

**The Place of FDI in China's Regional Economic Development:
Emergence of the Globalized Delta Economies**

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Paper presented at

**International Conference on
Globalization and Regional Economic Development**

Organized by
KEBA, RCIE, and KIET

Gyeong Ju, Korea
December 15-16, 2006

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Abstract

China's remarkable economic development and sustainable high growth rates since the 1980s have stimulated much discussion in recent literatures. Among the augments of China's rapid growth, voluminous recent literatures have emphasized that foreign direct investment (FDI) may best explain its recent growth record at both national and regional level. To understand how such sustained rapid regional growth happened in a huge country such as China, this paper examines the possible explanations of FDI absorption from the perspective of regional agglomerations by investigating (1) the emergence of two major globalized delta economies (GDEs), namely, Pearl River Delta (PRD) and Yangtze River Delta (YRD), due to FDI inflows; (2) the critical effects and functions of a core city in promoting FDI into GDEs; and (3) industry structure specialization in the periphery cities/counties in GDEs. Estimations were performed with a set of Panel data at the city/county level for 1993-2003. Research results show that both core cities in GDEs have played significant role in attracting FDI. Compared with PRD, YRD had relatively higher estimated elasticities in FDI absorption and more diversified industry structure similarities among its cities and hence, possible higher intra-regional competition in terms of industry production. The possible formation of any effective city link in GDEs was also investigated. Reflections and policy implications regarding FDI promotion and regional growth in China were discussed.

Keywords: FDI, regional growth, industry specialization and complementarity, city link, China

I. Introduction

China's remarkable economic development and sustainable high growth rates since the 1980's have stimulated much discussions and vigorous debates among academics during recent years. To understand how such a sustained rapid annual GDP growth of 9.6% has continued for the past quarter of a century during 1978-2004 in such a huge country as China, recent researches have attributed inward foreign direct investment (FDI) as the reason for this remarkable growth record. The huge FDI influx recorded to increase at an annual rate of more than 10% since 1985 and its spatial agglomeration/diffusion may best explain China's recent regional growth. Given the

concern regarding the accuracy of government statistics on GDP and FDI made known by the academic community (Young, 1997; Rawski, 2001), most of the empirical studies have supported the positive contributions of inward FDI to China's economic performance in general, and rapid growth in particular. Some recent studies have reconfirmed the critical importance of inward FDI upon future sustainable growth in China using a two-stage growth accounting decomposition approach (Whalley and Xin, 2006; Yao, 2006) while a regional growth perspective in other countries such as Russia (Brock, 2005) is also emphasized (Mullen and Williams, 2005).

To investigate the determinants of FDI flows and its regional agglomeration behavior, factors commonly cited by studies included costs of production factors, market size, agglomeration effects, financial incentives, and investment environment (such as in Taube and Ogutcu, 2002; Lim, 2001; Tuan and Ng, 1995; Ng and Tuan, 2002). A series of studies examining factors affecting FDI regional agglomerations and its impacts on regional economic development suggested two key approaches in understanding the issue of the economic development of Pearl River Delta region (PRD): (1) The impacts of regional agglomerations following Krugman's (1991a) concept of core-periphery system (CPS) or the city link, and (2) an institutional approach emphasized on economic reform in terms of timing of opening and the role of institutional reform. Selected major studies included Tuan and Ng (1995, 2001, 2002, 2003, 2004a, 2004b) and Ng and Tuan (2001, 2002, 2005, 2006). Following the steps of institutional reform in China, it is likely that the remarkable economic performance in GDP growth and FDI inflows in Yangtze River Delta (YRD) recorded since 1990s may well be explained by the same approach as in the early opened PRD.¹

1. Timing of Institutional Reform: PRD versus YRD

China's institutional reform and continuous improvements of her investment environment, among other external global factors, have also played significant roles in inducing FDI into China (Ng and Tuan, 2001, 2002; Tuan and Ng, 2003, 2004). During the first half of the post-1980 economic opening in China (1980-1992), institutional reform and FDI inflows enhanced each other mainly in PRD, Guangdong which was first designed and opened up as a showroom to receive FDI. New cities such as Shenzhen, Dongguan, and Zhuhai where manufacturing firms of foreign interests agglomerated, were rapidly urbanized via FDI-driven, export-led economic growth (Tuan and Ng, 1995). Since 1992 when the fundamental economic policy of further opening and reform in China was reconfirmed, more diversified FDI by origins flew into PRD including those from Europe and U.S.A in addition to the original dominating source from the two overseas Chinese economies of Hong Kong/Macau and Taiwan (Tuan and Ng, 2003; Whalley and Xin, 2006). Sustainable formation of production clusters and development of new industries enabled the region to uphold its leading role in export trade and output production.

The demonstration effects brought about by joint ventures, deepening institutional reform, and stepwise law-making by the China government, have facilitated the rapid growth and technology up-grade of local Chinese private enterprises in PRD (Ng and

Tuan, 2001; 2005). After the opening policy was effectively implemented in YRD since 1992, similar kind of development was simultaneously observed during the last decade. The 16 major cities which were all industrialized in the pre-reform period, had basically similar manufacturing industry structure as directed by the then planning economy. The effective opening and refinement of the institutional platform turned YRD into a high growth region with remarkable performance both in output production and export growth since the late 1990s.

Gradual refinement and better law making of the institutional platform have facilitated market force to demonstrate its significant impacts upon the economic growth of the major cities in both PRD and YRD. Similar development has been observed in other regions and cities today, such as in Beijing, Tienjin, and Tsindao in northern China.² The economic activities and performance measured by some basic economic indicators of the “Greater” PRD and YRD are presented in Table 1 for reference.

