzhen and Zhuhai, Dongguan, Zhongshan, Guangzhou, and Huizhou in the PRD became hot spots of FDI. Also, new clusters of high value and hot spots appeared in the YRD: Wuxi and Suzhou became the clusters of high FDIs; Suzhou was also a hot spot. In the same year, there were no clusters of high value and hot spots in the BRR, but there was a LISA outlier in this area: Tianjin, which indicates that Tianjin had a high volume of FDI and was surrounded by cities with low volumes of FDI. This shows that the BRR has the potential to become the next cluster of high FDI.

The spatial diffusion of FDI can be observed in Figure 5.8, which shows increasing hot spots in both coastal and interior regions from 2000 to 2010. In 2010, the clusters of high value and the hot spot appeared in the central region: the cities of Maanshan,

Table 5.2. LISA clusters (high value), LISA outliers, and Hot spots

| | Region | Area | LISA Cluster (High Value) | LISA Outlier | Hot Spot |
|---|---|---|---|---|---|
| 1990 | Eastern Region | PRD | Shenzhen, Zhuhai, Huizhou, Dongguan, Zhongshan, Foshan, Guangzhou, Jiangmen | - | Shenzhen, Zhuhai |
| | | YRD | - | - | - |
| | | BRR | - | - | - |
| | | Others | Sanya | - | Haikou |
| | Central Region | | - | - | - |
| | Western Region | | - | - | - |
| 2000 | Eastern Region | PRD | Shenzhen, Zhuhai, Dongguan, Zhongshan, Guangzhou, Huizhou, Foshan, Jiangmen, Zhaoqing | - | Shenzhen, Zhuhai, Dongguan, Zhongshan, Guangzhou, Huizhou |
| | | YRD | Wuxi, Suzhou | - | Suzhou |
| | | BRR | - | Tianjin | - |
| | | Others | Haikou, Sanya, Xiamen, Zhangzhou | - | Xiamen, Haikou, Sanya |
| | Central Region | | - | - | - |
| | Western Region | | - | - | - |
| 2010 | Easter Region | PRD | Shenzhen, Dongguan, Zhuhai, Zhongshan, Huizhou, Guangzhou, Foshan, Jiangmen | - | Shenzhen, Dongguan,Zhuhai |
| | | YRD | Suzhou, Shanghai, Wuxi, Changzhou, Jiaxing, Hangzhou, Zhenjiang, Yangzhou, Huzhou, Nanjing, Ningbo, Nantong, Taizhou | - | Suzhou, Shanghai, Changzhou, Wuxi, Hangzhou, Zhenjiang, Yangzhou |
| | | BRR | Dalian, Panjin, Shenyang, Yingkou, Dandong | - | Dalian, Tianjin, Shenyang, Panjin |
| | | Others | - | Heyuan | Xiamen |
| | Central Region | | Maanshan, Tongling, Wuhu | - | Eerduosi |
| | Western Region | | - | Chengdu | - |

Source: China City Statistical Yearbooks, 1991, 2001, 2011.

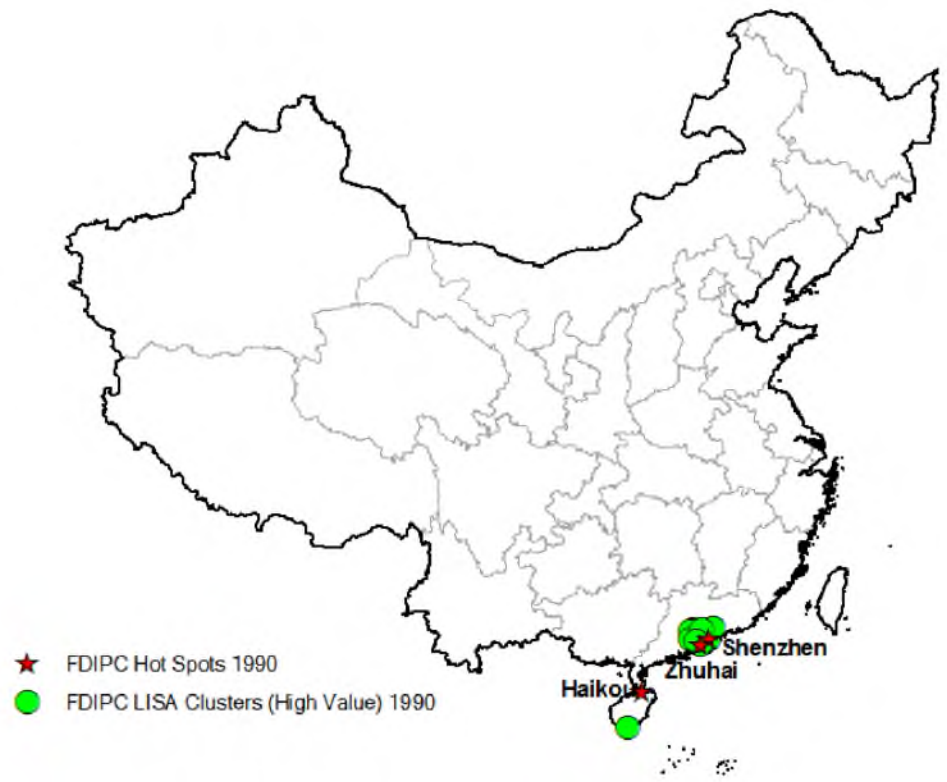


Figure 5.6. LISA clusters and hotspots cities for FDI per capita in 1990

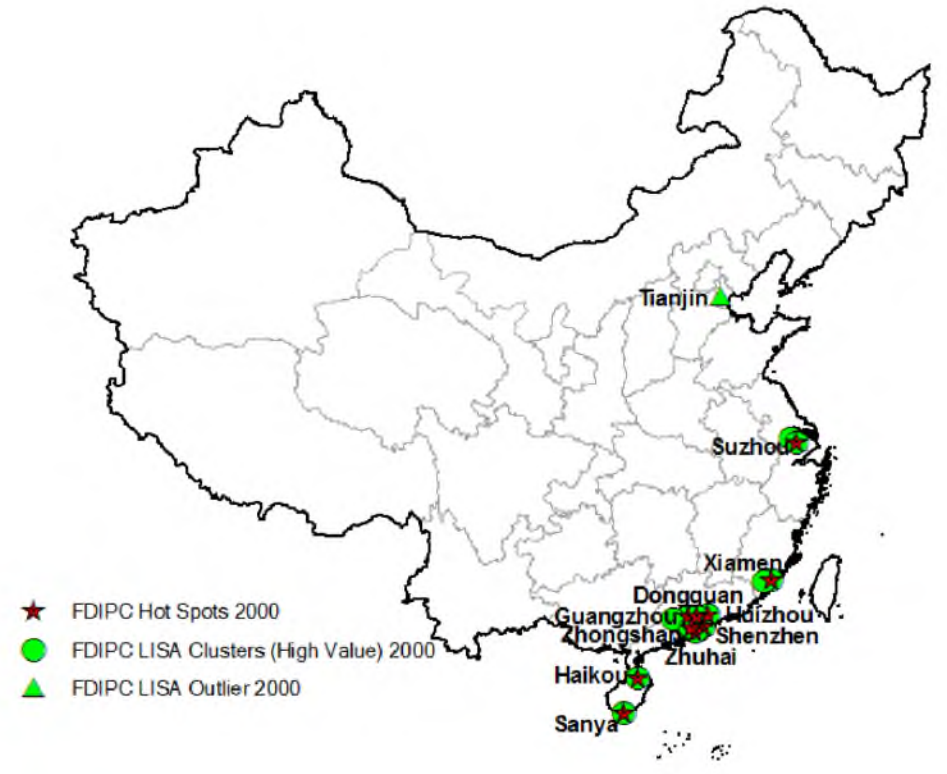


Figure 5.7. LISA clusters and hotspots cities for FDI per capita in 2000

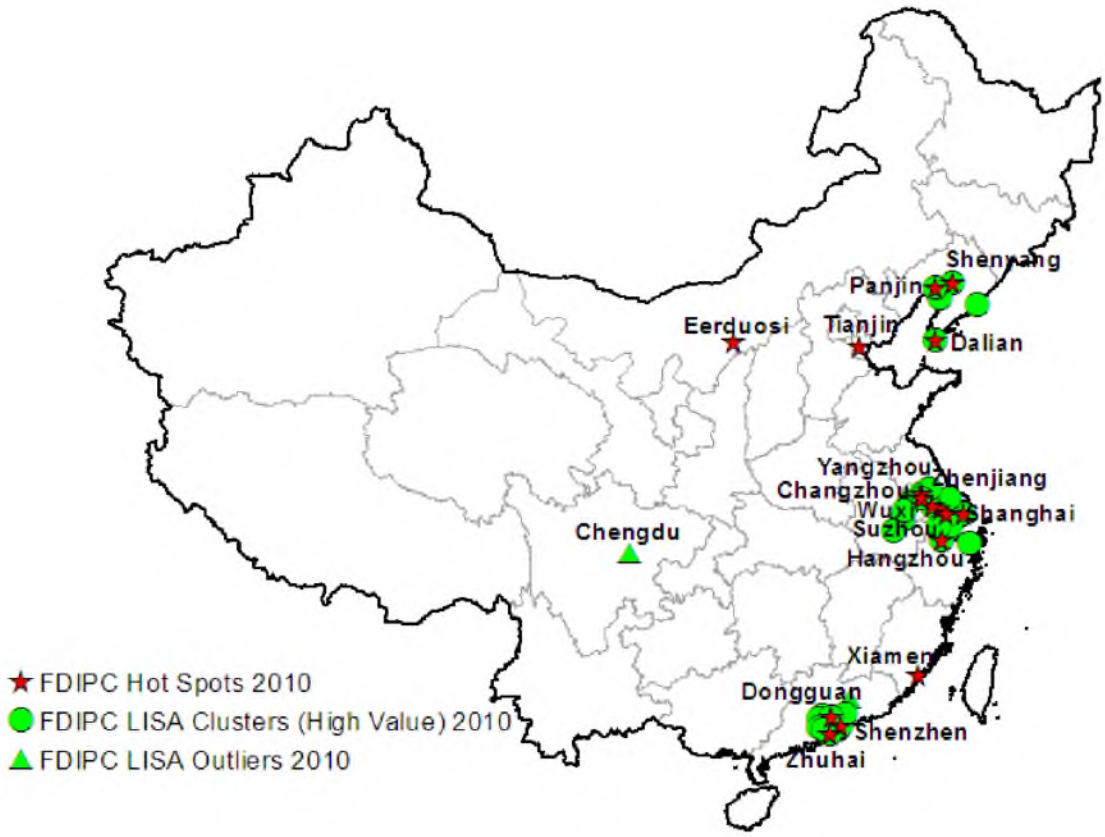


Figure 5.8. LISA clusters and hotspots cities for FDI per capita in 2010

Tongling, and Wuhu in Anhui Province became a spatial cluster of high volumes of FDI. This is an interesting finding compared to Huang and Wei's (2011) study: in 2004, Anhui was found to be a cluster with negative spatial autocorrelation at the provincial level, demonstrating that Anhui, a province with a low FDI level, was surrounded by provinces with high FDI levels. The contrasting results imply the significance of spillover effects of FDI from high-value areas in the coastal region to low-value areas in the central region. In addition to the high FDI clusters of three cities in Anhui Province, Eerduosi in the central region became a hot spot of FDI. Compared to the central region, high FDI clusters and hot spots did not appear in the western region in 2010. But Chengdu, a western city, was

found to be a LISA outlier. This means that Chengdu, a high-FDI-level city, was surrounded by cities with low FDI levels. Given the potential beneficial spillover effects shown from three cities in Anhui Province, the potential exists that Chengdu may become a cluster of high volume of FDI in the western region.

