REGIONAL ECONOMIC GROWTH AND FACTOR CONTRIBUTIONS IN THE ZHUJIANG DELTA REGION OF SOUTH CHINA

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Abstract: *This paper assesses the dynamics of spatial development in the Zhujiang delta region and the underlying causes of such dynamics. The region shows increasing regional differential in the 1980s, but "σ convergence" occurred in the early 1990s. Four types of development areas are identified. The production function approach is used to estimate the contributions of various factors, such as local capital, non-local investment, labour force growth and technical progress, to the economic growth among various areas in the region. Local capital was the most important factor in most areas throughout the period 1980-1994, but its importance declined after 1985. The importance of non-local capital increased steadily especially in less developed growing areas. Labour growth was an important factor in more developed growing areas while technology was also important in the period 1985-1994.*

Keywords: Zhujiang delta, regional development, factor contribution, local capital, non-local capital.

Introduction

The Zhujiang delta (Pearl River Delta) region has experienced rapid growth since the early 1980s and has become one of the main economic growth centers in China. Zhujiang delta had a high GDP per capita of 26075 yuan (US$ 3145) in 1998, more than four times the national average of China. The implementation of economic reforms and open door policy, the coastal development strategy, non-local direct investment (NLDI[1]), local initiative, adaptation and innovation, and advantageous location and the Hong Kong factor have been identified as the key factors behind such rapid growth in the region and in China in general (Fan, 1995a; 1995b; Sung et al., 1995; Soulard, 1997; Chan, 1998; Li, 1998; Weng, 1998; Yeung and Chu, 1998; Shen, 1999a; Shen et al, 1999; Shen et al., 2000; Gu et al., 2001). Direct investment from Hong Kong and Macau has been identified as an important driving force in Zhujiang delta (Eng, 1997; Sit and Yang, 1997). The key role of local governments during substantial institutional changes has also been identified (Lin, 1997; Wang, 1997; Shen, 1999b), similar to Oi's (1999) notion of "Local State Corporatism" in other parts of rural China. Due to decentralization and realignment of property rights through decollectivization and fiscal reform, local officials at the village, township and county levels are motivated to initiate and promote local economic development. In other words, when the institutional environment is favorable, local and non-local capital investments, labour mobility and factor productivity will increase, resulting in rapid regional economic growth.

A major issue in regional studies is whether and why the gap in the level of development between different areas is narrowing or widening (Friedmann and Alonso,

1975; Gilbert, 1976; Zhang and Shen, 1991; Alden and Boland, 1996). There has been a growing interest in economics and geography in the long-term convergence in per capita incomes among sub-national regions and among countries (Barro and Sala-i-Martin, 1995). There have been many studies on unbalanced development at the provincial level in China (Pannell, 1988; Fan, 1992; Zhou, 1993; 1996; Wei, 1996; 1998; 1999; Zhao, 1996). Most studies on Zhujiang delta focused on the region's overall growth; only a few studies have examined unbalanced development within it. Fan (1995b) identified the rising level of development in Shenzhen and Zhuhai in the early 1990s. Xu et al. (1999) found decreasing regional disparity within the Zhuiiang delta region in the 1990s.

Identifying the causes of different regional dynamics is important, especially in terms of policies for addressing the problem of uneven regional development. However, only a few studies have attempted to explain the reasons behind balanced/unbalanced development in Zhujiang delta. Fan (1995a) applied the concepts of development from above, below and outside to explain differential regional development in Guangdong and Jiangsu, using regression analysis to identify key determinants of per capita gross value of industrial and agricultural output. Li (1995) conducted an interesting study, using relatively simple elasticity measures, to analyze capital efficiency in the delta. But little has been done to assess the contributions of factors such as labour, local capital, non-local capital and technology to the economic growth of the Zhujiang delta region. This paper will build upon the existing literature and use a production function approach to decompose the contributions of various factors behind regional growth (Beeson, 1987; Yuen, 1998; Wang and Hu, 1999).

This paper has two main objectives. First, it will examine the dynamics of spatial development in the Zhujiang delta region. Second, the paper will identify the roles of contributing factors underlying regional economic growth in the region. The factors considered in the analysis include local and non-local investment, labour input, scale economies and technical progress as have been identified in other studies (Beeson, 1987; Spence and Vagionis, 1994). The rest of the paper is organized as follows. The research area and the data used in this study will be examined in the next section. Section three will examine the dynamics of regional differentials in the region for the period 1980-1998. Section four will discuss the methodology used to analyze the contributions of various factors and the detailed results. Some conclusions will constitute the final section.

Research Area and Data

In this paper, the Zhujiang delta region refers to the Zhujiang Delta Economic Region formally designated by the government of Guangdong province in 1994 (Lu, 1995). The region consists of 28 area units in 1998, including six urban areas of prefecture-level cities that administrate other county-level units, three prefecture-level cities, 16 county-level cities and three counties (Figure 1).

The data for the 28 area units for this research have been collected from official sources (Guangdong Statistical Bureau, 1992; 1995; 1996; 1999). Data for years 1980, 1985, 1990, 1991, 1993, 1994, 1998 were available. The analysis in the paper will cover the period 1980-1998, but detailed analysis of factor contributions will focus on 1980-1994

as the data for this period were relatively consistent. The accuracy of the official Chinese statistical data is often questioned by researchers. But the data used in this research are broadly consistent with personal observations, such as about the development of Shenzhen, and appear to be highly reliable. The official statistical data are the only source of systematic data for the 28 area units needed for the kind of analysis in this paper. Some adjustments to the available data are necessary for the analysis of the regional development in the region.

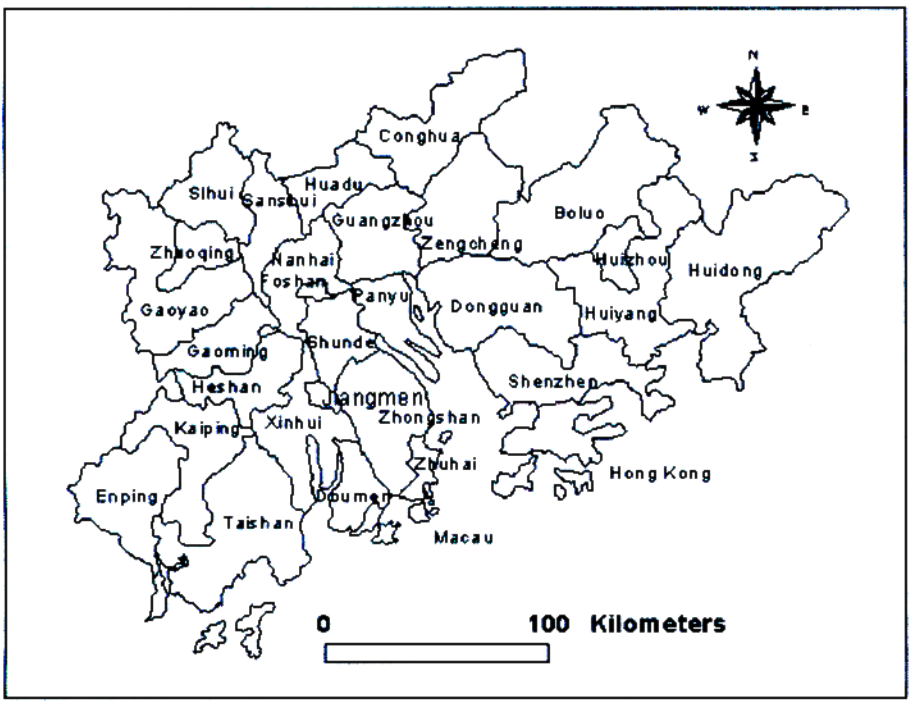

Figure 1. County-level area units in Zhujiang delta.