2. Objectives of the Study

While a remarkable economic growth of the nation was recorded especially since 1993 and with a market-oriented framework being provided for nation-wide, the two delta regions, PRD and YRD, have continued to outperform all other regions in China in terms of growth. This gives rise to a number of interesting research questions. Will other regions in China be able to replicate the experience of the impressive economic success record as observed in these two delta economies? Will such a development process being depicted by the path, that is, from FDI-led growth to that of local business-driven and from city growth to regional growth, become the most effective path of nation-wide economic development in China?

By focusing on a region growth perspective of regional agglomerations and core-periphery system (CPS) to be demonstrated by PRD and YRD, this study aims at the examinations of (1) the existence and effectiveness of GDEs in China via FDI absorption; (2) the effects of a core city as a service-dominated metropolis in facilitating and mobilizing FDI into its periphery cities/counties within GDEs; (3) the impacts of such FDI absorption on local industry structure and adjustments, and (4) the formation of any effective city link in the agglomerative (core-periphery) system in enhancing regional competitiveness. The research findings of PRD could serve as a benchmark for comparisons. Reflections and policy implications regarding the regional growth in China would be discussed.

II. Regional Growth and Development in China: The Place of FDI

1. The Significance of FDI on Regional Growth in China: Literature Review

The significance of FDI and its contributions to economic growth especially in developing economies has become an important subject attracting extensive discussions among academics especially since the late 1990s. In the literature, the impacts of FDI and

its on growth are believed to transmit via various economic and institutional sources to include human capital and skills, employment, export/import trade; institutional forces; market integration; innovations and technology transfer; and spatial agglomerations.³ Further in recent growth literature, a new perspective on FDI-led growth and the causal link between FDI and long- and short-run growth were investigated via econometric studies using co-integration, causality, and VAR method.⁴ These literatures had provided supports for both uni- and bi-directional causalities between FDI and GDP growth and in particular, a causal direction from FDI to long-term growth.

In studying the contributions of FDI to developing countries, FDI is also considered as a major transmission mechanism of technology advancements to foster GDP growth. FDI is believed to transfer technology and technological know-how via channels such as spillovers, demonstration, transfer of management know-how, and competitive effects. Voluminous research have discussed how FDI particularly from developed countries would facilitate technology flows into the recipients via technology advancements and R&D spillover activities.⁵ The external benefits in the form of spillovers derived from FDI would foster competition and growth especially through technology upgrading and diffusion, knowledge enhancement, and innovations. The strategic use of FDI for innovation in the host country demonstrated the significant goals of FDI in the country's long-term development process.

In the case of post-reform China, in particular, positive findings of FDI in contributing to GDP growth at both the national or mega-regional level were also reported (Chow, 1993; Borensztein, De Gregorio, and Lee, 1998; Zhang, 2001; Zhao, 2001; Liu, Burridge, and Sinclair, 2002; Shan, 2002; Mei, 2004). By means of a two-stage growth accounting approach (Whalley and Xin, 2006) and incorporating elements from internal and external environment (Yao, 2006), the significant contributions of FDI on economic growth in China were further validated.

More recently, more attentions on the impacts of FDI on regional growth have been recognized due to the fact that FDI tend to vary by industry, origin, and host country and thus offer a differential nature in the cross-country versus sub-national context (Mullen and Williams, 2005). Such an emphasis of the role of FDI on a regional growth context is particularly meaningful in the case of a huge, developing country like China where regional diversity in growth and differential economic performance are evident. Recent empirical evidence supporting the positive impacts of FDI on regional growth using sub-national level or provincial data included Sun and Parikh (2001), Zhang and Felmingham (2002), Gao (2002), Tuan and Ng (2003; 2004).⁶ As the earliest opened province, the critical contributions of Guangdong FDI to provincial growth and development were also explored (Vogel, 1989; Tuan and Ng, 1995; 2003).⁷ Using micro-firm level data, FDI's spatial concentration and strategic interactions with local investments provided significant positive effects on regional growth (Ng and Tuan, 2006).

2. China's Regional Growth: Emergence of Globalized Delta Economies (GDEs)

2.1 FDI Agglomeration and Regional Growth

Following the ideas of the central place theory and the urban/city growth theory (Henderson, 1974), urban and regional growth via agglomeration effects in a metropolitan economy (Black and Henderson, 1999), agglomeration economies and diseconomies (Richardson, 1995), and industry agglomeration and firm locality (Fujita, and Thisse, 1996, 2002; Paul and Siegel, 1999; Puga and Venables, 1996) had well demonstrated the significance of spatial agglomerations. Evidence on the effects of agglomeration (Ciccone, 2002) and the nature and sources of agglomeration economies (Rosenthal and Strange, 2003, 2004) were further studied. A collection of papers (Giersch, 1995) has adequately addressed the significance of urban agglomeration on spatial development and economic growth. Moreover, spatial agglomeration is also believed to contribute to endogenous growth via knowledge accumulation (Quah, 2002) and human capital (Wolff, 1985; Baldwin, 1997; Palivos and Wang, 1996).