In 2010, there was a dramatic increase in the number of high value clusters and hot spots in the YRD and the BRR. Eleven cities in the YRD were added into the high FDI clusters. In addition to Suzhou and Wuxi, Shanghai, Changzhou, Hangzhou, Zhenjiang, and Yangzhou became new hot spots in this area. At the same time, the FDI clusters spread further north to the BRR. Dalian, Panjin, Shenyang, Yingkou, and Dandong became new high FDI clusters in this area. Also, Dalian, Tianjin, Shenyang, and Panjin became new hot spots in the area.

### 5.4. Location Determinants: Findings from Regression Analysis

To better understand factors underlying shifting FDI locations, we have conducted regression analysis. The OLS regression models are significant at the 1% level and the adjusted $R^2$ values are high (0.502 in 1990; 0.739 in 2000; 0.682 in 2010) (Table 5.3). The estimates and measures of fit are given in the SEM model for FDI locational determinants in 2000. When we compare the Log-Likelihood, Akaike Information Criterion (AIC), and Schwarz Criterion (SC) for the SEM to those for the OLS, we notice an increase in the Log-Likelihood from -1368.2 for the OLS to -1367.3 for the SEM, a decrease in the AIC from 2762.39 for the OLS to 2760.52 for the SEM, and a decrease in the SC from 2807.42 for the OLS to 2805.55 for the SEM, suggesting an improvement of fit for the spatial error specification. They indicate that the independent variables explain well the FDI location

Table 5.3. Regressions for location determinants of FDI per capita

| | 1990 | | 2000 | | | | 2010 | |
|---|---|---|---|---|---|---|---|---|
| | OLS | | OLS | | SEM | | OLS | |
| | Coefficient | T Value | Coefficient | T Value | Coefficient | Z Value | Coefficient | T Value |
| GDPPC | 0.014*** | 6.943 | 0.009*** | 9.487 | 0.009*** | 9.886 | 0.005*** | 5.514 |
| Salary | -0.012 | -1.153 | -0.006 | -1.207 | -0.005 | -0.972 | 8.083E-5 | -0.164 |
| Transportation | | | | | | | | |
| Road passenger traffic | 0.001 | 1.637 | | | - | | - | |
| Road area per capita | - | | 4.150** | 2.039 | 4.368** | 2.220 | 1.760 | 0.963 |
| NDZ | 35.587** | 2.121 | 12.559 | 0.809 | 9.738 | 0.653 | 4.905 | 0.393 |
| PRD | 72.182*** | 4.665 | 272.907*** | 7.746 | 280.119*** | 7.863 | 297.534*** | 5.460 |
| YRD | -23.054** | -2.280 | -40.802 | -1.579 | -34.015 | -1.252 | 49.564 | 1.658 |
| BRR | -22.838** | -2.250 | -27.634 | -1.443 | -20.016 | -0.996 | 1.271 | 0.425 |
| SEZOCC | -3.234 | -0.238 | -8.639 | -0.352 | -13.565 | -0.579 | 29.497 | 0.625 |
| CAPITAL | 3.085 | 0.435 | -0.635 | -0.030 | 4.111 | 0.202 | 22.415 | 0.881 |
| FDIRTA | 7.37E-5 | 0.213 | 1.109E-4*** | 4.456 | 1.05E-4*** | 4.357 | 9.330E-5*** | 7.401 |
| Constant | -7.677 | -0.379 | -30.140 | -0.933 | -39.225 | -1.173 | -78.090 | -1.811 |
| R Square | 0.534 | | 0.753 | | 0.756 | | 0.696 | |
| Adjusted R Square | 0.502 | | 0.739 | | - | | 0.682 | |
| Log-Likelihood | -905.131 | | -1368.2 | | -1367.260 | | -1746 | |
| AIC | 1836.26 | | 2762.39 | | 2760.52 | | 3517.99 | |
| SC | 1878.2 | | 2807.42 | | 2805.55 | | 3564.96 | |
| F score | 16.552 | | 56.508 | | - | | 49.685 | |

*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

variation at the city level. Also, the multicollinearity condition numbers are less than 30 (27.689 in 1990; 22.891 in 2000; 15.554 in 2010) and thus not suggestive of multicollinearity problems.

First, market size has played important roles since 1990. The positive effect of market size has been highly statistically significant since 1990. This result is different from the negative effect of market size in the 1980s indicated in Gong's (1995) study. This implies that FDI in China was shifting from labor-oriented to market-oriented investments. In the 1980s, most FDIs were oriented toward cheap labor, especially for investments from

Hong Kong, Taiwan, and Macao, so they were located in small or medium-sized cities, such as SEZs. Shenzhen was a small town when it was opened to FDI at the beginning of 1980s. But since 1990, more and more FDI has been oriented toward the big Chinese market, especially when the share of investments from Hong Kong, Taiwan, and Macao decreased gradually. Big cities are more attractive for FDI than small cities. At the same time, the variables of road area per capita indicate that good transportation facilities attracted FDI in 2000. This finding supports the importance of roads in FDI locations, as shown in Knox and Taylor (1995). However, we also found that the role of labor costs was not significant. There were no statistically significant relationships between FDI per capita and average wage per year. It further confirms, on one hand, the shift of FDI from labor-oriented to market-oriented investments. On the other hand, a large number of migrant workers reduce the difference in labor costs among regions.

Second, the agglomeration effects in FDI had been increasing. This is consistent with microlevel case studies of FDI location decisions (e.g., Huang & Wei, 2014; Wei et al., 2009, 2011). In 1990, the agglomeration variable, FDI stock, was not statistically significant, but in 2000 and 2010, it was. Further, in 2010, the agglomeration effects on FDI were more significant compared to 2000. This indicates that the ability of FDIs to attract new ones depends on the scale of clusters: only when the clusters' area had expanded enough would it have the ability to attract new FDI. In 1990, few clusters were concentrated in the PRD, and their area was limited (Figure 5.6), so the agglomeration effects were not shown. In 2000, when more clusters were concentrated in the PRD and new clusters appeared in the YRD and BRR, expanding their total area, the agglomeration effects appeared.

Last, institutional factors have varied effects on FDI. SEZs and OCCs were favorable locations for FDI in the 1980s, but the SEZOCC variable was not statistically significant in 1990, 2000, and 2010, based on our models (Table 5.4), indicating that SEZs and OCCs were not especially attractive to FDI since foreign capital policy spread to cities all over the country. Also, development zones were losing their advantages over areas beyond them. In 1990, the variable NDZ had statistically significant positive impact on FDI. However, in 2000 and 2010, the variable NDZ was not statistically significant anymore. This finding provides evidence for debates on development zones' continued contribution to FDI attraction. Our models indicate that with the gradual elimination of preferential tax policies after China's accession to the WTO, development zones no longer enjoy policy advantages. With the depletion of developable land, development zones need to further reform and rethink their competitive advantage according to local resources and environments.

Moreover, the PRD, YRD, and BRR had different effects on FDI over time. The variable PRD variable had a statistically significant positive relationship with FDI in 1990, 2000, and 2010. This indicates that the policies in the PRD were having a positive effect on FDI. Comparatively, the YRD variable was statistically significant but negative in 1990, was still negative but not statistically significant in 2000, and became positive but still not statistically significant in 2010. It indicates that, although the YRD was opened to foreign investment in the 1980s, the YRD as a whole economic region did not show regional advantage in attracting FDI. The weak regional alliance of this area may explain this result. In the 1990s and early 2000s, the relationship among cities in the YRD had been very competitive since the YRD became a main manufacturing center in China. By 2003, due

to the change in central policy, cities in the YRD started to adopt a new development strategy of regional alliances to foster regional integration and enhance regional competitiveness (Zhang, 2006). The BRR variable indicates the same effects on FDI as the YRD variable. This implicitly confirms the competitive relationship between Beijing and Tianjin, which is shown in Huang and Wei (2011).

In summary, our regression analysis has identified the significance of market size and transportation infrastructure, the increasing importance of agglomeration effects, and disappearing significance of SEZs, OCCs, and development zones in attracting FDI in the last two decades. Among three economic regions, the PRD had been an attraction to FDI.

### 5.5. Summary

This chapter presents the results of FDI patterns and determinants resulting from the intercity competition for FDI. The results indicate that the eastern/coastal region still dominates in FDI, although FDI had spread to interior China, confirming the widely observed phenomenon of FDI concentration in core cities and regions in developing countries. FDI clusters were spreading from SEZs to core coastal open cities and regions, and a few clusters in the interior also appeared. However, SEZs, OCCs, and development zones were losing their advantages in FDI as the deepening reforms set in. We have found that market size was the most important determinant of FDI location in China, while labor cost was not significant since more developed areas were able to reduce labor costs through migrant workers. However, with the equalization of tax policies and the maturing of the Chinese market, agglomeration has replaced market size and institutional factors as the

most significant factor of FDI location. Chapter 6 presents the results of spatial patterns and determinants of FDI within a metropolitan area using a case study of Wuhan.

# CHAPTER 6

# INTRAMETROPOLITAN LOCATION OF FOREIGN DIRECT INVESTMENT: A CASE STUDY OF WUHAN CITY

## 6.1. Overview

This chapter presents the results of intrametropolitan location of FDI in interior China through a study of Wuhan, the largest metropolitan area in central China and the gateway to China's north-south and east-west linkages. This chapter identifies FDI as one of the most mobile forms of capital and a key agent of urban spatial transformation in China. Based on the 2008 economic census, this chapter uses spatial statistics and GIS to examine spatial-temporal patterns of FDI within Wuhan. It integrates a logistic model with geographically weighted regressions to investigate FDI locational determinants, paying special attention to the varying role of urban spatial structure and its interaction with agglomeration and institution. The objectives of this chapter are to map the shifts in patterns of FDI within Wuhan since 1990 and assess the effectiveness of relevant policies, to examine the influence of urban spatial structure and its interaction with agglomeration and institution in FDI, and to evaluate the effects of different accessibility.