First, GDP data are estimated on the basis of the value added data for the period 1980-1994, since a complete set of GDP data is not available for all sub-regions. These value added data generally only cover five so-called production sectors in China, including agriculture, manufacturing, construction, transportation, wholesale and retailing. For Guangdong province, the ratio of value added to GDP ranged from 1.1291 in 1980 to 1.3407 in 1994. The conversion ratios used in the paper are based on the Guangdong province for 1980-1985 and Zhujiang delta for 1990, 1991 and 1994. The 1998 GDP data are converted to 1990 price using an inflation ratio derived from the GDP in current price and the GDP in 1990 price calculated from the GDP growth index of Guangdong.

Second, the data on capital stock for various areas have to be estimated from initial capital stock and investment data in various years. The data on the total social capital investment are available and are converted to 1990 price using the retail price index of Guangdong. It is found that only 71.5 percent of Guangdong's capital investment in

1990 was turned into fixed capital; accordingly, this ratio is used to estimate the fixed capital formed from investment each year. Non-local investment (NLI), except loans from outside Mainland China, is apparently not included in the official figure of total capital investment. It is likely that certain amount of NLI originated in mainland China but was routed via Hong Kong in order to take advantage of the incentives for NLI. But it is not possible to identify the exact amount of such investment. The NLI contribution may be slightly overestimated by ignoring this problem. NLI data are converted to yuan using the official yuan/US$ exchange rate in various years (SSB, 1997). The exchange rates are 1.7051 yuan per US$ in 1980 and 8.6187 yuan per US$ in 1994 respectively. The same fixed capital formation rate of 71.5 percent is used for NLI.

Regional capital stocks in subsequent years are estimated by adding formed capital resulting from investment in each year. In calculating the fixed capital stock of the current year, a depreciation rate needs to be applied to the capital stock of the previous year. Depreciation rate depends on the life period of fixed capital, which is usually in the range of 10-30 years (Zhang and Shen, 1993). There is no unique and official depreciation rate available for the region. Here, it is assumed that the average life period of fixed capital is 20 years, and a depreciation rate of 5 percent is used. A low depreciation rate will retain more old capital in the current capital stock, and *vice versa*. In rapidly growing regions like Zhujiang delta, capital stock grows rapidly and the share of old capital would be small in the current capital stock. Thus current capital stock would not be very sensitive to the depreciation rate used. The fixed capital stock of local capital and the fixed capital stock of NLI can be calculated respectively, which can be compared in order to assess the relative importance of local capital and NLI.

Under the household registration system in China, each person is assigned a hukou (household registration) stating his/her place of residence. Since the 1980s, many people have left their hukou places but have not transferred or could not transfer their hukou to their new places of residence. Therefore, there is a mismatch between the hukou population and the resident population of an area. The official population statistics usually only report hukou population, though there may be large non-hukou population whose hukou is elsewhere. In this paper, this problem is partly avoided by using only employment data in the production function analysis. Employment data report all employees in various economic sectors. It is likely that large proportions of migrant workers are included but not every non-hukou migrant worker is reported. Such employment data are available for the delta's 28 areas. But employment data are not used to calculate GDP per capita, since the former exclude the non-working population. Instead, official population data are used to calculate GDP per capita, which may be over- or under-estimated in some areas. This problem may not unduly affect the general pattern of regional development in terms of GDP per capita, because in general GDP growth rate is higher than population growth rate. The data on the number of employees, together with GDP data, capital investment and capital stock data, permit a comprehensive analysis of the regional development in the Zhujiang delta region. In the causal analysis, the cross sectional data are pooled together to estimate production functions, as the time series data of six years do not allow separate estimations of production function for each of the 28 areas.

Uneven Regional Development in Zhujiang Delta

There has been a growing interest in the long-term convergence in per capita incomes among regions (Barro and Sala-i-Martin, 1995). In the expanding literature on the issue of "convergence", two kinds of convergence have been identified. "β-convergence" occurs if there is negative correlation between regional growth rate and the level of per capita income at the beginning of the period. "σ convergence" occurs if the variance of relative per capita income decreases. Based on the "σ convergence" approach, this section will use coefficient of variation, an indicator widely used in the literature, to examine the trends of uneven regional development in the Zhujiang delta.

GDP per capita is the key indicator used in this section. Table 1 presents the mean, standard deviation and coefficient of variation (CV) of GDP per capita. It shows that the regional differential initially increased in the period 1980-1985 as the coefficient of variation increased from 0.78 in 1980 to the peak of 1.14 in 1985. The regional differential then declined gradually from 1985 to 1998, during which "σ convergence" occurred. By 1998, the coefficient of variation was 0.87 smaller than that of 1985 but was still greater than that of 1980.

Table 1. Measures of unbalanced regional development in terms of GDP per capita 1980-1998 (in 1990 price).

Year	Mean (Yuan)	Standard deviation (Yuan)	CV
1980	1036	811	0.78
1985	2389	2718	1.14
1990	4859	5516	1.14
1991	6114	6814	1.11
1993	10034	10861	1.08
1994	11722	11525	0.98
1998	14670	12708	0.87

Data sources: Processed from *Guangdong Statistical Bureau* (1992; 1995; 1999).
Notes: CV = coefficient of variation.

In addition to simple summary measures of convergence, it may be useful to examine the detailed paths of economic growth in various areas. Figures 2 and 3 present GDP per capita for various areas in the region in 1980 and 1998 respectively. According to Figure 2, in 1980, Guangzhou, Zhuhai, Foshan and Jiangmen had the highest level of GDP per capita, while the least developed areas were located in the northeastern and northwestern parts of the region. By the year 1998 (Figure 3), there were two significant changes. Shenzhen joined the top area group with the highest GDP per capita while Jiangmen was downgraded to the second group. Areas in the southwestern part of the region also became the least developed areas. There is a clear pattern of a more developed core area around the mouth of Zhujiang river and a less developed ring along the border of the region.

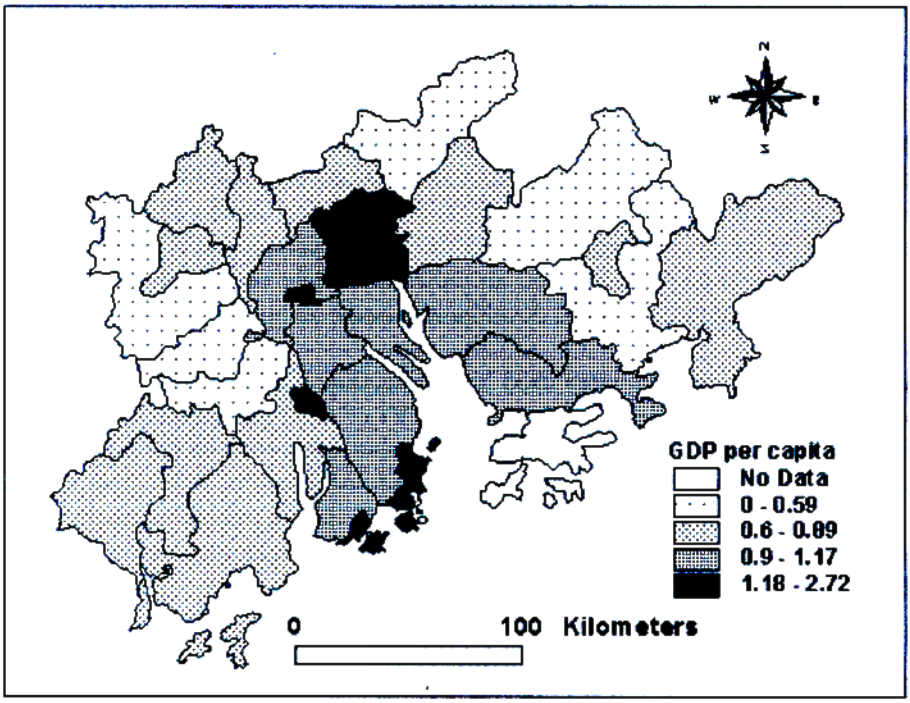

Figure 2. GDP per capita in Zhujiang delta in 1980 (thousand yuan).