The evolution of the spatial economics with the emphases on the significance of market forces, spatial concentration and agglomeration economies/diseconomies, and localization helps to understand economic growth from a new perspective. The rediscovery of the “New Economic Geography” which emerged as the fourth wave of increasing-returns revolution has given the study of spatial economics a new dimension (Fujita, Krugman, and Venables, 1999). Krugman’s (1991a, 1998) idea of the core-periphery system (CPS) and the agglomerative implications on urban/city growth (Quigley, 1998) provided important rationale for the studies of FDI and its flow patterns in the cases of PRD and YRD GDEs. As far as the mobilization of FDI in China on a regional perspective is concerned, regional agglomeration economies and its effect on the mobilization of FDI can be observed via a three tier agglomeration framework (Tuan and Ng, 2002).⁸ The types of agglomeration economies derived from the corresponding three-tier effects in the China context were further empirically validated (Tuan and Ng, 2004b).⁹

2.2 Emergence of GDEs: Regional FDI Agglomerations and Spatial Diffusion

Fujita and Hu (2001) considered China’s increasing regional disparity from the aspects of economic liberalization and regional development policy and concluded that globalization via export and FDI had played an important role in the resultant regional biased development in China. The persistent disparity in regional economic conditions in developed countries offered important challenges in view of the expanding role of FDI especially when FDI is considered as a “manifestation of the forces of globalization” (Mullen and Williams, 2005). Thus, the heavy flows of FDI into in the southern and eastern regions and the FDI agglomerations in major PRD and YRD cities have provided the two delta regions with opportunities for internationalization other than achieving rapid sustained growth during the past two decades.

According to Fujita and Hu (2001), the trend of regional disparity can be viewed from the industry agglomeration perspective of the following types: (1) Production agglomeration as illustrated by strong/weak agglomerated manufacturing sectors (industry groups); (2) self agglomeration (include producer services and trade-related services) especially from FDI due to geographical and historical conditions; and (3)

agglomeration without inter-regional migration (such as labor). Further, de Mello (1999) argued that the degree of complementarity and substitutability between foreign and domestic capital was highly important and the growth effects were significant when FDI was doing business complementarily with existing local business.

Given the agglomeration effects derived from FDI concentration and the agglomeration economies generated in the two delta regions being internationalized via FDI and export promotion strategies, sustained growth in the regions is expected to continue. Furthermore, with the presence of a city core with global accessibility to act as the gravity center in the attraction and diffusion of FDI to its peripheral region, regional competitiveness is expected to be enhanced. It follows that the emergence of such globalized delta economies (GDEs) in the two coastal, distinct geographic parts of China, being equipped with distinctive, positive economic and institutional conditions, should offer some kind of unique experience which will not be easily replicated in the other regions in China.

In order to understand the above arguments, the following sections provide the methodologies to analyze the regional agglomeration economies generated by GDEs (CPS) via FDI absorption and spatial diffusion. The relevant behaviors to be empirically examined are: (1) The presence and functions of the globalized city core is essential to GDEs in the effective absorption and diffusion of FDI through gravity (frictional) effect; (2) FDI by industry type and its complementarity to domestic investment would be significant to enhance local industry competitiveness and productivity; and (3) FDI would induce industry adjustments among cities overtime and the subsequent possible formation of any effective city links to enhance regional competitiveness.

III. Methodology

The role of FDI in facilitating the globalization of the two delta economies (PRD and YRD) is studied empirically by examining (1) the functions of the core city in the absorption of FDI into the delta economies; (2) the impacts of such FDI inflows on industrial structural adjustments; and (3) the formation of effective city links or clusters in facilitating regional growth.

1. FDI Agglomeration and Spatial Diffusion: Gravity Analysis

To demonstrate the critical effects of regional agglomerations and the function of a core city in the delta region in FDI absorption, the following gravity model basing on Krugman's idea of core-periphery relation (1991a) and validated by Tuan and Ng (2002) at the micro(firm)-level is hypothesized as below.¹⁰

$$FDI_{itr} = \beta_0 D_{itr}^{\beta_1} L_{itr}^{\beta_2} U_{itr}^{\beta_3} M_{itr}^{\beta_4} \varepsilon \quad (1)$$

FDI_{itr} is the volume of FDI in i^{th} city/county at time t for region r where $i=1$ to n , $t=1$ to t , and $r=1$ to r . D_{it} is the frictional (gravity) factor of road (highway) distance in kilometers

from the core city to the i^{th} FDI destination (city/county) at time t .¹¹ L_{it} , U_{it} , and M_{it} denote land supply (a proxy of rental), degree of urbanization, and local market potential measured respectively by land area (Area), population density (Pop/Area), and GDP per capita (GDP/Pop) of the i^{th} city/county level at time period t . β_s are the parameters (elasticities) to be estimated with expected signs $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 > 0$, and $\beta_4 > 0$. ε is the disturbance term.

Besides, the regional geographic characteristics in both delta regions are believed to be important in directing the pattern of FDI inflows. Since both PRD and YRD are geographically partitioned by the Pearl River into east- versus west-bank and Yangze River into north- versus south-bank, a river-bank dummy variable (D_RB) is used. Hence, the hypothesized model (equation 1) can be rewritten as:

$$FDI_{itr} = \beta_0 D_{itr}^{\beta_1} L_{itr}^{\beta_2} U_{itr}^{\beta_3} M_{itr}^{\beta_4} e^{\beta_6 D_RB} \varepsilon \quad (2)$$

where $D_RB=1$ for PRD-east ($r=1$) and YRD-north ($r=2$) and else (PRD-west or YRD-south)=0. Further in YRD, due to the fact that the YRD cities/counties are located in two provinces, Jiangsu and Zhejiang, a province binary variable (D_P) is also added such that

$$FDI_{itr} = \beta_0 D_{itr}^{\beta_1} L_{itr}^{\beta_2} U_{itr}^{\beta_3} M_{itr}^{\beta_4} e^{\beta_6 D_RB} e^{\beta_5 D_P} \varepsilon \quad (3)$$

where $D_P=1$ for Zhejiang and else (Jiangsu)=0. A Panel data of PRD ($i=1$ to 9) and YRD cities/counties ($i=1$ to 15)¹² for the period of 1993-2003 ($t=1$ to 11) would be used for statistical estimations. The hypothesized models (equations 1-3) would be estimated in log-linear form using OLS and Panel Data Analysis.