### 6.2. FDI in Wuhan: Basic Profile

The annual change in FDI amount reflects the combined effects of national policies and global forces in attracting FDI into Wuhan. The FDI amount in Wuhan was low in 1990 and 1991. However, after Wuhan was approved as one of five open cities along the Yangtze River in 1992 and thereafter officially opened to foreign investors, it had a dramatic increase in FDI. Figure 6.1 shows the annual change in FDI flows. From 1991 to 1995, FDI jumped from 15 million dollars to 592 million dollars. In 1992, the increase rate of FDI was 373%, the highest recorded rate of increase of FDI in history. In 1993, 1 year after the official open year, the increase rate of FDI was 314%. These remarkable increases after the official opening suggest the strong effects of national policies in attracting FDI into an inland city. In addition to national policies, the changing global economic environment was another consideration for FDI decisions. In 1996, a negative increase rate of FDI was shown after 5 consecutive years of rapid increase. Between 1996 and 1998, the

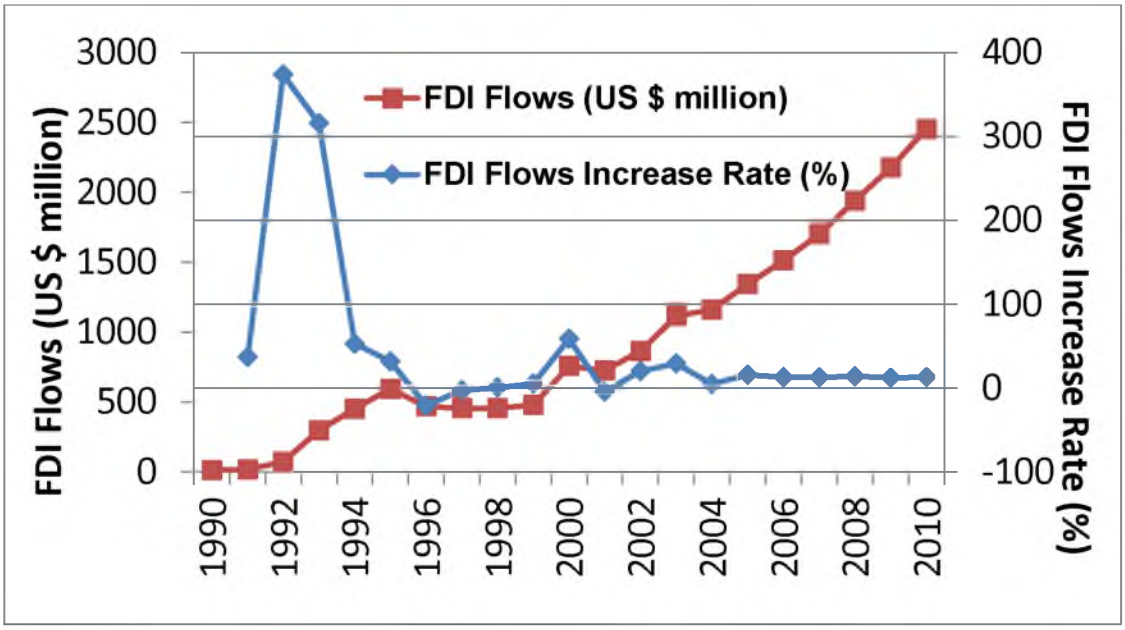


Figure 6.1. The annual growth of FDI flows in Wuhan during 1990-2010.

negative or almost zero increase rate of FDI indicated the negative influence of the 1997 Asian financial crisis on foreign investment in Wuhan. Following an adjustment period in 1998-2001 and China's entry into World Trade Organization (WTO) in 2001, Wuhan has experienced a continuous growth of FDI.

Sectors of foreign investment reveal how local socio-economic contexts and national economic strategies together influence FDI in Wuhan. Foreign firms invested in a variety of industries in Wuhan, but manufacturing, real estate, and wholesale and retail have been the three largest sectors of FDI. Based on the 2008 economic census, manufacturing, real estate, and wholesale and retail respectively account for 39.2%, 17.6%, and 16.9% of the total FDI (Table 6.1). These three largest sectors of FDI reflect the characteristics of the economic structure of Wuhan, the largest industrial and commercial city of Central China. The largest share of FDI in the manufacturing sector implies the labor-intensive nature of FDI in Wuhan, reflecting the history of being one of the major national industrial bases. Similarly, a large percent of FDI in wholesale and retail reveals the advantages of being the largest commercial center of Central China. FDI in the real estate sector shows the strong influence of national policies on foreign investment because the central government had been pursuing an expansionary monetary policy and encouraged investments in the real estate industry for better part of the time since the late 1980s. The real estate sector has been the pillar industry in the economy in China.

National development zones played a leading role in attracting FDI in Wuhan. They accounted for 55.3% of the total foreign investment in 2008. They are located within the suburban districts along the boundary of central city. Each national development zone has a total area of around 200 square kilometers or more. Comparatively, provincial level

Table 6.1. Profile of foreign firms

| Attribute | Category | Number of cases | % |
|---|---|---|---|
| No. of employees | <100 | 906 | 74.3 |
| | 100-199 | 130 | 10.6 |
| | 200-500 | 124 | 10.2 |
| | >500 | 60 | 4.9 |
| | Total | 1220 | 100 |
| Industry | Agriculture, forest, livestock, and fishing | 0 | 0 |
| | Mining | 2 | 0.2 |
| | Manufacturing | 478 | 39.2 |
| | Electricity, gas, and water production | 7 | 0.6 |
| | Architecture | 44 | 3.6 |
| | Transportation, warehouse, and postal services | 40 | 3.3 |
| | Information transmission, computer services, and software | 53 | 4.3 |
| | Wholesale and retail | 206 | 16.9 |
| | Hotel and restaurant | 65 | 5.3 |
| | Real estate | 215 | 17.6 |
| | Research, technical services, and geological survey | 48 | 3.9 |
| | Water, environment, and public facility management | 7 | 0.6 |
| | Neighborhood services and other services | 25 | 2.0 |
| | Education | 8 | 0.7 |
| | Health, social security, and social welfare | 2 | 0.2 |
| | Culture, sports, and entertainment | 16 | 1.3 |
| | Public administration and social organization | 4 | 0.3 |
| | International organization | 0 | 0 |
| | Total | 1220 | 100 |

Source: 2008 Economic Census

development zones' abilities to attract foreign investments were very limited. They only accounted for 1.4% of the total foreign investment in 2008. Compared to national development zones, these provincial level development zones have much smaller land areas. Each of them in the city center has a total area of less than 10 square kilometers, while each in the suburb has a total area of no more than 20.

## 6.3. Spatial Patterns of FDI: Global and Local Statistics

FDI distribution has been clustered since 2006 under the influence of the proposal of the *Rise of Central China Plan* in 2004 and the implementation of relevant specific

policies thereafter. Figure 6.2 highlights the changes of global Moran's *I* and global Getis-Ord *G* for FDI from 1992 to 2008. Global Moran's *I* has been positive and the Z score for global Moran's *I* has been greater than 2.58 since 2006. This indicates that FDI has shown the apparent clustering pattern of positive spatial autocorrelation since 2006. Similarly, global Getis-Ord *G* has been positive and the Z score for global Getis-Ord *G* was greater than 1.96 in 2006, and was greater than 2.58 in 2007 and 2008. This indicates that FDI has shown the apparent clustering of high value at different significance levels since 2006. This suggests the effectiveness of a series of policies under the *Rise of Central China Plan*. After it was proposed in 2004, relevant specific policies were implemented thereafter, which were effective in improving inland cities' attraction to foreign firms and bringing more FDI to cities in Central China.

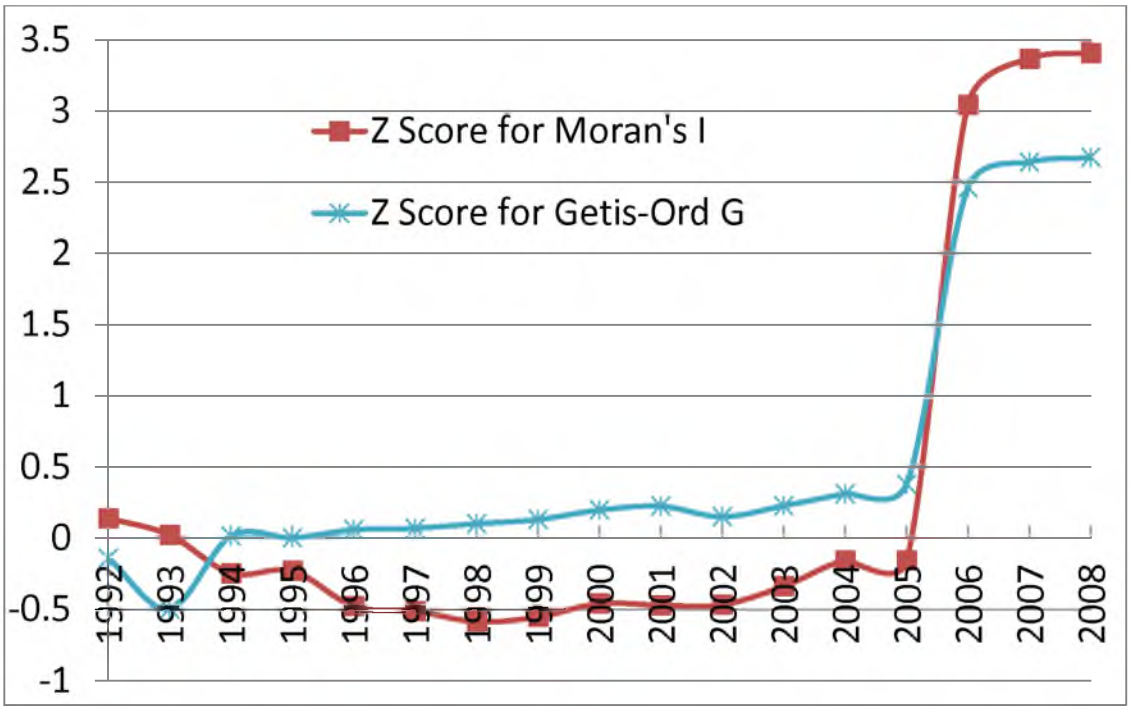


Figure 6.2. Z score for Moran's *I* and Getis & Ord *G* during 1992-2008

Three parts of the metropolitan area mentioned above, Hanyang, Hankou, and Wuchang, have very different spatial patterns of FDI, reflecting the centralized nature of FDI. Hanyang exerts a strong centralizing influence. Figure 6.3 presents the results of local Getis-Ord *G* in 1995, 2000, 2005, and 2008, showing the strong contrast among Hanyang, Hankou, and Wuchang. In Hanyang lies a major concentration area of FDI; districts in Hankou adjacent to Hanyang are also concentration areas of FDI; no concentration areas