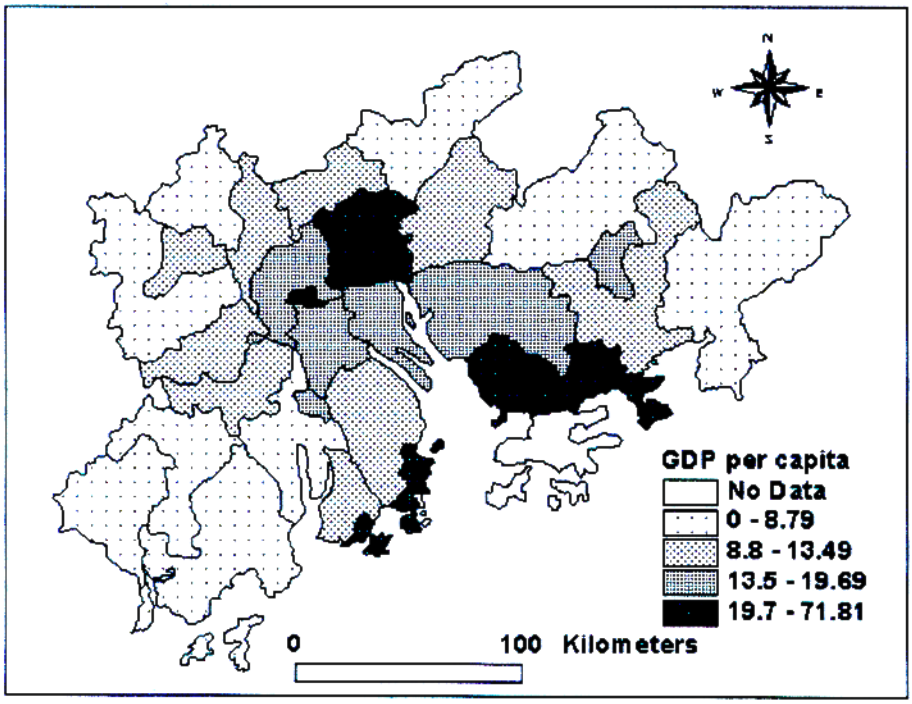

Figure 3. GDP per capita in Zhujiang delta in 1998 (thousand yuan).

Location quotients of GDP in terms of population are also calculated for various areas and are presented in Table 2. If the location quotient of an area is greater than one, then the area has a greater share of GDP than its share of population, meaning that its GDP per capita is above the average of the entire region.

Table 2. Location quotients of GDP in 1980-1998 and GDP per capita in 1998 in Zhujiang Delta.

Area	1980	1985	1990	1994	1998	GDP per capita in 1998 [a] (1000 Yuan)	Area type[b]
Shenzhen	0.92	3.01	3.81	4.24	4.31	71.81	A_1
Zhuhai	1.10	2.13	2.77	3.10	2.13	35.51	A_1
Huizhou	0.53	0.54	0.98	1.14	1.10	18.34	A_2
Panyu	0.99	1.07	0.91	0.94	1.05	17.43	A_3
Nanhai	0.95	1.12	1.04	0.97	1.01	16.84	A_3
Dongguan	0.79	0.85	1.12	0.77	0.91	15.26	B_1
Huadu	0.58	0.60	0.51	0.88	0.81	13.49	B_1
Sanshui	0.51	0.70	0.90	0.98	0.64	10.75	B_1
Gaoming	0.37	0.39	0.58	0.61	0.62	10.35	B_1
Huiyang	0.46	0.28	0.58	0.59	0.60	10.04	B_1
Heshan	0.49	0.42	0.55	0.61	0.58	9.74	B_1
Gaoyao	0.44	0.54	0.46	0.40	0.53	8.78	B_1
Zengcheng	0.59	0.39	0.40	0.63	0.61	10.15	B_2
Conghua	0.37	0.31	0.36	0.36	0.40	6.73	B_2
Boluo	0.33	0.28	0.35	0.33	0.35	5.82	B_2
Guangzhou	2.30	1.83	1.32	1.31	1.24	20.76	C
Foshan	1.62	2.13	2.29	1.56	1.18	19.71	C
Jiangmen	1.71	1.57	1.44	1.03	1.11	18.50	C
Shunde	0.97	1.15	0.98	0.91	0.94	15.72	D_1
Zhongshan	0.77	0.81	0.96	0.74	0.73	12.22	D_1
Zhaoqing	0.73	0.72	0.80	0.78	0.72	12.00	D_1
Kaiping	0.51	0.42	0.50	0.53	0.48	7.94	D_1
Doumen	0.99	1.18	0.98	0.51	0.53	8.82	D_2
Sihui	0.54	0.56	0.56	0.48	0.44	7.27	D_2
Huidong	0.63	0.46	0.48	0.42	0.41	6.90	D_2
Xinhui	0.57	0.57	0.62	0.53	0.41	6.82	D_2
Taishan	0.51	0.50	0.49	0.38	0.34	5.73	D_2
Enping	0.66	0.55	0.52	0.38	0.32	5.33	D_2
Total	1.00	1.00	1.00	1.00	1.00	16.68	

Data Source: Calculated by the authors.

Notes:

a. GDP per capita in 1990 price.

b. area types: A: more developed growing areas
A1: most developed rapidly growing areas
A2: more developed rapidly growing areas
A3: more developed slowly growing areas
B: less developed growing areas
B1: less developed rapidly growing areas
B2: less developed slowly growing areas
C: more developed relatively declining areas
D: less developed relatively declining areas
D1: less developed relatively slowly declining areas
D2: less developed relatively rapidly declining areas

All the 28 areas can be classified into four types, according to the dynamics of their location quotients and their relative positions in the Zhujiang delta region. In Table 2, which includes also GDP per capita in 1998, the 28 areas are sorted by area types. According to Figure 4, growing areas (area types A and B) were mostly in the eastern wing of the delta region, while relatively declining areas (area types C and D) were in the western wing.

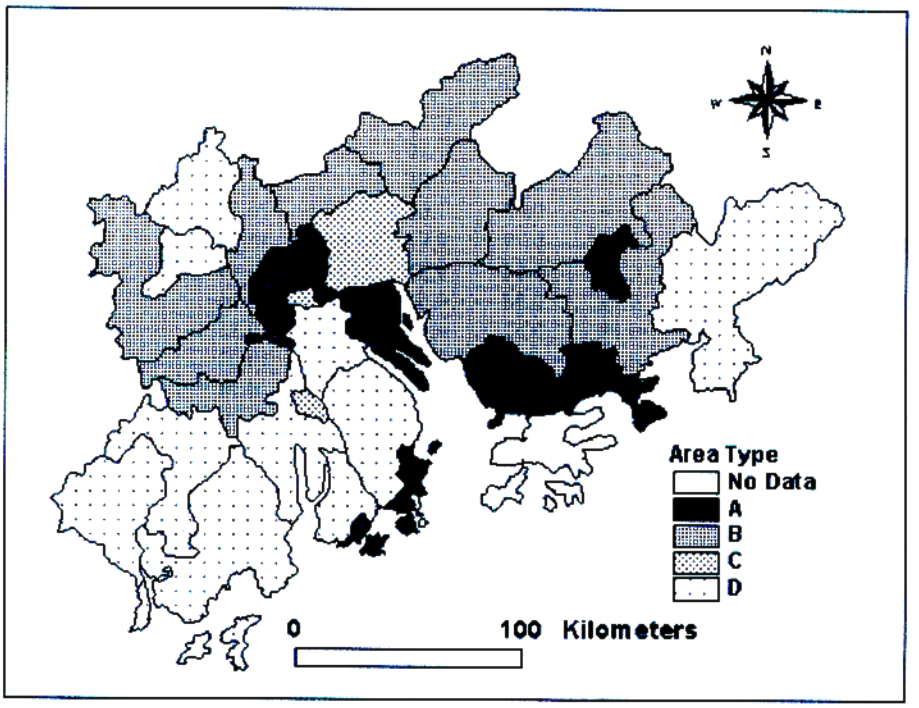

Figure 4. Area types in the Zhujiang delta region.