2. Industry Complementarity and Structural Adjustments

2.1 Industry Complementarity (I): Industry Specialization Index (ISI)

Industry agglomerations (production clusters) and industry complementarity (specialization) behavior in terms of industrial structure in each PRD and YRD cities/counties in the two delta regions would be estimated and compared following Krugman's (1991b) industry specialization index (ISI) modified using output share as follows:

$$ISI_{jk} = \sum_i |S_{ij} - S_{ik}| \quad (4)$$

S_{ij} and S_{ik} represent the output share of i^{th} industry in j^{th} and k^{th} city; respectively; where $i=1$ to i ; $j=1$ to j ; and $k=1$ to k . $S_{ij} = Q_{ij}/Q_j$ and $S_{ik} = Q_{ik}/Q_k$ where Q_{ij} and Q_{ik} are the values of i^{th} industry output in city j and k , respectively; and Q_j and Q_k are the total output values in city j and k , respectively.

Hence, ISI_{jk} is the sum of the absolute values of the differences in output share (S) over i industries in city j and k . It follows that the range of ISI is '0' to '2' where '0' stands for perfect substitution among i industries (that is, no complementarity or no

specialization) implying identical industry structure while ‘2’ stands for no substitution (that is, complete complementarity/specialization) implying perfect differential industry structure. ISI_{jk} would be computed at both the provincial and city/county level. A total of 30 manufacturing industry groups classified at the ISIC 3-digit level by j and k city/county (that is, $i=1$ to 30; $j=1$ to j ; and $k=1$ to k) is used for the measurement and computations.

2.2 Industry Complementarity (II): Rank (Spearman) Correlation Analyses

To address the limitations of the Krugman (ISI) index, the authors recommended to investigate the same problem by the method of Rank (Spearman) correlation of output share (S).¹³ Following the derivations from above, $S_{ij} = Q_{ij}/Q_j$ and $S_{ik} = Q_{ik}/Q_k$ would be computed and ranked by output share (S_{ij} and S_{ik}) in the order of size, $\forall i,j$ and $\forall i,k$. 30 manufacturing industry groups ($i=1$ to 30) in PRD cities/counties ($j=1$ to 9) and YRD cities/counties ($k=1$ to 16) would be used for the computations. A maximum number of 105 city pairs is expected.

The rank (Spearman) correlation (γ_{jk}) between S_{ij} and S_{ik} , $\forall i,j$ and $\forall i,k$, has a range of ‘0’ to ‘1’ where ‘0’ (that is, zero correlation) represents an absence of substitution (that is, complete complementarity/specialization) or perfect differential industry structure; while ‘1’ implies the reverse is true, that is, perfect substitution (or no complementarity/no specialization) or identical industry structure.

2.3 Industry Structural Adjustments through Time

To further study the adjustments of industrial structure and specialization behavior of GDEs through time, ISI_{jk} and γ_{jk} are further computed for the period of 1987-2003¹⁴ at both provincial and city/county level to facilitate comparisons of the changing industrial (complementarity/specialization) structure among the FDI recipient cities/counties in both PRD and YRD.

2.4 Formation of Effective City Links and Regional Competition

The formation of any effective city link in the delta regions and the related intra-regional competition among cities/counties would be estimated and verified by comparing the industry structure of each city/county relative to the core city in the region. The city links in GDEs are estimated with the help of the estimated industry specialization index (ISI_{jk}) and rank correlation coefficients (γ_{jk}) of city/county pairs to determine any existence of an effective city link in terms of industry structure similarities/complementarities. Two major types of city link are expected: (1) City link of the core city with its peripheral cities – Shanghai with its periphery cities/counties in Jiangsu/Zhejiang and Hong Kong with its peripheral cities/counties in Guangdong; and (2) city link among the periphery cities/counties.¹⁵ Regional competition can be inferred and compared via the results of the formation of any effective city links.

IV. Statistical Results

1. FDI Absorption and Diffusion: Results of OLS and Panel Data Estimations

The estimation results of the hypothesized models 1-3 for PRD and YRD GDEs by OLS and Panel Data Analysis with fixed effects are presented in Table 2. For the OLS estimation results (equations 1.1 and 2.1) in Table 2, all the estimated relations were highly statistically significant (F-Stat; $p < 0.01$) with satisfactory goodness-of-fits ($\text{adj-}R^2 > 0.73$) and the correct expected signs, that is, $b_1 < 0$, $b_2 > 0$, $b_3 > 0$, and $b_4 > 0$. Similar significant statistical results were obtained for the Panel data estimation results, the statistical insignificant F-Stat obtained for PRD equations (equations 1.2-1.3) shows that no fixed effect had obtained while the statistical significant F-Stat for the YRD equations (equations 2.2-2.3) show that fixed panel effects were present.¹⁶

1.1 Functions of the Core Cities: FDI Diffusion via Gravity

The gravity effect of the core cities in PRD (that is, Hong Kong) and YRD (that is, Shanghai) in the promotion of FDI in the periphery region in GDEs was measured by the friction or distance of the city/county from the gravity center. The strength of the frictional effect in YRD GDE was found approximately double that of PRD implying that YRD cities/counties were more elastic in FDI absorption with reference to its gravity center Shanghai. The estimated elasticity due to distance in PRD was about -0.2 (equations 1.1-1.3) and that of YRD was about -0.5 when estimated by OLS (equation 2.1) and -0.37 by Panel estimation (equation 2.2-2.3) (Table 2). In this regard, reducing the friction between the gravity center in both GDEs is highly important but the impacts on FDI absorption and hence, diffusion into the GDEs peripheral cities/counties is much stronger in YRD.