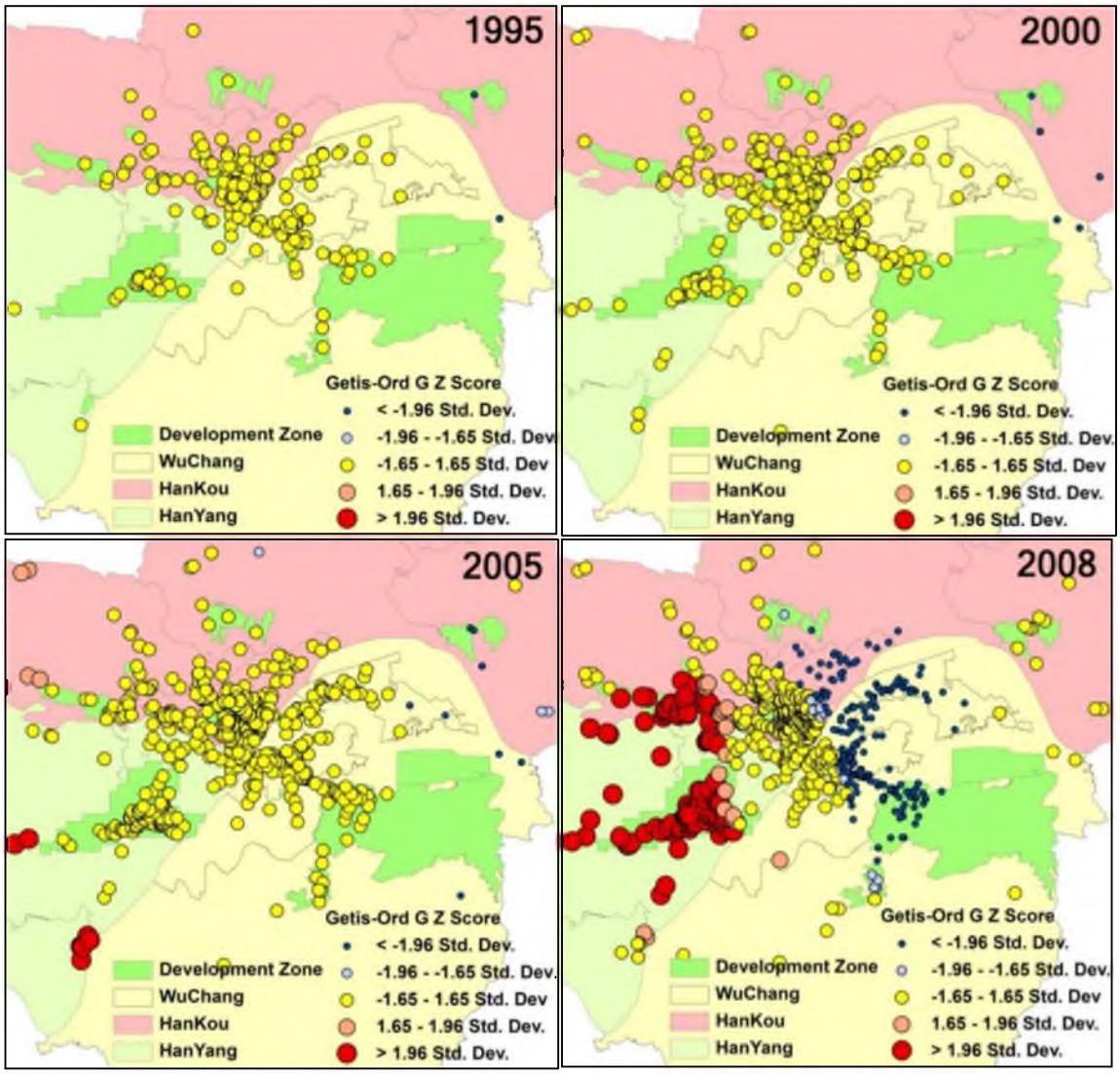


Figure 6.3. Hotspots and coldspots of FDI within Wuhan in 1995, 2000, 2005, and 2008

of FDI are found in Wuchang. In 1995 and 2000, there were no obvious cold spot or hot spot patterns in Wuhan. In 2005, a very small number of hot spots emerged in suburban Hannan district and Caidian district of Hanyang, and also in the suburban Dongxihu district of Hankou, while a few cold spots emerged in the Qingshan district, Hongshan district, and the suburban Jiangxia district of Wuchang, and also in the suburban Xinzhou district and Huangpi district of Hankou.

In 2008, an increasing number of hot spots emerged and formed clusters in Hanyang, while an increasing number of cold spots emerged and formed clusters in Wuchang. At the same time, in Hankou, districts adjacent to Hanyang had small clusters of FDI hot spots while districts adjacent to Wuchang had small clusters of FDI cold spots.

Two national development zones, the Wuhan ETDZ of Hanyang and the Wujiashan ETDZ of Hankou, are major agglomeration areas of FDI. Extremely large joint ventures are found to sustain a significant pull, showing the strong interaction among urban spatial structure, agglomeration, and institution. Figure 6.4 presents the LISA results of FDI in 1995, 2000, 2005, and 2008, showing both negative and positive spatial autocorrelation. In 1995, there was only one cluster with negative spatial autocorrelation in the Wuhan ETDZ. This cluster centered on the largest joint venture company with high FDI, Dongfeng Peugeot Citroen Automobile Company LTD, which is surrounded by firms with low FDIs. In the same year, there were no clusters with positive spatial autocorrelation. In 2000, in addition to one existing cluster in the Wuhan ETDZ, another two clusters with negative spatial autocorrelation were found in the Jiang'an district and the suburban Xinzhou district of Hankou. In the same year, there were no clusters with positive spatial autocorrelation. In 2005, in addition to three existing clusters, one more cluster with

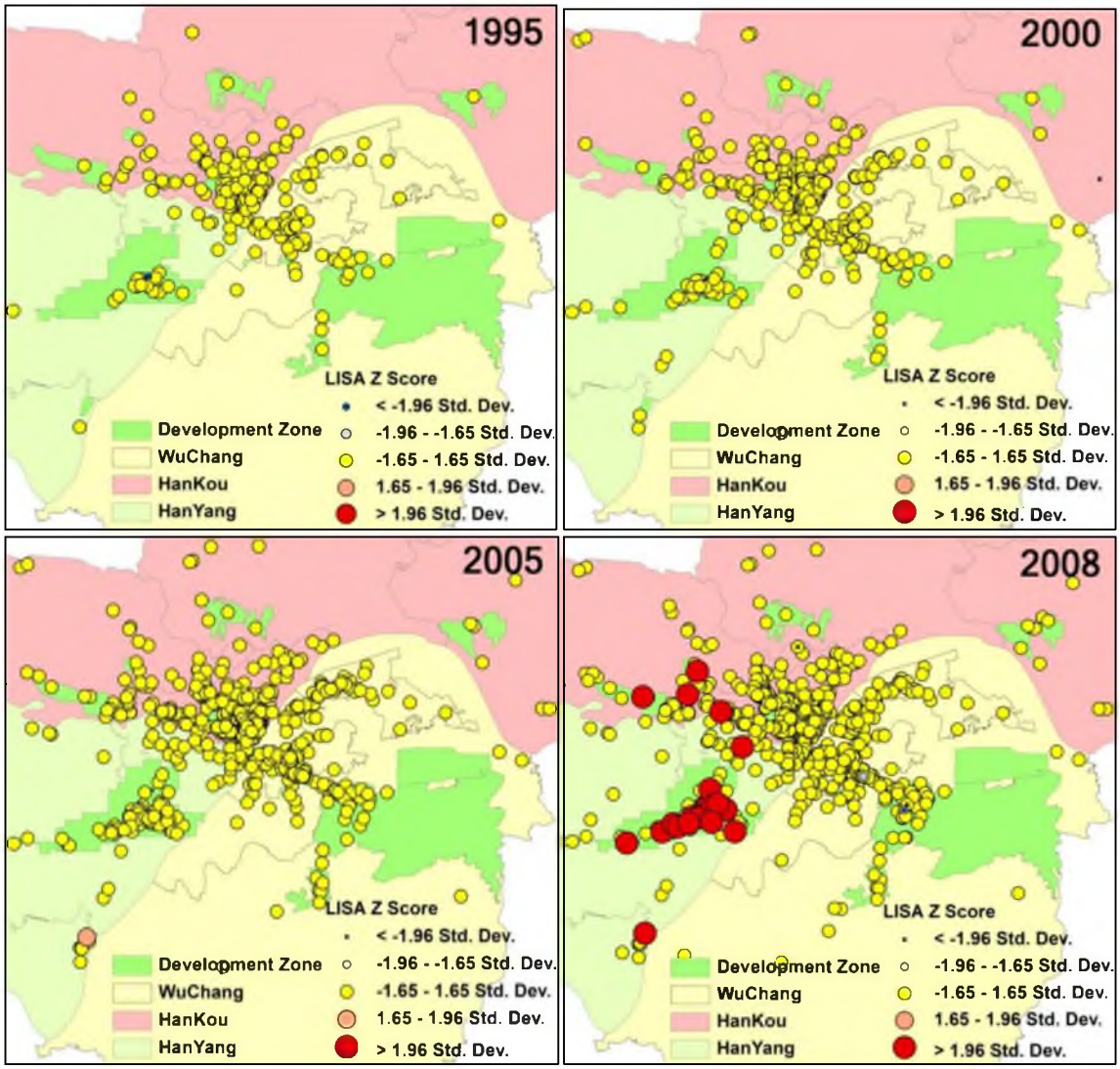


Figure 6.4. LISA results of FDI within Wuhan in 1995, 2000, 2005, and 2008

negative spatial autocorrelation was formed in the Wuhan ETDZ. This cluster centered on another largest joint venture company with high FDI, Dongfeng Motor Company Limited. In the same year, there were still no clusters with positive spatial autocorrelation.

In 2006, all previous clusters with negative spatial autocorrelation in the Wuhan ETDZ became clusters with positive spatial autocorrelation, forming the clusters of high FDI. Apparently, two extremely large joint ventures, Dongfeng Peugeot Citroen Automobile Company LTD and Dongfeng Motor Company Limited, played important

roles in forming these clusters of high FDI in the Wuhan ETDZ of Hanyang by strong intra-industry linkages.

In addition to the transformation of clusters with negative spatial autocorrelation into clusters with positive spatial autocorrelation, other new clusters with positive spatial autocorrelation emerged in the Wuhan ETDZ since the Wuhan ETDZ has established a good reputation in the quality investment environment toward FDI through years of efforts and experiences under the influence of the *Rise of Central China Plan*. In 2006, two clusters with positive spatial autocorrelation emerged in another national development zone, the Wujiashan TBIZ. In 2007 and 2008, respectively, one more cluster with positive spatial autocorrelation was added in the Wuhan ETDZ.

## 6.4. Location Determinants of FDI in Wuhan

As shown in Table 6.2, the Nagelkerke R square for the logistic model is 0.781, so the logistic model is appropriate for examining the locational determinants of FDI in Wuhan. Table 6.3 shows that the adjusted *R* square for the GWR is 0.681. This indicates that 68% of the variation can be explained. Also, the GWR results indicate that the relationships between FDI and influential factors are not invariant over space. The variant relationships show local effects that a global logistic regression model would not provide.