Type A (more developed growing areas) areas show an increase in location quotient and relative level of development, and their GDP per capita was above the regional average by 1998. There are three sub-types. Shenzhen and Zhuhai belong to sub-type A_1 (most developed rapidly growing areas) -- their GDP per capita was around the regional average in 1980 but increased to more than twice the regional average in 1998. Huizhou belongs to sub-type A_2 (more developed rapidly growing areas), whose GDP per capita increased dramatically from around half the regional average to just above the regional average by 1998. Panyu and Nanhai belong to sub-type A_3 (more developed slowly growing areas), whose GDP per capita was around the regional average in 1980-1998 and whose relative positions had slightly improved during this period.

Type B (less developed growing areas) areas show an increase in location quotient and relative level of development, but their GDP per capita was still lower than the regional average by 1998. There are two sub-types. Dongguan, Huadu, Sanshui, Gaoming, Huiyang, Heshan and Gaoyao belong to sub-type B_1 (less developed rapidly growing

areas) with rapid increase in their relative levels of development. Zengcheng, Conghua and Boluo belong to sub-type B_2 (less developed slowly growing areas) with slight improvement in their relative levels of development.

Type C (more developed relatively declining areas) areas show a decrease in location quotient and relative level of development, while their GDP per capita remained above the regional average in 1998. Guangzhou, Foshan and Jiangmen belong to this type. They were more developed areas in the region but their relative levels of development had declined.

Type D (less developed relatively declining areas) areas show a decrease in location quotient and relative level of development, and their GDP per capita was also below the regional average in 1998. There are two sub-types. Shunde, Zhongshan, Zhaoqing and Kaiping belong to sub-type D_1 (less developed relatively slowly declining areas) with slight decline in their relative levels of development. Doumen, Sihui, Huidong, Xinhui, Taishan and Enping belong to sub-type D_2 (less developed relatively rapidly declining areas) with dramatic decline in their relative levels of development.

Overall, there were three developed areas that became even more developed and six less developed areas that became relatively less developed in the period 1980-1998. The dynamics of these areas had increased the overall regional disparity in the region. On the other hand, there were also three developed areas which became relatively less developed and six less developed areas which became more developed in the period 1980-1998. The dynamics of these areas had reduced the overall regional disparity in the region. A net result is that regional disparity in the delta was still higher in 1998 than in 1980, while regional disparity increased in the 1980s and decreased in the 1990s.

The evolving spatial economic structure in the Zhujiang delta region can also be revealed through an analysis of the economic strength of various areas in terms of their GDP shares in the total GDP of the region. Table 3 presents the GDP shares of major areas in the region during the period 1980-1998.

Guangzhou was the dominant regional economic centre in the Zhujiang delta prior to the 1980s. Before the economic reforms, major capital investment and construction concentrated in this provincial capital especially in its state owned sector. By 1980, at the beginning of the reform period, Guangzhou accounted for 42.8 percent of the total GDP of the Zhujiang delta region and only 18.86 percent of the region's population. Guangzhou was clearly the leading economic center in the region. There were only five other areas each accounting for 4-6 percent of the region's total GDP. They were Panyu, Dongguan, Zhongshan, Nanhai and Shunde, together accounting for 23.68 percent of the region's GDP. No area in the region posed any serious challenge to the leading position of Guangzhou.

In subsequent years, regional development in the Zhujiang delta was characterized by the relative rise and fall of Shenzhen and Guangzhou respectively. The GDP share of Guangzhou declined rapidly from 42.80 percent in 1980 to 24.44 percent in 1990 and further to only 22.20 percent by 1998. The leading position of Guangzhou in the region was significantly weakened and faced increasing competition from Shenzhen. The GDP

share of Shenzhen in the region increased dramatically from only 1.82 percent in 1980 to 13.56 percent in 1990 and 22.04 percent in 1998. By 1985, Shenzhen had become the second largest economic power in the region, though its GDP was still only 1/4 of that of Guangzhou. By 1998, Shenzhen's GDP share had become very close to that of Guangzhou and was significantly greater than other areas in the region. A new spatial economic structure with two economic centres in the region has emerged. The combined GDP share of Guangzhou and Shenzhen was as high as 44.24 percent, while the third largest economic center, Dongguan, accounted for only 6.08 percent of the region's total GDP in 1998. A causal analysis in the next section seeks to explain the rapid and uneven regional development in the Zhujiang delta.

Table 3. Shares of GDP by selective areas in Zhujiang Delta region 1980-1998.

Area	1980	1985	1990	1994	1998
Guangzhou	42.80	34.23	24.44	23.69	22.20
Panyu	4.00	4.29	3.64	3.78	4.18
Shenzhen	1.82	8.19	13.56	19.00	22.04
Zhuhai	0.86	1.88	3.02	4.90	3.81
Dongguan	5.47	5.88	7.65	5.18	6.08
Zhongshan	4.80	4.87	5.75	4.36	4.26
Nanhai	4.68	5.41	5.04	4.69	4.83
Shunde	4.73	5.54	4.69	4.29	4.43
Subtotal	69.16	70.29	67.79	69.89	71.83
Other areas	30.84	29.71	32.21	30.11	28.17
Total	100	100	100	100	100

Data Source: Calculated by the authors.

Factor Contributions in Regional Development

The basic inputs in the regional economy include land, capital, labour, technology and management and can be from local, non-local or foreign sources. Government policy, institutional changes and social networks are also important factors of regional development. However, some inputs and factors are usually not explicitely considered in regional economic modelling for the following reasons. Land input is crucial in agricultural sector, but the quality and value of land vary substantial among agricultural, industrial and residential land uses. In a typical regional economy, some portion of the capital is used to buy or rent land for development; therefore, land input is at least partially accounted for by capital investment. On the other hand, aggregated land area in a region is usually fixed. Thus, land input is not included in the analysis in this paper. Secondly, the technology factor in regional economic modelling is defined in a broad sense. It refers to all changes other than labour and capital that are explicitly modelled and their contribution is usually refereed to as residual. Advances in knowledge, economies of scale, improved allocation of resources, reduction in the age of capital, decrease in the time lag in applying the knowledge, organizational improvement, increased education and training, and learning by experience all contribute to economic development, and their contributions are often identified as components of technical progress (Nafziger, 1990; Todaro, 1997). The contribution of scale economy will be

estimated separately in this paper. Thirdly, government policy, institutional changes and social networks have substantial impacts on the regional development process both in China and elsewhere (Amin, 1999; Lin, 1997). They may facilitate capital investment or improve the efficiency of regional economy. The contributions of these factors are partly accounted for by capital growth and partly by technical progress in a broad sense. Quantitative data of such variables are generally unavailable for various area units in the delta. Therefore, no attempt will be made in this paper to estimate the contributions of such factors explicitly. Qualitative studies, using institutional approach for example (Amin, 1999; Oi, 1999), that focus on such factors would complement the quantitative analysis in this paper and would certainly enhance the understanding of regional development. In future research, it would also be useful to analyze the relationship between government policy and institutional changes on one hand and the capital growth and factor productivity on the other.