1.2 Effects of Regional Agglomerations in FDI Mobilization

When the other measures of agglomerations in economic activities are taken into consideration, YRD had also demonstrated double its impacts in terms of resources supply, degree of urbanization or urban agglomerations, and market potential and size. The corresponding estimated partial regression coefficients (elasticities) in YRD were all larger than unity, that is, relatively elastic, while that of PRD smaller than unity, that is, relatively inelastic to FDI absorption. These statistical results may well imply that increasing regional agglomerations in YRD is of critical importance to FDI absorption and diffusion.

It is important to point out that natural geographic hurdle may retard the absorption of FDI into the periphery region of GDEs. In PRD, the east bank where the center core, Hong Kong is found, is proven to receive higher FDI than the west by the positive estimated partial regression coefficient ($D_RB > 0$ where $D_RB = 1$ stands for PRD-eastern region; equations 1.1-1.3, Table 2). The same effect is true in YRD where the north bank received significantly lower FDI than the south ($D_RB < 0$ where $D_RB = 1$ stands for YRD-northern region; equations 2.1-2.3, Table 2). Moreover, province effect

in FDI promotion is also found in YRD where Zhejiang had received significantly lower FDI than Jiangsu province.

1.3 Outstanding Cities/Countries in FDI Absorption: Panel Effects

With reference to the above regression results of the Panel data of both GDEs presented in Table 2, some superior or lagged behind cities/counties in terms of FDI absorption can be identified. Since the Panel estimation results of PRD did not support the presence of a fixed effect, all the nine cities/counties should be considered as rather homogenous in their performance in FDI absorption. In the case of YRD, however, the presence of a fixed panel effect suggested that two cities/counties showed significantly higher FDI absorption, that is, Hangzhou and Ningbo in Zhejiang province. Moreover, one city/county showed significantly lower performance in FDI absorption, that is, Suzhou in Jiangsu province (equations 2.2-2.3, Table 2).

2. FDI Agglomerations, Industry Structural Adjustments, and Effective City Link: Results of Industry Specialization Index and Rank Correlation Analyses

2.1 FDI Diffusion and Industry Structural Adjustments

It is believed that FDI absorption and diffusion into the periphery cities/counties would induce industry production agglomerations and hence, local industry structural adjustments of the FDI receiving cities/counties. Both Industry Specialization Index (ISI_{jk}) and rank (Spearman) correlation analyses (γ_{jk}) of industry output between j^{th} and k^{th} cities/counties for both PRD and YRD GDEs for the period of 1987-2003 were computed and the corresponding results are given in Table 3. The statistical findings obtained from both the methods of ISI_{jk} and γ_{jk} showed consistent results. The major findings observed from the results of rank correlation which are easier for interpretations and comparisons, are presented as follows (Table 3):

- (1) Specialization or complementarity of industry output production: Both PRD and YRD diversified and had become more specialized in industry output production since 1987. γ_{jk} of PRD dropped only slightly from 0.629 in 1987 to 0.626 in 2003 while YRD recorded a larger decrease from 0.712 to 0.529, respectively.
- (2) Range of industry specialization: PRD cities/counties showed a wider range of industry specialization in earlier years as suggested by the range of minimum and maximum γ_{jk} values (that is, range in 1987=0.411-0.851 or change $\Delta=0.44$ for PRD; and =0.657-0.82 or change $\Delta=0.163$ for YRD). The corresponding range values in 2003 were 0.355-0.87 or change $\Delta=0.515$ for PRD and 0.162-0.917 or change $\Delta=0.755$ for YRD. Therefore, in recent years, YRD had showed a wider range of industry specialization among cities/counties instead.
- (3) Rate of industry structural adjustments: A slower rate of adjustments in the industry structure among cities/counties over time was observed in PRD as compared to YRD. Statistics showed that PRD adjusted from the change in the correlations of industry structure (Δ) of 0.44 in 1987 to 0.515 in 2003 representing an average adjustment of

0.491 during 1987-2003 while that of YRD from 0.163 to 0.755, respectively, representing an average adjustment of 0.573 during the same period.

- (4) Competition of industry outputs among cities/counties: Although YRD has become more specialized in industry output, it is also observed that some cities/counties within the region have been competing more vigorously with each other in terms of industry output structure. This is reflected by the upper bound of the range of γ_{jk} to equal 0.82 in 1987 and increased to 0.917 in 2003. In this regard, the performance in PRD is more satisfactory in view of its lower competition among cities/counties because the upper bound value of γ_{jk} was found to increase only very modestly from 0.851 to 0.87 in the respective years.

2.2 Effective City Links and Regional Competitiveness

In order to establish whether an effective city link existed in GDEs, both methods of Industry Specialization Index (ISI_{jk}) and rank (Spearman) correlation analyses (γ_{jk}) were used to study the industry output structure between the city core with its peripheral cities. Table 4 presents the results from ISI_{jk} and γ_{jk} of YRD cities/counties by province with its core Shanghai. Statistical results in Table 4 show that Shanghai has established a relatively more effective city link with Zhejiang cities/counties ($\gamma_{jk}=0.706$, on average) than that of Jiangsu ($\gamma_{jk}=0.856$, on average). Such a result may well imply that a higher degree of competition or a less effective city link measured by industry output structure had existed between the core city, Shanghai, with its periphery cities/counties in Jiangsu than that in Zhejiang.

When comparing with PRD, it is obvious that YRD should be under-performed in view of the fact that Hong Kong being the core city of PRD, has well transformed into a service-dominated city center as a metropolis (Tuan and Ng, 1998; 2002). Hence, a near complete specialization in industry structure or alternatively, least competition with its periphery cities/counties in PRD should be expected. That is, a more effective city link in PRD than in YRD is being established. The more effective PRD city link may very much demonstrate the critical functions of the city core in both facilitating FDI into the region and economic integration with its periphery cities/counties to function as an coherent whole in the enhancement of regional competitiveness and sustainable growth of GDE.