### 6.4.1. National Development Zones

National development zones have the most significant positive impacts on the FDI location within Wuhan. A foreign investor is 4.8 times more likely to invest in a national

Table 6.2. Logistic regression results for FDI in Wuhan

| | B | Sig. | Exp (B) | 95% C.I. for Exp (B) | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| NationalETDZ | 1.575 | 0.000 | 4.829 | 2.006 | 11.621 |
| LocalETDZ | 0.202 | 0.692 | 1.224 | 0.451 | 3.321 |
| Hanyang | 0.774 | 0.080 | 2.168 | 0.913 | 5.148 |
| Hankou | 0.417 | 0.309 | 1.517 | 0.680 | 3.384 |
| FirmDensity | 0.016 | 0.000 | 1.016 | 1.009 | 1.022 |
| FDIDensity | 0.000 | 0.102 | 1.000 | 1.000 | 1.000 |
| Suburb | 0.245 | 0.554 | 1.277 | 0.568 | 2.875 |
| DistanceAirport | -1.698 | 0.222 | 0.183 | 0.012 | 2.791 |
| DistancePorts | -2.383 | 0.360 | 0.092 | 0.001 | 15.220 |
| DistanceCBD | -6.286 | 0.033 | 0.002 | 0.000 | 0.603 |
| DistanceRoad | -38.595 | 0.000 | 0.000 | 0.000 | 0.000 |
| DistanceRail | -0.129 | 0.951 | 0.879 | 0.014 | 53.890 |
| Constant | 1.729 | 0.001 | 5.637 | | |
| -2 Log likelihood | 469.989 | Cox & Snell R Square | 0.506 | Nagelkerke R Square | 0.781 |

Table 6.3. Geographically weighted regression results summary

| | |
|---|---|
| Residual Squares | 57.817 |
| Sigma | 0.241 |
| AICc | 10.243 |
| R Square | 0.692 |
| Adjusted R Square | 0.681 |

development zone than outside. Contrastively, we also find that provincial level development zones have no statistically significant effects on the FDI location in Wuhan due to very limited land area, as we mentioned in section 6.1.

Figure 6.5 shows the GWR parameter surface of national ETDZs. Hanyang has the highest coefficient for the national ETDZ while Wuchang has the lowest coefficient. In Hankou, the area adjacent to Hanyang has a higher coefficient than the area adjacent to

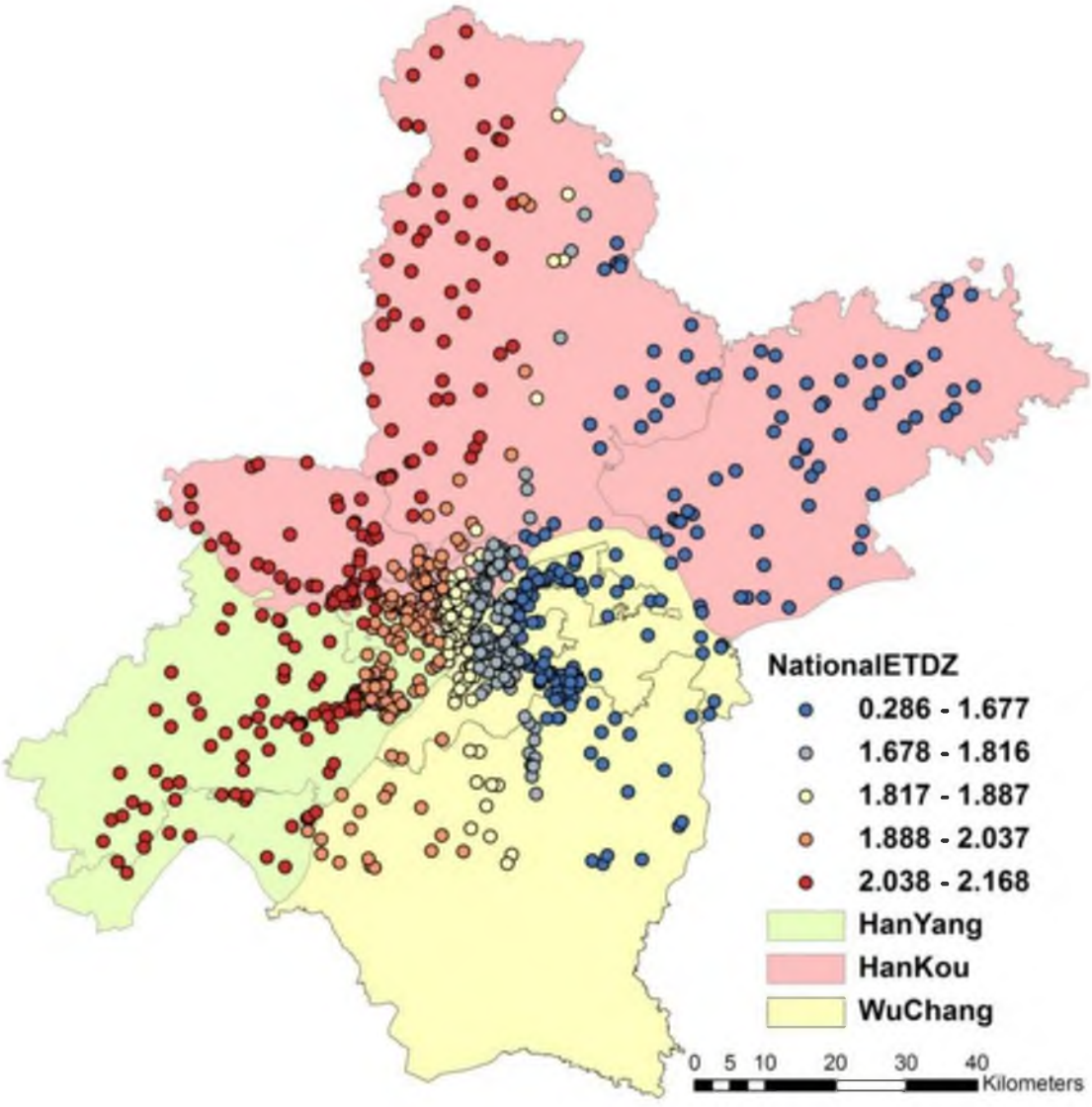


Figure 6.5. GWR parameter surface of national ETDZ

Wuchang. Therefore, the Wuhan ETDZ in Hanyang has more positive impacts on FDI than the Wujiashan TBIZ in Hankou. And the Wujiashan TBIZ in Hankou has more positive impacts on FDI than the Wuhan ELHTZ in Wuchang. This further confirms the strong centralizing influence of Hanyang and significance of the Wuhan ETDZ located in Hanyang compared to another two national ETDZs.

### 6.4.2. Urban Structure

The location of Hanyang has positive influence on attracting FDI within Wuhan. A foreign firm is 2.2 times more likely to invest in Hanyang than outside. This finding endorses the observed cluster pattern from local Getis-Ord $G$ results, indicating the significance of Hanyang in attracting foreign investment due to its strong auto industrial base. Hanyang, as a traditional industrial core, has the highest percentage of industrial activities. It provides advanced infrastructure, comprehensive transportation and facilities, and other amenities. The significance of Hanyang shows the importance of traditional centers to foreign investors.

FDI tends to locate in proximity to local firms, as evidenced by the significant coefficient for the FirmDensity variable, displaying strong industrial linkages with local firms. However, the FDIDensity variable is not statistically significant. This indicates that FDI does not locate near other foreign firms. FDI has weak linkages with each other.

In addition, Figure 6.6 shows the GWR parameter surface of firm density. It indicates that effects of firm density vary between suburb and central city. The suburb of Wuhan has a higher coefficient for firm density than the central city.

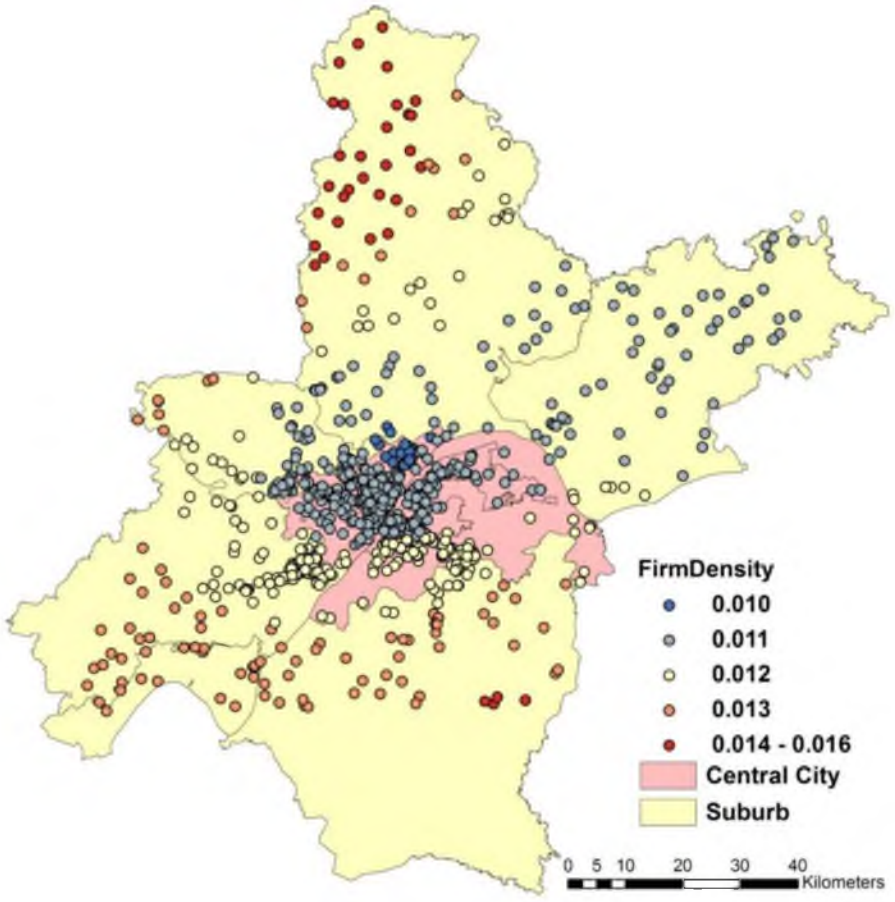


Figure 6.6. GWR parameter surface of firm density

6.4.3. Accessibility

Among five accessibility variables, only the variables DistanceCBD and DistanceRoad are significant, indicating that proximity to CBDs and roads has positive impacts on FDI. Other accessibility variables, DistanceAirport, DistancePorts, and DistanceRail are not significant, indicating that proximity to airports, ports, and railways has no impacts on FDI. Figure 6.7 shows the GWR parameter surface of distance to major roads. Proximity to major roads in Hankou and Wuchang has larger positive effects on FDI than in Hanyang. It suggests that, considering the relatively comprehensive infrastructure