Some studies have already analyzed and modeled regional economic growth with an attempt to identify the contributions of capital, labour and productivity on regional growth (Beeson, 1987; Treyz, 1993; Spence and Vagionis, 1994). Various forms of production functions with different theoretical assumptions are available, but they generally produce close estimates of parameters (Zheng and Fan, 1999). This paper adopts a well-known Cobb-Douglas production function, which was also used in recent studies of regional development in Guangdong and China (Yuen, 1998; Wang and Hu. 1999). The regional economy can be expressed by the production function as follows:

$$Y = ce^{vT} L^a K^d \tag{1}$$

Here Y is the regional GDP, L the labour force employed, K the capital stock, T the time, c the constant parameter, a the output elasticity of labour, d the output elasticity of capital, and v the rate of technical change. These parameters can be estimated using time-series or cross sectional data of the regional economy.

Equation (1) can be logrithmatically differentiated with respect to time:

$$\dot{Y} = a\dot{L} + d\dot{K} + v \tag{2}$$

Here $\dot{Y}$, $\dot{L}$ and $\dot{K}$ are respectively the percentage growth rates of output, labour and capital. The above equation essentially decomposes the output growth rate into three components: labour growth (G_L), capital growth (G_K) and technical progress. It is noted that there are constant returns to scale when a+d=1, decreasing returns to scale when a+d<1 and increasing returns to scale when a+d>1. It has been suggested that when there is increasing returns to scale, labour and capital growth contributions should be calculated using the following equation in order to exclude the contribution of the scale economy (Beeson 1987):

$$G_L + G_K = \frac{1}{a+d}(a\dot{L} + d\dot{K}) \tag{3}$$

$$G_L = \frac{1}{a+d} a\dot{L} \tag{4}$$

$$G_K = \frac{1}{a+d} d\dot{K} \tag{5}$$

A separate component of scale economy (G_S), which is not included in the component of technology in this paper, can be calculated as:

$$G_S = (1 - \frac{1}{a+d})(a\dot{L} + d\dot{K}) \quad (6)$$

The capital contribution in equation (5) can also be decomposed into contributions by local capital (G_{KL}) and non-local capital (G_{KNL}), using the share of non-local capital in total capital stock formed in a period through investment (R_{KNL}), thus:

$$G_{KL} = (1 - R_{KNL}) \frac{1}{a+d} d\dot{K} \quad (7)$$

$$G_{KNL} = R_{KNL} \frac{1}{a+d} d\dot{K} \quad (8)$$

The percentage growth of output can be decomposed into five components–contributions by labour, local capital, non-local capital, scale economy and technical progress–as in the following:

$$\dot{Y} = G_L + G_{KL} + G_{KNL} + G_S + v \quad (9)$$

As mentioned before, pooled cross sectional data for the periods 1980-1985, 1985-1990 and 1990-1994 will be used to estimate three sets of parameters of the production function respectively. The time series data of six years do not allow separate estimations of production function for each of the 28 areas. Thus it is assumed that the parameters in the production function are the same in various areas, *i.e.*, similar production technology was used in all sub-regional areas. This is in aggregate terms and means that the most appropriate technology has been adopted in the delta region. This assumption may not very problematic for this small region since information about appropriate technology may diffuse to the entire region in a short time. Separate production functions for various sub-regional areas are preferred if data are available. Nevertheless, the approach used here makes it possible to estimate the contributions of various factors to regional economic growth, as various areas show different growth rates in production factors and economic output. This approach is clearly more informative than simple growth rate analysis.

Table 4 presents the estimated results of the regional production functions for the pooled cross-sectional data in the three periods 1980-1985, 1985-1990 and 1990-1994. For the periods 1980-1985 and 1985-1990, data for two years are available and the total number of data observations is 56 for each period. Data for the four years 1990, 1991, 1993 and 1994 are available, and the number of observations is 112 for 1990-1994. Three different production functions can reveal possible changes in production technology in the entire period 1980-1994. A regional production function using all the data for the period 1980-1994 is also estimated. Overall the production equations are well estimated with adjusted R squares over 0.96. The F statistic is also significant for all equations. The technical progress parameter was not significant for the period 1980-1985 but was significant in other periods. The estimated labour elasticity was significant in all periods and decreased gradually from the early 1980s to early 1990s.

The estimated capital elasticity was also significant in all periods and was the largest in the period 1990-1994. These parameters–output elasticity of labour and capital–are then used to estimate the contributions of various factors to regional economic growth using equations (4)-(8). Output, labour and capital growth rates in various areas are calculated from the empirical data.

Table 4. Parameter estimates of regional production functions.

Period	1980-85	1985-90	1990-94	1980-94
Number of observations	56	56	112	168
R	0.972	0.975	0.961	0.978
Adjusted R^2	0.942	0.949	0.922	0.955
F	297	339	437	1194
ln constant	-3.126	-3.042	-1.744	-2.086
	(5.336)	(5.258)	(3.343)	(5.382)
v	-0.023*	0.073	0.088	0.064
	(1.500)	(5.770)	(4.944)	(10.320)
a	0.578	0.550	0.391	0.464
	(8.700)	(8.999)	(6.867)	(10.244)
d	0.598	0.595	0.640	0.619
	(12.130)	(14.687)	(15.966)	(19.224)

Data source: Calculated by the authors.
Notes: R = correlation coefficient of regression equation; F = F statistic;
v = parameter of technical progress; a = labour elasticity; d = capital elasticity;
* = insignificant at 0.05 level; t-values in brackets.

Tables 5, 6 and 7 present the percentage contributions of various factors to economic growth in various areas in three periods 1980-1985, 1985-1990 and 1990-1994 respectively. The absolute contributions of various factors to GDP growth in an area are related to its percentage GDP growth in each period. The change in location quotient of GDP, which is used to classify four area types of development in the previous section, is related to both percentage GDP growth and percentage population growth. Therefore, the percentage growth of population and GDP is also presented in Tables 5-7 for reference.

In the first period 1980-1985, the total GDP of the Zhujiang delta increased by 116 percent. Decomposing regional economic growth, 79.2 percent of it was due to local investment, 16.5 percent due to the increased scale of the regional economy, 7.0 percent due to increased labour force, and 7.5 percent due to NLI. In this period, there was a lot of investment in the delta, and total capital increased by 192.1 percent, though factor productivity declined. There was no overall technical progress. The negative contribution of technology (-10.2 percent), which reflects the broad meaning of technology in this analysis, does not refer to the use of less advantaged technology to

replace more advanced technology in existing firms. Instead, it may reflect the use of less advanced technology in new firms. In the early 1980s, many collectively and privately owned firms were established, which might have employed less advantaged technology than the existing state owned firms which dominated the regional economy then. In other words, the average level of technology in a regional economy may be reduced by the expansion of many small firms using less advanced technology.

Table 5. Percentage growth of population and GDP and percentage contributions to GDP growth in each area by various factors 1980-1985 (%).