V. Conclusion

Recent literatures have provided extensive supports for the positive relations and contributions of FDI to economic growth and development process especially in the large FDI receiving developing countries such as China. This study draws on the existing literatures and evidence and attempts to explain the emergence of the two major GDEs (PRD and YRD) as distinctive cases being different from the rest of China in regional growth in the presence of FDI. We have further argued that regional agglomeration effects as demonstrated by the functions of the city core and the interactions with its periphery cities to act together as an economic entity (CPS) will facilitate mobilization and absorption of FDI in GDEs and hence, sustainable regional growth.

Both Hong Kong and Shanghai were confirmed respectively as the core cities of PRD and YRD GDEs through the gravity (frictions) effect and the dominant factor of FDI absorption and mobilization into the periphery region. The time adjustments of industry structure in GDEs in the presence of FDI to become more specialize or lower degree of similarity in industry output production may well suggest less competition among cities/counties and hence, potentially higher possibility for the cities/counties to materialize their comparative advantage. The formation of an effective city link between the core and its periphery cities/counties would further enhance regional and global competitiveness. The Hong Kong-PRD city link and GDEs growth experience would also well serve as a benchmark for further regional growth in other parts of China, given the possible replication of such a distinctive experience. Using PRD as a reference line, the gradual transformation of Shanghai from an industrial city in the early 1980s to a more service-dominated city core in YRD and the formation of more effective city links, YRD should be able to replicate the PRD experience and even in a larger scale in view of its high potential in growth.

Given the high, rapid economic growth performance of 7-10 % during the past decades, the quest of China's sustainable growth issue will continue to draw much research attention while sustainable FDI inflows has been argued as a critical factor. The implication derived from the findings of this study supported the critical importance of FDI and its spatial agglomeration while the existing mode of diffusion and concentration would continue in order to exploit the regional agglomeration economies in the region. Consequently, regional diversity and disparity will persist in light of the FDI-driven growth. Both PRD and YRD GDEs are unique experience being governed and much determined by the advantages derived from regional agglomerations and therefore, would be rather difficult to replicate. Such a replication, if any, the Beijing and Tianjin region could possibly be the next candidate, as far as existing findings are concerned. To achieve sustainable high growth from a national perspective, other parts of China would have to search for ways other than FDI-driven growth. In this connection, to facilitate the development of local private businesses and stimulation of domestic consumption are perhaps the two most feasible strategies in promoting further China's sustained growth (Tuan and Ng, 2006).

Notes

1. From official definitions, Yangtze River Delta (YRD) economic region has 16 cities/counties including Shanghai and eight cities/counties in Jiangsu province and seven cities/counties in Zhejiang province. It has a total area of 109.6 thousand square kilometers and a registered population of 82.1 million in 2004. Pearl River Delta (PRD) economic region which comprises of nine cities of Guangdong province has an area of 41.5 thousand square kilometers and a registered population of 24.5 million in 2004. YRD and PRD, which account for 1.1% and 0.4%, respectively, of China's national area, produced 21% and 10%, respectively, of national GDP in 2004. Starting from the late 1990s, rapid growth in YRD has been observed. After China's WTO accession in the year of 2001, YRD has taken over the predominant role of Guangdong as the top national regional FDI recipient to become the top ranked regional FDI destination in the nation. It was recorded that in year 2000, YRD received 27.5% of the national inward FDI and PRD 27.7%. However, in 2004, YRD exceeded PRD by receiving 34.6% while PRD 16.5%. Together, both delta economies had accounted for more than half of the total national FDI receipts. For a visual inspection of GDEs by GIS, please see Tuan, Ng, and Lin (2006).
2. For a brief description and comparison of the economic activities of the three delta regions, Pearl River Delta (PRD), Yangtze River Delta (YRD), and Bohai Gulf regions, see Tuan and Ng (2004).
3. See Yao (2006) and Lim (2001) for a review of the related literature on the various approaches to explain the effects of FDI on economic growth. For evidence on the significance of FDI spatial agglomeration, see Ng and Tuan (2006).
4. For discussions of the literatures and empirical evidence using the econometric methods of co-integration, causality, and VAR and particularly with applications to the case of China, see Shan (2002) and Liu, Burrige and Sinclair (2002).
5. Voluminous literatures have emphasized the significant role and spillover effects of FDI in transfer of technology and innovations, see studies such as Teece (1977); Aitken and Harrison (1999); de la Potterie and Lichtenberg (2001); Mytelka and Barclay (2004). The importance of globalization and the global generation of innovations by MNEs were discussed in Archibugi and Iammarino (2004).
6. For a review of literatures on FDI and regional growth theories, see Berthelemy and Demurger (2000), Mullen and Williams (2004), Brock, (2005), and Whalley and Xin (2006).
7. Ng and Tuan (2001) provided a review and evaluation of the FDI policies implemented in Guangdong, the first designed showcase for FDI absorption.
8. The three-tier agglomeration economies generated in a core-periphery system were suggested to include the agglomeration of a core-peripheral system, the city as an

agglomeration, and intra-industry agglomeration (Tuan and Ng, 2002). The effects of agglomeration economies in the diffusion of FDI and formation of networked clusters within the core-periphery economy had been tested (Tuan and Ng, 2001).