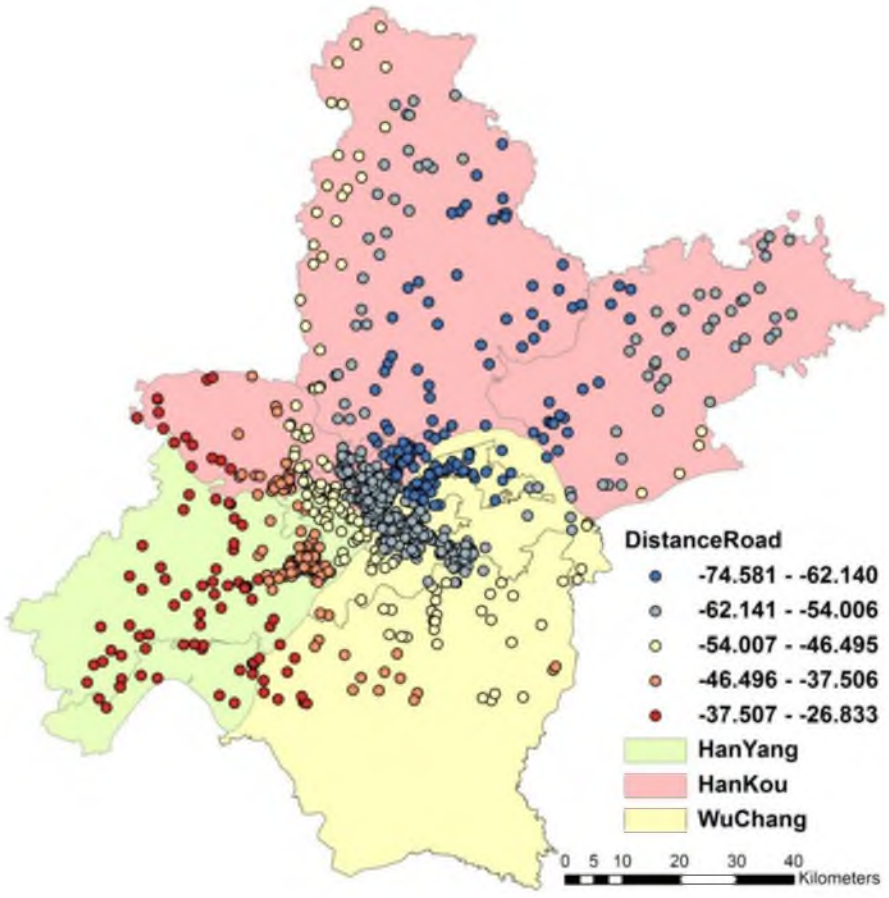


Figure 6.7. GWR parameter surface of distance to major roads

in Hanyang, road infrastructure investments in Hankou and Wuchang can have greater positive impacts on FDI than those in Hanyang.

FDI is centralized around the CBDs, evidenced by the significant coefficient for the DistanceCBD variable. FDI seems to enjoy substantial urbanization economies. As mentioned in section 4.1, real estate and wholesale and retail have a major presence in the FDI of Wuhan. The positive impact of CBDs on the FDI location also indicates the significance of traditional commercial and business centers to foreign investors. This

further confirms the advantages of the traditional centers and their increasing attraction to foreign firms due to easy access to infrastructure and commercial resources, and proximity to both consumer and labor markets. Figure 6.8 shows the GWR parameter surface of distance to CBDs. The distance to CBDs has a stronger influence in the suburb than that in the central city, which suggests that CBDs tend to have global influence on FDI across the whole area.

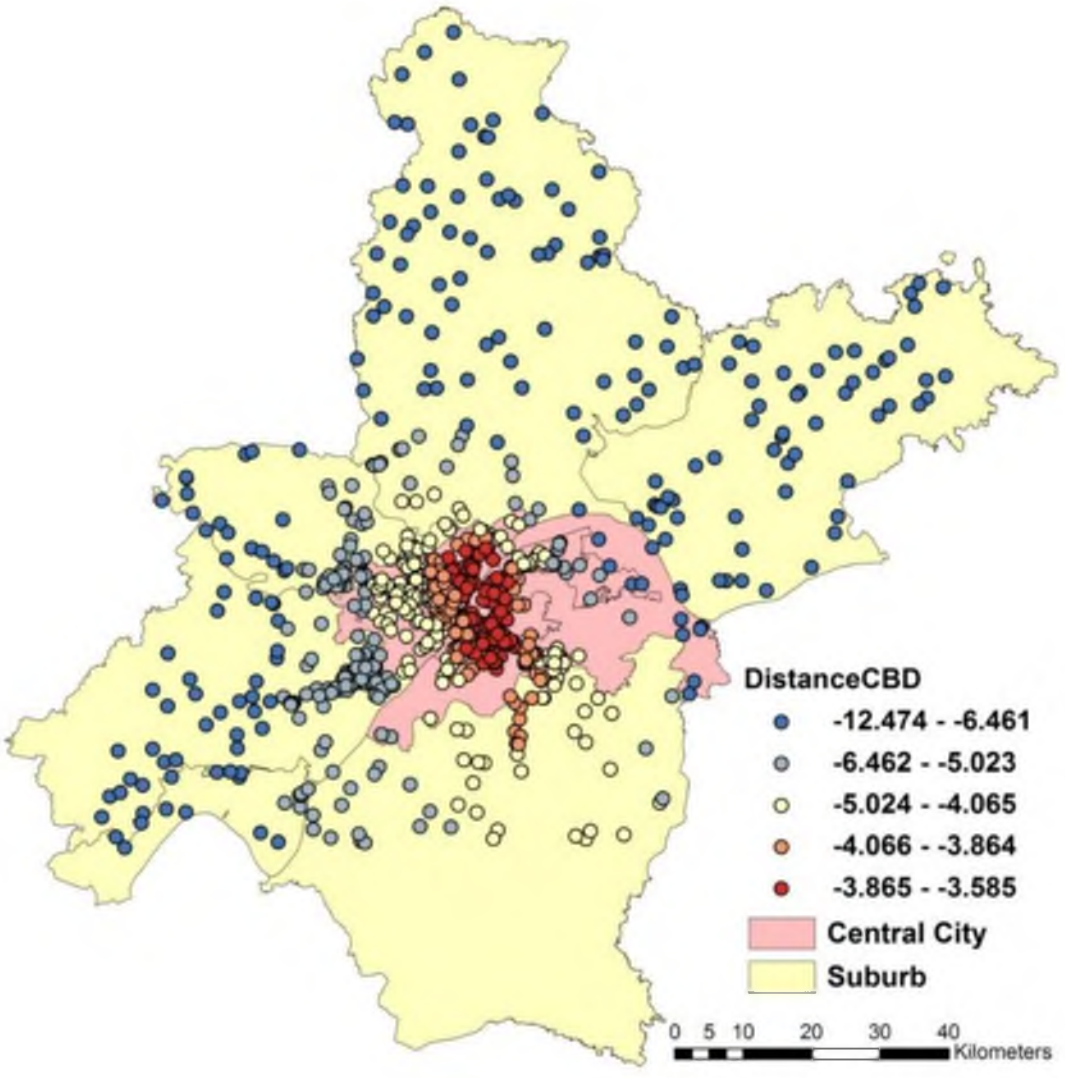


Figure 6.8. GWR parameter surface of distance to CBD

## 6.5. Summary

This chapter presents the results of analyzing the characteristics and processes of FDI location in an inland area through a study of the Wuhan metropolitan area, China's largest inland transportation hub and information center. The results indicate that FDI in Wuhan has become more concentrated over time and is centralized on the Wuhan Economic and Technological Development Zone, a national development zone. In addition, FDI in Wuhan is a result of interaction among institution, urban structure, and accessibility. Also, easy access to road and the CBDs has positive impacts on the FDI location. Last, the importance of urban spatial structure is identified through the significance of the traditional auto industrial base, Hanyang, in the FDI location.

# CHAPTER 7

# DISCUSSION

## 7.1. Overview

This chapter discusses the results of the spatial patterns and locational determinants of FDI at three spatial scales. The first section focuses on how national policy and globalization affect the temporal and spatial change of FDI, why FDI spread from Guangdong to the Pan-YRD and the BRR, as well as difference in dynamics within each region. The second section explains why eastern/coastal region still dominated FDI and simultaneously the relative gap between the eastern/coastal region and the rest of China was narrowing and provides information on how and why market size, agglomeration effects, and institutions are shaping the evolution and development of FDI. The last section discusses the results of intrametropolitan location of FDI in Wuhan City, specifically highlighting the explanation of the significance of traditional industrial centers and national development zones as well as the interaction among urban spatial structure, agglomeration, and institutions.

## 7.2. Results of FDI by Province and Region

The variation of FDI amounts over years reflects the effects of national policy and globalization on FDI since FDI has grown drastically during two time periods: one is in

the early and mid-1990s when China deepened its economic reforms and the other is the early 2000s after China joined the WTO in December 2001. Also, at the provincial level, FDI has shown the apparent pattern of positive spatial autocorrelation since 2002, which further confirms the effects of the WTO.

Within the eastern/coastal region, FDI spread from Guangdong to the Pan-YRD and the BRR. Guangdong attracted the earlier infusion of FDI, with the opening up of Special Economic Zones in south China. In the 2000s, local concentrations of FDI in the eastern region show a trend of movement from Guangdong to the Pan-YRD and BRR. This shows the effects of national open policies and development strategies on FDI. In the 1980s and the earlier 1990s, Guangdong spearheaded the open door policy, enjoying preferential treatments in terms of land and tax. In the mid- to late 1990s, China explicitly shifted the focus of national development policy from Guangdong to the Pan-YRD, with the implementation of "T-Shaped Development Strategy." This strategy proposed that national development would be centered in Shanghai, spreading along the north-south axis the coastline and the east-west axis of the transportation corridor (Zhang & Zhao, 2007). In the 2000s, the BRR is the focus of a new round of national policy initiatives, with the designation of Binhai New Area of Tianjin as a new area for comprehensive experimental reforms, providing fiscal and land incentives to encourage FDI.

The results of space-time scan statistics suggest that the Pan-YRD is a cluster during the period from 2002 to 2008, which implies the potential effects of China's entry into the WTO in 2001 on FDI in the Pan-YRD. It may mean that the Pan-YRD is most probably chosen as the region for FDI after entry into the WTO. In addition, the BRR is another cluster during the period from 2004 to 2008, implying the potential relationship

with the comprehensive reform launched in this region in 2006. The reform may contribute to the concentration of FDI in this region.