Area	Type	Population growth	GDP growth	Labour	Local capital	Non-local capital	Capital total	Scale economy	Technology
Shenzhen	A_1	49.1	875.0	5.1	69.6	11.3	80.8	15.1	-1.0
Zhuhai	A_1	22.1	371.1	2.5	71.1	12.6	83.7	15.2	-1.4
Huizhou	A_2	15.8	135.8	8.9	73.5	10.6	84.0	16.4	-9.3
Panyu	A_3	6.5	131.8	8.0	81.0	4.3	85.3	16.4	-9.8
Nanhai	A_3	5.7	149.7	4.6	87.6	2.4	90.1	16.7	-11.3
Average	A	19.8	332.7	5.8	76.6	8.2	84.8	16.0	-6.5
Dongguan	B_1	7.2	132.4	7.1	81.1	5.5	86.6	16.5	-10.2
Huadu	B_1	8.0	123.0	13.3	90.3	3.4	93.8	18.9	-25.9
Sanshui	B_1	5.6	189.2	0.7	84.6	5.2	89.8	15.9	-6.4
Gaoming	B_1	8.0	130.6	4.9	91.2	1.7	92.9	17.2	-15.0
Huiyang	B_1	8.2	30.6	15.5	80.7	3.7	84.4	17.6	-17.5
Heshan	B_1	3.0	79.3	5.4	83.0	3.1	86.1	16.1	-7.6
Gaoyao	B_1	5.8	158.9	22.4	84.3	1.0	85.3	19.0	-26.7
Zengcheng	B_2	10.5	45.8	15.0	80.9	4.7	85.5	17.7	-18.2
Conghua	B_2	9.6	85.3	38.3	74.0	1.4	75.3	20.0	-33.5
Boluo	B_2	6.9	82.8	41.2	114.0	2.5	116.5	27.8	-85.5
Average	B	7.3	105.8	16.4	86.4	3.2	89.6	18.7	-24.7
Guangzhou	C	8.7	72.8	9.0	85.9	6.0	91.8	17.8	-18.6
Foshan	C	13.5	199.3	4.1	78.6	6.6	85.2	15.7	-5.0
Jiangmen	C	10.2	102.0	15.0	85.1	1.1	86.2	17.8	-19.0
Average	C	10.8	124.7	9.4	83.2	4.6	87.8	17.1	-14.2
Shunde	D_1	6.8	152.6	8.7	87.7	3.5	91.2	17.6	-17.5
Zhongshan	D_1	4.9	119.1	8.1	78.7	10.2	88.9	17.1	-14.0
Zhaoqing	D_1	12.7	121.2	11.3	81.3	6.4	87.7	17.4	-16.5
Kaiping	D_1	3.5	68.2	7.2	88.4	2.2	90.6	17.2	-15.0
Doumen	D_2	7.7	156.3	4.5	90.4	3.6	94.0	17.3	-15.7
Sihui	D_2	6.6	119.6	29.1	96.2	3.0	99.2	22.6	-50.8
Huidong	D_2	7.9	57.7	11.4	80.0	3.6	83.7	16.7	-11.8
Xinhui	D_2	4.0	108.8	5.9	87.4	2.1	89.5	16.8	-12.2
Taishan	D_2	1.5	99.1	8.7	87.3	3.4	90.7	17.5	-16.8
Enping	D_2	5.0	75.7	5.2	82.1	4.7	86.8	16.2	-8.2
Average	D	6.1	107.8	10.0	86.0	4.3	90.2	17.6	-17.9
Total		7.9	116.0	7.0	79.2	7.5	86.7	16.5	-10.2

Data source: Calculated by the authors.

In the second period 1985-1990, the total GDP in the Zhujiang delta increased by 109.8 percent, slower than the previous period as a result of overall economic adjustment in the country. The slower GDP growth reflected much slower capital growth than the previous period. The total capital in the delta increased only by 90.8 percent in 1985-1990. The growth rate of labour was similar to the previous period. The percentage

growth of labour was 16.1 percent in the period 1980-1985 and 17.4 percent in the period 1985-1990. As a result, production productivity increased in the period 1985-1990. Thus, technical progress had become an important factor of economic growth, accounting for 36.5 percent of the regional economic growth in the Zhujiang delta. The contribution by capital declined to 47.1 percent in this period due to slow capital growth. Specifically, 39.2 percent of the economic growth in the region was due to local investment, 8.1 percent due to the increased scale of the regional economy, 8.4 percent due to increased labour force, and 7.9 percent due to NLI.

Table 6. Percentage growth of population and GDP and percentage contributions to GDP growth in each area by various factors 1985-1990 (%).

Area	Type	Population growth	GDP growth	Labour	Local capital	Non-local capital	Capital total	Scale economy	Technology
Shenzhen	A_1	43.4	247.1	30.5	30.9	8.3	39.2	10.1	20.1
Zhuhai	A_1	35.6	237.3	31.5	28.2	7.2	35.4	9.7	23.4
Huizhou	A_2	27.0	339.9	10.9	26.3	36.1	62.4	10.6	16.2
Panyu	A_3	9.5	77.7	2.5	51.3	5.9	57.2	8.7	31.7
Nanhai	A_3	9.8	95.3	1.5	34.2	4.0	38.2	5.8	54.5
Average	A	25.1	199.5	15.4	34.2	12.3	46.5	9.0	29.2
Dongguan	B_1	9.1	172.7	6.2	33.3	12.1	45.4	7.5	40.9
Huadu	B_1	11.1	81.4	6.6	47.2	4.7	51.9	8.5	33.0
Sanshui	B_1	7.4	164.3	14.3	30.2	8.5	38.7	7.7	39.3
Gaoming	B_1	7.7	205.0	8.3	41.6	17.2	58.8	9.7	23.2
Huiyang	B_1	7.6	331.2	8.9	58.4	2.4	60.8	10.1	20.2
Heshan	B_1	4.8	158.5	4.9	43.9	6.7	50.6	8.1	36.5
Gaoyao	B_1	8.0	75.3	13.5	26.1	3.8	29.9	6.3	50.3
Zengcheng	B_2	8.6	113.7	7.8	40.0	11.3	51.2	8.6	32.4
Conghua	B_2	8.3	136.9	7.0	55.9	2.0	57.9	9.4	25.7
Boluo	B_2	4.6	149.8	3.2	44.1	1.3	45.4	7.1	44.3
Average	B	7.7	158.9	8.1	42.1	7.0	49.1	8.3	34.6
Guangzhou	C	8.8	49.8	3.7	40.4	4.0	44.4	7.0	45.0
Foshan	C	17.0	140.1	9.7	42.7	9.8	52.5	9.0	28.7
Jiangmen	C	23.4	116.8	14.0	29.7	6.2	36.0	7.2	42.8
Average	C	16.4	102.2	9.1	37.6	6.7	44.3	7.8	38.8
Shunde	D_1	8.3	77.6	6.9	27.0	9.1	36.2	6.3	50.7
Zhongshan	D_1	8.4	147.4	7.9	40.3	7.6	47.9	8.1	36.1
Zhaoqing	D_1	14.0	142.2	13.9	24.4	8.0	32.4	6.7	47.0
Kaiping	D_1	6.0	144.4	6.6	37.9	3.4	41.3	7.0	45.1
Doumen	D_2	13.9	81.5	5.1	37.1	7.7	44.8	7.2	42.9
Sihui	D_2	5.6	103.3	8.2	17.4	3.8	21.2	4.3	66.3
Huidong	D_2	7.5	114.3	12.3	46.0	0.6	46.6	8.5	32.6
Xinhui	D_2	4.1	116.2	8.5	31.6	4.0	35.6	6.4	49.5
Taishan	D_2	3.7	95.3	6.2	36.2	1.2	37.5	6.3	50.0
Enping	D_2	8.7	97.5	5.0	29.1	11.1	40.2	6.6	48.3
Average	D	8.0	112.0	8.1	32.7	5.7	38.4	6.7	46.9
Total		9.7	109.8	8.4	39.2	7.9	47.1	8.1	36.5

Data source: Calculated by the authors.