9. Tuan and Ng (2003) established that agglomeration economies in various forms have been the key mechanism in facilitating FDI into a region in the host country.
10. Hong Kong and Shanghai are respectively considered as the cities of the two delta regions, PRD and YRD (Tuan and Ng, 1995, 2001, 2004a, 2004b; Zhao, 2001).
11. Other than PRD and YRD GDEs, the same model (equation 1) is also applied to Beijing-Tienjing-Heibei (BTH) region to test empirically whether such a core-periphery framework will also be applicable to the BTH region as well.
12. According to government definitions, PRD in Guangdong province consists of nine cities/counties by administrative zones, namely, Guangzhou, Shenzhen, Zuhai, Weizhou, Dongguan, Zhongshan, Jiangmen, Foshan, and Zhaoqing; and YRD in Zhejiang and Jiangsu (provinces) consists of Shanghai and 15 other cities/counties, namely, Hangzhou, Ningpo, Jiasiang, Wuzhou, Shiusing, Zhoushan, Taizhou, Nanjin, Wuxi, Changzhou, Suzhou, Nantung, Yangzhou, and Chengjiang. PRD together with its core city Hong Kong and YRD with its core city Shanghai are recently officially identified as 9+1 and 15+1.
13. The limitations of the index of industry specialization (Krugman, 1991b) include first, as recognized by Krugman, the computations of the index involve high aggregations of data and hence, under estimations of the actual level than that of when more disaggregated data used. Second, the range of the index from '0' to '2' is less efficient both in use and interpretation when compared with that of correlation from '0' to '1'.
14. In 1987, economic openings of the coastal regions in the 'Large' PRD (Guangdong) via tax preferentials and YRD via Economic Strategic Development policy (Tuan and Ng, 1995) were implemented. For details of various developmental stages of opening and implementations of preferential FDI policies, see Ng and Tuan (2001).
15. The industry structure (and city link) of Hong Kong with Guangdong cities/counties was not computed because of the too obvious differential industrial structure that Hong Kong, as the service-oriented core city of PRD, has more than 85% of its GDP generated by the services sector.
16. The same model is applied to the estimation of the FDI behavior of Bohai delta region which include Beijing, Tianjing, and Hebei (BTH) by assuming Beijing as the center core using both OLS and Panel data estimation for the period of 2000-2003 due to data availability. No statistical significance was found with respect to the gravity and regional agglomeration effects implying that BTH has not followed the same model of FDI absorption and diffusion as in the two GDEs.

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Table 1 Globalized Delta Economies in China: Basic Economic Indicators (1993-2003)

	South China: Greater Pearl River Delta[#]		East China: Greater Yangtze River Delta[#]		
Indicator	Hong Kong	Guangdong	Shanghai	Jiangsu	Zhejiang
Population (mil) (2003)	680.3	7723.4	1711.0	7405.8	4551.6
<i>Output Performance</i>					
Real GDP Growth* (%)	0.4 1.3	15.8 10.6	15.4 9.2	18.5 10.8	15.6 12.5
Per Capita Real GDP Growth* (%)	0.1 -0.1	14.9 8.5	14.8 8.8	15.6 9.5	17.4 10.9
Current GDP** (2003)	1564.1	1648.0	756.0	1544.7	1206.3
<i>Trade Performance**</i>					
Total Imports (2003)	2257.2	1306.7	639.2	545.3	198.2
Total Exports (2003)	2178.0	1528.5	484.8	591.4	416.0
Re-exports (2003)	2025.9	-	-	-	-
<i>Industry Base*</i>					
Manufacturing/GDP* (%)	3.91 5.94	53.6 50.5	50.1 51.3	54.3 51.4	53.6 50.5
Service/GDP* (%)	85.2 81.4	38.4 37.5	48.4 46.6	36.8 35.0	37.1 36.0
<i>Investment</i>					
Fixed Assets/GDP* (%)	22.1 -1.8	36.9 36.2	39.2 50.8	31.8 30.6	36.9 36.2
FDI** (2003)	136.3	155.8	58.5	158.0	54.5
<i>Wages and Prices</i>					
Composite CPI (2003) (1993=100)	118.0	144.9	172.8	157.3	161.8
Real Growth of Wages Index*	0.7 1.5	12.2 10.1	13.7 8.6	15.2 10.8	12.3 12.8

Notes: * figures on first line in 1993 price and second line 1993-2003 average; **unit=US\$100mil; [#]due to the limitations and difficulties in compiling data at the city/county level, Guangdong is used to approximate the “Greater” PRD (GPRD) while Shanghai, Jiangsu, and Zhejiang to approximate “Greater” YRD (GYRD). Regardless of the types of economic data, the approximation is nearly accurate because economic activities and performance have concentrated in both the PRD and YRD cities/counties in GPRD and GYRD regions, respectively.

Source: Hong Kong Census and Statistics Department and Guangdong, Shanghai, Jiangsu, Zhejiang Provincial Statistics

Table 2 Gravity Analyses of Globalized Delta Economies: OLS and Panel Data Estimations (1993-2003)