Temporal variations of clusters within each region indicate that Guangdong, the Pan-YRD, and BRR have different dynamics to attract FDI. Within the Pan-YRD, Shanghai first became a concentration of FDI in 1992. After that, Jiangsu and Zhejiang, around Shanghai, have shown as concentrations of FDI since 2000 and 2003, respectively. The temporal sequence of FDI clusters in Shanghai, Jiangsu, and Zhejiang implies the spread of concentrations from Shanghai to Jiangsu and Zhejiang among the Pan-YRD. It implies the notion that within the Pan-YRD beneficial effects spill over province borders and provinces benefit each other as an integrated area in regional development to compete against other regions. These beneficial effects help promote regional development and form a positive feedback cycle between economic growth and FDI. This positive cycle raises the purchasing power and causes a huge market, which currently becomes a major driver to FDI in the Pan-YRD. This demonstrates that the relation of firms with local and regional environments plays an important role in regional economic development, as mentioned in Oinas (1997).

Compared to the Pan-YRD, the BRR shows a different temporal and spatial pattern of FDI. Within the BRR, Tianjin and Beijing became concentrations of FDI in 1995 and 1998 sequentially. However, Hebei, around Tianjin and Beijing, did not attract more FDI. The concentration of FDI did not spread toward it. Conversely, Hebei has shown as a location of negative spatial autocorrelation in 2006 and 2007. The negative spatial autocorrelation implies a different regional development model from the positive spatial autocorrelation pattern. It implies these provinces compete with each other for foreign

capitals and resources. So it is possible that Beijing and Tianjin deters FDI from coming into Hebei.

The interesting part is that Liaoning, adjacent to Hebei, has become a concentration of FDI recently. It is probably the result of mixed influence of the BRR and "Reviving Northeastern Region" policies. Broadly speaking, the BRR demonstrates a spreading process of FDI in leaps. In addition, Beijing and Tianjin have almost the same spatial and temporal patterns, which implies that they are almost in the same development stages and have same rhythms and steps in FDI. It is probably the result of implementing similar national policies in these two municipalities. They are hot spots, but recent years have witnessed the growth of Tianjin and decline of Beijing in FDI shares. It shows a potential that the Binhai New District of Tianjin, designated by the central government as a new experimental area for comprehensive reforms in 2006, has a positive effect on FDI, and therefore causes a new round of growth.

In the central region, Anhui had local negative spatial autocorrelation in 2004. It demonstrates that Anhui, with a low FDI level, was surrounded by provinces with high FDI levels. It shows a weak ability of Anhui to attract FDI, but it also shows opportunities: how to take advantage of good surrounding FDI environments to establish links between its own resources and outside environment through local industrial and FDI policies, and therefore potentially attract more FDI. In the western region, a new concentration of low value of FDI emerged in Sichuan and neighboring areas, which indicates that the western region still lacks attractions to FDI. Compared to other regions and corresponding policies, the Western Development Strategy has little effect in bringing more FDI to western China.

Recently, all three FDI hot spots are centrally administered municipalities –

Beijing, Shanghai, and Tianjin. This indicates the important role of municipalities in attracting FDI in China. These cities are the centers of globalizing city regions, which is consistent with the notions in previous studies that FDI in developing countries is concentrated in globalizing city regions and these globalizing cities are emerging nodes of the global economy (Wei & Leung, 2005).

Last, positive effects of institution, transportation, and agglomeration effects on FDI vary among regions. Institution had the most influence to Guangdong, transportation had the most influence on FDI in Pan-YRD, and agglomeration had the most influence on FDI in BRR. It shows the factor that matters has been changed during different stages of development of FDI. Guangdong is the region that first opens to FDI. After that, the open policies spread to the Pan-YRD, then to the BRR. It may imply that the agglomeration effect is the most important during the initial time period of FDI. When more FDI is attracted into the region, advanced transportation matters. Finally, when FDI grows to a certain level, agglomeration diseconomies may emerge. During this time period, institution matters the most to FDI.

### 7.3. Results of Intercity Competition for FDI

It has been found that the eastern/coastal region still dominated FDI, but the relative gap between the eastern/coastal region and the rest of China was narrowing. The clusters of FDI were spreading from the eastern/coastal region to the central and western regions. This finding indicates that, while FDI has spread from developed countries to developing countries, FDI is still heavily concentrated in the core area of developing countries and the gap between the core and periphery remains large. This finding is

consistent with the overwhelming evidence on the uneven distribution and core-dominance of FDI in developing countries (e.g., Berkoz & Eyuboglu, 2007; Farole & Winkler, 2013; Jordaan, 2008). At the same time, we observed the diffusion of FDI to China's interior, especially cities near the coastal core region. The relative gaps among the eastern/coastal, and central and western regions were narrowing, which implies the positive impact of implementation of development policies in central and western regions. This finding indicates that the *Great Western Development Strategy* in 2000 and the *Rise of Central China Plan* in 2004 were at least partially effective in attracting foreign firms to invest in interior China.

It has also been found that the roles of labor cost, market size, and agglomeration are changing over time with shifting institutional and development environments; academic debates about their influences cannot be isolated from space and time. We found that there was no statistically significant relationship between FDI and labor, which can be explained by the fact that the coastal region, despite being more developed, was able to reduce labor costs through cheap migrant workers from interior China, and consequently, labor cost across cities in China was not significant in FDI locations.

If not labor cost, then what were the important determinants of FDI location? We have found that the market has played an important role in FDI location since 1990, and rather than labor-oriented, FDI within China was market-oriented. This finding indicates that while labor cost is often cited as the most important variable for foreign firms investing in China, when it comes to specific location choice, it was not labor cost, but market size that was the primary location determinant of FDI. The incremental economic growth of China and decreasing labor cost inequality may explain this result. On one hand, the

economic rise makes China become one of important international markets. On the other hand, lifting restrictions to migration increase labor mobility and thus decrease labor cost.

With the maturing of the Chinese market, the equalization of taxes across regions, and rising living costs in coastal China, the SEZs and OCCs were not significant attractions any longer and development zones were losing their advantages. So, how do coastal regions remain competitive in attracting FDI so that by 2010, FDI in China can remain highly concentrated in the coastal region? The answer has a lot to do with the rise of agglomeration effects, which, as shown in our regression analysis, has replaced market size and become the most significant variable determining FDI location in China in 2010. This finding is significant, since it not only confirms the findings from FDI surveys in case study cities about the replacement of policies by agglomeration (e.g., Wei et al., 2009; 2011), but also the widely observed phenomena of the power of agglomeration effects in FDI location (Guimaraes et al., 2000; He et al., 2011; Head & Ries, 1996; Tan & Meyer, 2011). In this sense, the role of institutional factors has been reduced deliberately by the government through equalizing tax policies across regions. This finding is also consistent with studies of FDI in other countries that, in the postcrisis period, market-seeking FDIs in manufacturing industries have decreased (e.g., Ledyaeva et al., 2012).

## 7.4. Results of Intrametropolitan Location of FDI

### 7.4.1. Centralizing Influence of Hanyang

The strong centralizing influence of Hanyang manifests the benefits of localization economies to the FDI location. As a strong local auto industrial base, Hanyang is able to provide a diverse range of technological capabilities, abundant skilled laborers,

and more-than-adequate production capacity to meet requirements from foreign investors. It, along with affinity to this area with the highest percentage of industrial land, probably reflects the propensity of FDI to locate in predominantly industrial areas. The avoidance of Wuchang, which has high proportions of cultural and educational activities, suggests the avoidance of areas where little industrial linkages are occurring.

The significance of Hanyang also shows the importance of traditional centers to foreign investors. This finding is different from the tendency shown in cities of Western countries that traditional centers have seen a declining attraction to new firms, while emerging new suburban centers have increasingly attracted them (Shukla & Waddell, 1991). In China, traditional centers still have increasing attractions to foreign investors because of their structural advantages, agglomeration effects, and investment incentives. The structural advantages of the traditional centers include easy access to infrastructure and industrial resources, closeness to both consumer and labor markets, and strong linkages to local firms (Liefner et al., 2013). The significance of Hanyang provides evidence for increasing attraction of traditional centers to foreign firms. However, this increasing attraction is exerting pressure on traditional centers because of very limited available land resources and congestion caused by increasing firm density there. Thus, the suburb is showing the potential to attract FDI. As the GWR parameter surface of firm density indicates, the same amount of increase in firm density has larger effects on FDI in the suburb than that in the central city. It implies that encouraging firms to locate in the suburb has the potential to produce more agglomeration effects and thus attract more FDI. Also, compared to the central city, the presence of more available land resources is another advantage that the suburb can provide.

### 7.4.2. Significance of National Development Zones

National development zones played a leading role in attracting FDI in Wuhan because of the large enough land area, favorable preferential policies, and advanced infrastructure facilities. Two national development zones, the Wuhan ETDZ of Hanyang and the Wujiashan ETDZ of Hankou, are major agglomeration areas of FDI. Thus, agglomeration areas of FDI were basically formed in the Wuhan ETDZ and the Wujiashan TBIZ in 2006, indicating the effectiveness of implementation of its relevant specific policies after Wuhan became a strategic pillar city playing a leading role in the *Rise of Central China Plan*.

Comparatively, provincial-level development zones' abilities to attract foreign investments were very limited. The significance of national development zones and the insignificance of provincial-level development zones indicate the important roles of land areas in FDI location. Limited land area constrains provincial-level development zones to attract more foreign investment since the largest percentage of foreign investment within Wuhan consists of manufacturing firms, which usually need a large amount of industrial land for their operation. On the other hand, it implies that each provincial level development zone should select appropriate industries to develop unique strategies to attract foreign investment in certain industries, in terms of its own historical, locational, and socio-economic advantages, in order to avoid aggravating competition and inefficient land use by expanding land area and lowering land price.

### 7.4.3. Interaction among Urban Spatial Structure, Agglomeration, and Institution

The evolution and development of FDI clusters in two national development zones show the strong interaction among urban spatial structure, agglomeration, and institution. The significance of Dongfeng Peugeot Citroen Automobile Company LTD and Dongfeng Motor Company Limited indicates that the extremely large joint ventures played important roles in shaping spatial clusters of FDI. As the two largest foreign investments in Wuhan, both of them are automotive assembly plants attracting a large amount of foreign upstream suppliers surrounding them. These upstream suppliers are the manufacturers of auto parts and fittings. They range from individual parts and components to entire subassemblies, such as seating systems and integral automobile interiors. The Wuhan ETDZ has institutional advantages of national development zones and specific policies of the *Rise of Central China Plan*, which provide an array of preferential policies and superior infrastructure facilities and thus strengthens competitiveness of the Wuhan ETDZ for attracting those extremely large joint ventures into this zone at the initial stage. Hanyang, a strong auto industrial base with the highest percentage of industrial land, has a large amount of existing infrastructures, facilities, and skilled laborers, which provide the essential elements of firm operations. This thus sustains a significant pull of attracting foreign upstream suppliers surrounding those established extremely large joint ventures to form clusters of FDI at the following stage, generating agglomeration effects. Therefore, this spatial-temporal pattern of FDI in the Wuhan ETDZ is a consequence of the strong interaction among urban spatial structure, agglomeration, and institution.