In the third period 1990-1994, economic growth in the delta region speeded up again with more capital investment and also high production productivity. The total GDP of the region increased by 187.7 percent, the highest rate among the three periods. In 1990-1994, total capital in the delta increased by 128.5 percent; local capital by 105.8

Table 7. Percentage growth of population and GDP and percentage contributions to GDP growth in each area by various factors 1990-1994(%).

Area	Type	Population growth	GDP growth	Labour	Local capital	Non-local capital	Capital total	Scale economy	Technology
Shenzhen	A_1	36.9	254.4	39.8	26.8	11.3	38.1	2.4	19.8
Zhuhai	A_1	57.2	587.3	23.9	36.7	17.4	54.0	2.4	19.7
Huizhou	A_2	34.0	309.7	12.1	43.9	25.3	69.2	2.5	16.2
Panyu	A_3	9.0	188.0	3.4	62.2	14.0	76.2	2.5	17.9
Nanhai	A_3	8.8	186.6	6.5	54.3	9.3	63.7	2.2	27.7
Average	A	29.2	305.2	17.1	44.8	15.5	60.2	2.4	20.2
Dongguan	B_1	7.2	94.5	3.0	32.6	37.5	70.1	2.3	24.7
Huadu	B_1	8.5	368.9	2.6	51.3	21.0	72.2	2.3	22.9
Sanshui	B_1	8.1	156.8	5.7	45.2	15.6	60.8	2.1	31.4
Gaoming	B_1	7.5	225.5	-0.8	56.3	17.3	73.6	2.3	25.0
Huiyang	B_1	4.4	205.0	3.9	39.2	30.7	69.9	2.3	24.0
Heshan	B_1	3.0	211.6	2.9	50.5	17.7	68.2	2.2	26.7
Gaoyao	B_1	2.4	164.9	1.8	52.6	23.3	75.9	2.4	19.9
Zengcheng	B_2	9.1	345.0	2.2	56.2	21.8	78.0	2.5	17.3
Conghua	B_2	7.3	153.7	1.6	59.2	16.8	76.0	2.4	20.0
Boluo	B_2	5.0	54.8	3.3	49.7	23.6	73.3	2.4	21.1
Average	B	6.3	198.1	2.6	49.3	22.5	71.8	2.3	23.3
Guangzhou	C	6.3	165.0	4.8	44.9	11.1	56.0	1.9	37.3
Foshan	C	17.0	151.9	9.4	44.6	12.0	56.6	2.1	31.9
Jiangmen	C	36.1	157.3	14.7	37.1	17.3	54.4	2.1	28.8
Average	C	19.8	158.1	9.6	42.2	13.5	55.7	2.0	32.6
Shunde	D_1	8.0	168.5	9.6	50.3	17.2	67.5	2.4	20.5
Zhongshan	D_1	7.6	147.3	7.9	47.7	21.6	69.3	2.4	20.4
Zhaoqing	D_1	22.0	208.7	4.5	72.9	6.7	79.6	2.6	13.4
Kaiping	D_1	3.7	230.9	-1.9	54.0	11.9	65.9	2.0	34.0
Doumen	D_2	-5.6	70.5	-11.6	54.7	26.4	81.1	2.2	28.3
Sihui	D_2	3.9	159.3	2.2	47.7	15.6	63.4	2.0	32.4
Huidong	D_2	7.8	110.2	7.5	52.6	14.4	66.9	2.3	23.2
Xinhui	D_2	-2.7	134.5	-0.3	48.5	17.5	66.1	2.0	32.2
Taishan	D_2	2.5	97.0	2.5	45.6	13.9	59.5	1.9	36.1
Enping	D_2	5.0	102.6	1.1	34.3	16.4	50.7	1.6	46.6
Average	D	5.2	143.0	2.1	50.8	16.2	67.0	2.1	28.7
Total		8.7	187.7	8.5	45.3	16.7	62.0	2.2	27.3

Data source: Calculated by the authors.

percent; and non-local capital by 310.1 percent. In general, non-local capital grew faster than local capital throughout the period 1980-1994. The former's share in capital investment increased from 8.6 percent in 1980-1985 to 16.8 percent in 1985-1990 and 26.9 percent in 1990-1994. Local capital and NLI became more important than the previous period due to their faster growth. In 1990-1994, 45.3 percent of the economic growth in the region was due to local investment, a contribution greater than the previous period 1985-1990 but smaller than the first period 1980-1985. But the share of NLI in the region's economic growth had increased steadily from 7.5 percent in 1980-1985 to 7.9 percent in 1985-1990 and 16.7 percent in 1990-1994. Technical progress became slightly less important in 1990-1994, but it still contributed 27.3 percent of the regional economic growth in the Zhujiang delta. The contribution by labour was 8.5 percent, similar to the previous period. The contribution of scale economy to the economic growth in the region was only 2.2 percent, continuing a declining trend from

16.49 percent in 1980-1985 and 8.05 percent in 1985-1990. This decline may be due to the formation of a more mature economy with increasing competition in the 1990s. In 1980-1985, economic growth benefited from the expanding scale of regional economy. But in the later periods, the role of the scale economy had declined due to increasing competition, and economic growth relied mainly on factor growth and technical progress.

It is possible to trace the causes of why one area's economy has been growing or declining relatively by examining the results of factor contributions. The previous section has identified four main area types based on the changing location quotients of GDP in various areas. As mentioned before, both GDP growth and population growth will affect the changes of location quotient. But GDP growth rate is the key factor as it was much greater than population growth rate. The averages of percentage population growth, GDP growth and factor contributions for four area types are presented in Tables 5-7. These data can be used to analyze factors underlying the economic dynamics of various areas.

Figure 5 presents the percentage GDP growth in the four area types in the three periods 1980-1985, 1985-1990 and 1990-1994. It is clear that more developed growing areas (type A) had the highest growth rate in all three periods. The less developed growing areas (type B) had much higher growth rates in the second and third periods than relatively declining areas (types C and D). The more developed relatively declining areas (type C) and less developed relatively declining areas (type D) had growth rates below the averages of the Zhujiang delta especially in the third period 1990-1994. It is clear that the differential in GDP growth rate between the growing areas and relatively declining areas had widened most considerably in the period 1990-1994. However, this does not result from absolute economic decline in areas of types C and D. In fact, on average, the percentage GDP growth of area types C and D in the period 1990-1994 was higher than that in the previous two periods 1980-1985 and 1985-1990. The faster economic growth of less developed growing areas also reduced the overall regional inequality in the Zhujiang delta during the entire study period.

The different economic dynamics (GDP growth rates) of the four area types was due to differential factor growth and contributions of scale economy and technology. Figures 6-8 present the growth of total capital, local capital and non-local capital of the four area types in various periods. The patterns of total capital growth and local capital growth in Figures 6-7 are similar as the majority of capital was local. It is clear that area type A had much greater percentage growth of local capital than the other three types, especially in the first period 1980-1985. Local capital growth of type B was similar to that of types C and D in the first period 1980-1985, but the former appeared higher in 1985-1994. As local capital contributed to at least 39 percent of economic growth in the Zhujiang delta, such differentials in the percentage growth of local capital among the four area types were the key reasons for their faster or slower growth.

The percentage contribution of local capital to economic growth of an area depends on local capital growth but also on the relative contribution of other factors, which will be examined later in this section (Table 5-7). Although percentage growth of local capital was the highest in area type A, the percentage contribution of local capital growth to economic growth in area type A was the smallest due to relatively high contributions of

non-local capital in 1980-1994 and of labour in 1985-1994. The percentage contribution of local capital growth to economic growth in area type B was larger than that in area types C and D as the former's percentage contribution of technical progress was smaller.