Region	PRD			YRD		
	(1.1)	(1.2)	(1.3)	(2.1)	(2.2)	(2.3)
Variable	OLS	Panel	Panel	OLS	Panel	Panel
Fixed Effect:						
CS (N)	-	Nil	Nil	-	Yes ^(b1)	Yes ^(b2)
TS (T)	-	Nil	-	-	Nil	-
Intercept	9.118 [#] (0.465)	8.994 [#] (0.674)	9.140 [#] (0.641)	4.666 [#] (0.947)	4.541 [#] (0.938)	4.678 [#] (0.914)
Distance	-0.202 [#] (0.069)	-0.199 ^{**} (0.084)	-0.196 ^{**} (0.081)	-0.502 [#] (0.095)	-0.371 [#] (0.100)	-0.379 [#] (0.099)
Area	0.507 [#] (0.063)	0.514 [#] (0.070)	0.508 [#] (0.069)	1.343 [#] (0.100)	1.185 [#] (0.108)	1.199 [#] (0.105)
Pop/Area	0.552 [#] (0.080)	0.577 [#] (0.089)	0.561 [#] (0.086)	1.171 [#] (0.251)	1.108 [#] (0.245)	1.126 [#] (0.240)
GDP/Pop	0.474 [#] (0.060)	0.475 [#] (0.088)	0.479 [#] (0.085)	1.187 [#] (0.106)	1.916 [#] (0.247)	1.859 [#] (0.238)
D_RB	0.442 [#] (0.075)	0.434 [#] (0.082)	0.437 [#] (0.081)	-1.051 [#] (0.145)	-0.386 (0.262)	-0.437 [#] (0.254)
D_P	-	-	-	-1.123 [#] (0.130)	-1.001 [#] (0.132)	-1.009 [#] (0.130)
Length: N,T		9, 11	9, 11		15, 11	15, 11
F-Stat ^(a)	64.47 [#]	0.630	0.39	146.18 [#]	1.75 [#]	2.62 [#]
Adj-R ²	0.734	0.781	0.825	0.850	0.886	0.881
DF	88	70	79	155	131	141
RMSE	0.347	0.361	0.304	0.557	0.528	0.521

Notes: Dependent variable (Y)=Realized FDI; all variables in log-linear form; [#] and ^{**} represent statistical significance of $p < 0.001$ and $p < 0.05$, respectively; D_RB is a dummy where D_RB=1 for east bank of Pearl River in PRD and else (west-bank)=0, and D_RB=1 for north bank of Yangze River in YRD and else (south-bank)=0; D_P is a province dummy with binary values where D_P=1 for Zhejiang and else=0 (that is, Jiangsu);

^(a) testing of presence of fixed effects for Panel estimations;

^(b1) the two YRD cities/counties (CS) with statistical significant positive effects are CS1-2 where CS1=Hangzhou (est-b=1.238, est- σ =0.435; $p < 0.01$) and CS2=Ningpo (est-b=0.614, est- σ =0.357; $p < 0.10$); and

^(b2) the three YRD cites/counties (CS) with statistical significant effects (CS1-2 and 11): CS with positive effects are CS1-2 where CS1=Hangzhou (est-b=1.154, est- σ =0.422; $p < 0.01$) and CS2=Ningpo (est-b=0.577, est- σ =0.347; $p < 0.10$); and city/county with statistical significant negative effects is CS11 where CS11=Suzhou (est-b= -0.402, est- σ =0.239; $p < 0.10$).

Table 3 Industry Complementarity Structure and Adjustments in PRD and YRD Cities/Counties: Industry Specialization Index and Rank Correlations (1987-2003)

Year	PRD Cities/Counties				YRD Cities/Counties			
ISI_{jk}	N	Mean	Range (Min-Max)	Change (Δ)	N	Mean	Range (Min-Max)	Change (Δ)
1987	21	0.709 (0.110)	0.582-0.774	0.189	3 [^]	0.809 (0.186)	0.542-1.107	0.565
1992	36	0.812 (0.179)	0.374-1.131	0.757	36	0.636 (0.198)	0.353-1.114	0.701
1997	36	0.761 (0.187)	0.449-1.400	0.951	91	0.724 (0.209)	0.274-1.255	0.981
2000	36	0.775 (0.184)	0.312-1.104	0.792	91	0.819 (0.234)	0.313-1.306	0.993
2003	36	0.855 (0.277)	0.279-1.385	1.106	105	0.899 (0.237)	0.379-1.481	1.102
γ_{jk}								
1987	21	0.629 (0.140)	0.411-0.851	0.440	3 [^]	0.712 (0.093)	0.657-0.820	0.163
1992	36	0.655 (0.131)	0.394-0.838	0.444	36	0.672 (0.127)	0.383-0.899	0.516
1997	36	0.619 (0.118)	0.335-0.807	0.472	91	0.605 (0.153)	0.219-0.916	0.697
2000	36	0.616 (0.155)	0.279-0.863	0.584	91	0.555 (0.161)	0.173-0.909	0.736
2003	36	0.625 (0.128)	0.355-0.870	0.515	105	0.529 (0.175)	0.162-0.917	0.755

Notes: standard errors in parentheses; N denotes number of city/county pairs.

Table 4 Industry Complementarity Structure in YRD: City Link by Region by Province (1987-2003)

Year	ISI _{jk}		γ_{jk}	
	Core City (Shanghai) with		Core City (Shanghai) with	
	Zhejiang Cities	Jiangsu Cities	Zhejiang Cities	Jiangsu Cities
1987	0.610 [^]	-	0.652 ^{# ^}	-
1992	0.599	0.453	0.699 [#]	0.871 [#]
1997	0.489	0.411	0.740 [#]	0.879 [#]
2000	0.535	0.420	0.722 [#]	0.868 [#]
2003	0.661	0.475	0.663 [#]	0.804 [#]
1992-2003 Average	0.571	0.440	0.706	0.856

Notes: ISI_{jk} has a range of 0-2 where '0' represents no complementarity/no specialization of industry structure (perfect substitution implying identical industry structure) and '1' complete complementarity/specialization (no substitution implying complete differential industry structure);

[^] less comparable due to limited number of observations (limited FDI) in early years;

[#] represents γ_{jk} coefficients are statistically significant at $p < 0.001$ with a range 0-1 where '0' represents no correlation (that is, complete complementarity/specialization or no substitution implying differential structure) and '1' perfect correlation (that is, no complementarity/no specialization implying perfect substitution and identical structure).