The GWR result indicates that foreign firms locate near other firms in general, but not locate near other foreign firms. Two reasons may explain this result. First, for the joint

venture firm, the location of Chinese partners has a great impact on FDI location and foreign firms tend to be close to their Chinese partners (Sun et al., 2013; Wei et al., 2008; Zhang, 2000). One survey study conducted by Zhang (2000) identified the location of Chinese partners as the most important factor in FDI location decisions. Second, not all local content requirements were eliminated and foreign firms were still required to achieve a certain degree of local content, although China enforced the provisions of the Trade-Related Investment Measures agreement after accession to the WTO. For example, in 2004, the National Development and Reform Commission formulated the new industrial policy in the auto industry. The policy still included provisions that discourage auto manufacturers from using imported auto parts (Branstetter & Lardy, 2008).

CBDs and road access are valued, while airport, ports, and railways access are not valued. This reflects the distinction in effects of accessibility on FDI location between the intermetropolitan level and the intrametropolitan level. Ports, airports, and railways are used to connect with networks outside a metropolitan area, and are thus important transportation infrastructures for FDI location at the intermetropolitan level. When a foreign firm compares Wuhan with other metropolitan areas to make an investment decision, it may place higher importance on access to airports, ports, and railways. But when it has already chosen Wuhan as its destination area and made a decision on investing in Wuhan, access to airports, ports, and railways might not be emphasized. Proximity to roads has a positive influence on the FDI location within Wuhan. This implies the significance of intrametropolitan transportation infrastructure networks in FDI location since roads are major infrastructures connected with resources within a metropolitan area.

# CHAPTER 8

# CONCLUSION

## 8.1. Summary

This research uses data at three spatial scales (provinces, prefectural cities, and a metropolitan area) to analyze spatial and temporal variations of FDI patterns and determinants in China from 1990 to 2010. Our main focus has been on the spatial-temporal change of and institutional effects on FDI location, including foreign capital policy and regional and local development policy. The analysis also sought to investigate whether different comparative advantages influence locational decisions of FDI and how the effects changed when China deepened its economic reforms to further open up to the global economy. We have also examined how the agglomeration effects change along with institutional transformations, and we have expanded the literature on foreign investment in developing countries.

Based on spatial statistics, GWR, and recent FDI data, this research has studied the spatial and temporal patterns and determinants of FDI distribution. The FDI share in central China increased during the last two decades, but the eastern region still dominates. At the provincial level, there have been hot spots since 1989. Before 2002, hot spots were located in south China and municipalities, and Guangdong had been a hot spot. Since 2002, all hot spots are municipalities. They are Shanghai, Tianjin, and Beijing.

In addition, FDI has shown clusters of spatial autocorrelation since 1998. The majority of local patterns of spatial autocorrelation with high level of FDI are located in the Pan-YRD and the BRR within the eastern region. The evolution and development of clusters of spatial autocorrelation within the Pan-YRD and the BRR shows that different dynamics shape the concentration of FDI clusters in each region. Contrastively, a few concentrations of negative spatial autocorrelation and positive spatial autocorrelation with low level of FDI have also emerged in the central and western regions.

Institution, transportation, and agglomeration factors have positive effects on FDI. However, effects of these factors vary in different regions. Among three regions, institution had the most influential to Guangdong, transportation had the most influence on FDI in Pan-YRD, and agglomeration had the most influence on FDI in BRR.

This research also investigates the spatial-temporal pattern and determinants of FDI in Wuhan, a hub metropolitan area of Central China, during the last two decades. The shifts in patterns of FDI in Wuhan reflect the combined effects of local socio-economic contexts, national policies, and global forces. FDI increased dramatically between 1992 and 1995 after Wuhan was officially opened to foreign investors in 1992. Between 1996 and 1998, FDI had declined under the influence of the 1997 Asian financial crisis. Since China joined the WTO in 2001, FDI has recorded years of continuous growth. Major FDI sectors were manufacturing, real-estate, and wholesale and retail, which reveals the effects of local industrial and commercial history, and national economic policies. More than half of the FDI was located in national development zones, showing the significant role of national development zones in FDI location.

Institution, urban structure, and accessibility were three significant factors

determining FDI location. They interacted with each other to shape patterns and influence locational decisions of foreign investment. First, under the influence of the proposal of the *Rise of Central China Plan* in 2004 and the ensuing implementation of relevant policies, FDI patterns started to exhibit geographical clustering within Wuhan in 2006. Therefore, our results provide evidence for the effectiveness of the *Rise of Central China Plan* in attracting more FDI and forming clusters within Wuhan, a strategic pillar city of this plan. Second, FDI has shown an overwhelmingly centralized nature since 2006. They are centralized on the Wuhan ETDZ due to the interaction among institutional advantages of national development zones, the agglomeration effects of extremely large foreign investment, and the transformation of traditional industrial areas. With the support of national and local preferential policies, extremely large foreign investment played important roles in generating agglomeration effects of FDI in the traditional industrial core through attracting other foreign upstream firms close to them. Third, urban structure has significant impacts on FDI location. Traditional centers in the metropolitan area still have an increasing attraction to foreign firms. Hanyang, as an old industrial base and center, is the major area of foreign investment, especially for manufacturing industries, due to strong technological and production capacity, easy access to infrastructure and industrial resources, and abundant skilled labors. In addition, access to roads and CBDs are important for the FDI location within Wuhan, further confirming the increasing attraction of traditional centers to FDI.

## 8.2. Policy Implications

The findings have important policy implications. This research shows the significance of certain policies designated by the central government. Comparison of spatial and temporal changes of FDI in Guangdong, the Pan-YRD, and BRR suggests the significance of national government incentives, especially at the initial stage. The comparison among regions further indicates that the relation of firms with local and regional environments, and transportation infrastructure play important roles in the later stage of regional economic development, as mentioned in Oinas (1997) and Wei et al. (2010). A positive linkage between FDI and local economies becomes a major sustainable driver for FDI inflows.

The great effectiveness of the *Rise of Central China Plan* in 2004 provides a striking contrast to the ineffectiveness of the *Great Western Development Strategy* in 2000 (Huang & Wei, 2011). The positive externalities from agglomeration effects of coastal areas may explain the effectiveness of the *Rise of Central China Plan* because Central China is adjacent to the coastal areas. Thus, if the central government gives higher priority to Central China, it may more effectively and efficiently promote national economic growth through rapid economic increase of the central areas. And the economic increase of the central areas may provide positive externalities to the western areas adjacent to them.

With the gradual reduction of institutional gaps across spaces, China's development zones, mostly located in cities in the coastal region, are losing their advantages in attracting FDI. The role of geographic agglomeration in local competitiveness will increase further. Local governments therefore need further reform to the current foreign capital policies to establish new competitive advantages by fully

utilizing local resources and environments. However, the case study of Wuhan metropolitan area indicates that large foreign investment firms played key roles in agglomeration effects of national development zones. This implies that targeting industries and selecting large foreign firms is important for development zones to develop strategies to attract foreign investment. Since the competition for large foreign investment firms is always highly intense, development zones need to integrate local historical, socio-economic, institutional, and locational advantages to develop strategies to target industries and firms. Suitable selection of targeting industries and large foreign investment can put limited resources together to increase the chances of success in attracting these large foreign investments, and can therefore bring more relevant foreign investments into development zones through positive agglomeration effects of these large foreign investments.

### 8.3. Contributions and Future Research

This research demonstrates that the spatial-temporal framework for FDI research on China can be used to reveal the changes in the relative importance of comparative advantages, agglomeration effects, and institutional effects in different development stages, along with deeper institutional and global changes. First, results provide new understanding of how globalization, national institutions, and local contexts interact to affect FDI location at different spatial levels in developing countries, especially for transition economies. This is significant because it provides insights to utilize and integrate FDI with economic factor endowments and other resources in developing countries when facing globalization and its challenges. Second, results reveal evolution and development of FDI by comparing the

relative importance of factors in different development stages. This contributes to the evolutionary economic theory by adding historical dimensions to current research on FDI. Third, results provide evidences on continual debates on roles of different institutional factors, such as preferential policies and national development zones, which expands the literature on institutional economies in Chinese context.

This expands the literature by connecting the forces influencing FDI location with the development stages and contexts in developing countries. The increasing attraction of traditional centers to foreign firms within Wuhan contributes to the literature on location theory by providing evidence in Chinese context. At the same time, the assessment of national policies on FDI in inland cities contributes to the literature on institutional economics by identifying and evaluating the role of institutional evolution and change in the economic behavior of firms.

The significant performance of three centrally administered municipalities – Beijing, Shanghai, and Tianjin, indicates the important role of municipalities in attracting FDI in China. This indicates the competitive advantages of these cities as the centers of globalizing city regions, which is consistent with the notion that FDI in developing countries is concentrated in globalizing city regions (Wei & Leung, 2005; Wei et al., 2010). This further confirms the importance of emerging global cities in global capital flow and spatial restructuring (Scott, 2001). More research on the different hierarchy of cities is needed to further understand the locations, processes, networks, and how embedded FDI is in China's urban areas.

### 8.4. Limitations

This research has limitations in methods and results. One is concerned with the appropriateness of GWR for making inferences about varying spatial relationships and capturing true coefficient processes because using GWR as an inferential tool should be cautious, especially for smaller samples (Paez et al., 2011). The case study of Wuhan metropolitan area had 1220 foreign firms, based on the 2008 Economic Census, that are larger samples, so there may be a positive note for appropriateness of GWR in this case, but diagnostics need be conducted to test with the stability of the GWR model. Alternative methods, such as spatial-filtering formulation of the expansion method (Griffith, 2008) and Bayesian spatially varying coefficient models (Gelfand et al., 2003), may be considered, depending on the results of diagnostics. In addition, at the provincial level, GWR is used with 31 samples. For this very small sample size, the spatial variation of GWR coefficient surfaces is inherently generated by the method, so results should be interpreted with extreme caution (Paez et al., 2011). Alternative methods need be used to compare their results.

Although the new understanding from results has the potential to be applied to other developing countries, the results have limits in this application, due to the uniqueness of the Chinese context. The Chinese dual-track approach to market liberalization offers a robust example of successful experimentation. This dual-track system changes in a gradual way, known as gradualism, which is very different from transition economies with relatively rapid institutional changes. The specific historical condition for gradualism is the political continuity of the government, which is very different from countries pursuing radical reforms (Fan, 1994). In addition, China is a one-party system. Within this one-party

system, local institutional settings are relatively similar under a hierarchy of nested institutions, which is different from countries consisting of administrative districts with distinct institutional settings. Thus, the spatial-temporal contiguity of Chinese institutions is the unique condition under which the results are drawn from this research.

## 8.5. Conclusion

In conclusion, this research has documented the patterns and determinants of FDI at different spatial scales in China and demonstrated the influence of the *Rise of Central China Plan*. Agglomeration has the significant impacts at all spatial scales. The agglomeration, transportation, and institution have varied effects on FDI across different areas. The significance of national development zones, urban structure, and accessibility were identified in the intrametropolitan location of FDI. This research has shown that different theoretical perspectives on FDI are complementary, and integrating them might be more effective in achieving a more thorough understanding of FDI theories.

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