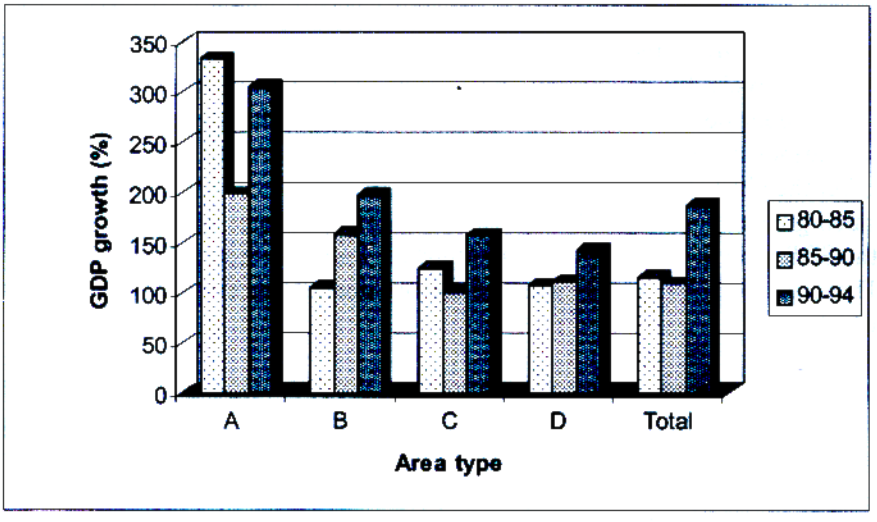

Figure 5. Percentage GDP growth in different area types.

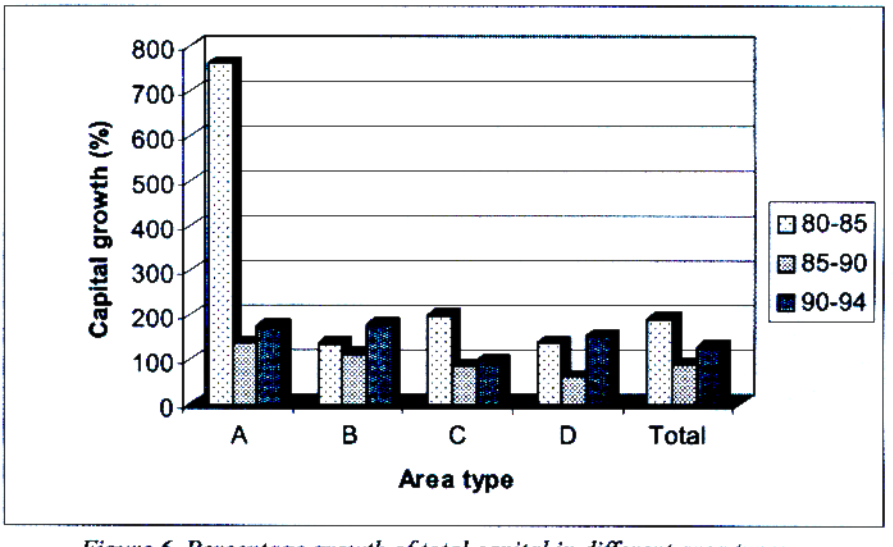

Figure 6. Percentage growth of total capital in different area types.

Non-local capital grew much faster than local capital in the three periods. For some areas, it is not possible to calculate the growth rate of non-local capital in the period 1980-1985, as their value was zero in the year 1980. Thus Figure 8 only presents the data for two periods 1985-1990 and 1990-1994. In contrast to the pattern of local capital growth, the percentage growth of non-local capital was the highest in the less

developed growing areas (type B), while other area types had similar growth rates in the period 1985-1994. The actual contribution of non-local capital depends on the share of non-local capital in total capital formed in each period, which is presented in Figure 9. In the first and second periods 1980-1985 and 1985-1990, the share of non-local capital was the highest in area type A (more developed growing areas), indicating that the majority of non-local capital was received by more developed growing areas. Indeed, non-local capital contributed on average 8.2 percent and 12.3 percent to the economic growth in area type A, and less than 4.6 percent and 7.0 percent in the other three area types, in 1980-1985 and 1985-1990 respectively. However, the share of non-local capital in total capital formed in type B in 1990-1994 was the highest among the four area types, and the shares of non-local capital in types C and D became closer to that of type A. As a result, in 1990-1994 non-local capital contributed as much as 22.5 percent to economic growth in less developed growing areas (type B), the highest among the four area types (Figure 10). It appears that non-local capital played an important role in the narrowing of regional inequality in the 1990s, which has been identified in the previous section. It is interesting to note that in 1990-1994 non-local capital contributed only 11.31 percent and 17.35 percent of economic growth in Shenzhen and Zhuhai respectively, the main destinations of non-local investment. This is simply due to the fact that a large amount of local investment from mainland China was also received by these two cities. In general, the contribution of local capital to the economic growth was much larger than that of non-local capital in the entire period 1980-1994, but the importance of non-local capital increased throughout the period. It is also important to note that non-local investment may facilitate the use of advanced technology and good management practices. Such indirect impact is difficult to estimate and is not estimated in the current analysis.

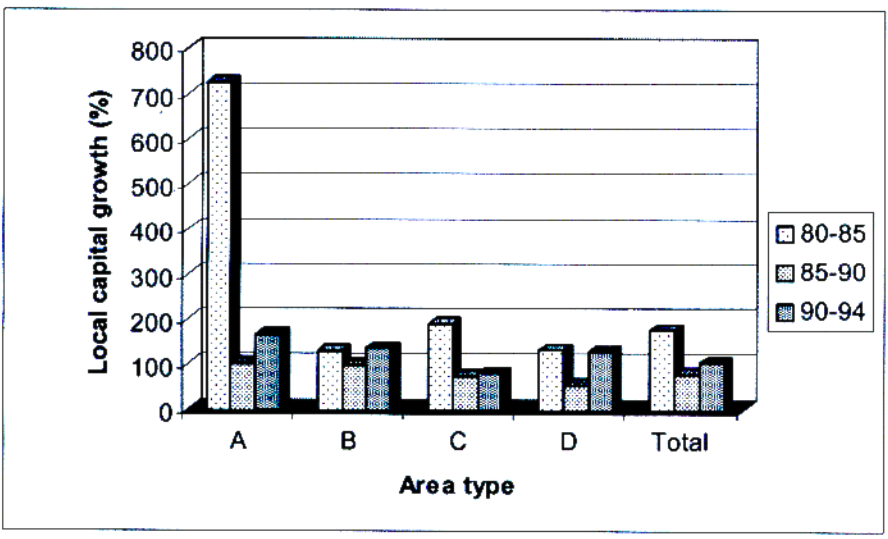

Figure 7. Percentage growth of local capital in different area types.

Many more developed growing areas (type A), such as Shenzhen, Zhuhai and Huizhou, experienced rapid growth in its labour force in the period 1980-1994 (Figure 11). However, the percentage contribution of labour force to economic growth was small in

1980-1985 due to the much faster growth of total capital. But labour contribution became significant when capital growth slowed down in the period 1985-1994. Labour force growth accounted for nearly 31 percent and 40 percent of economic growth in Shenzhen in the periods 1985-1990 and 1990-1994 respectively. On average, the percentage contributions of labour to economic growth in area type A were 5.8 percent, 15.4 percent and 17.1 percent in the three periods 1980-1985, 1985-1990 and 1990-1994 respectively (Tables 5-7). The percentage contributions of labour to economic growth in area types B, C and D were small especially in the period 1985-1994.

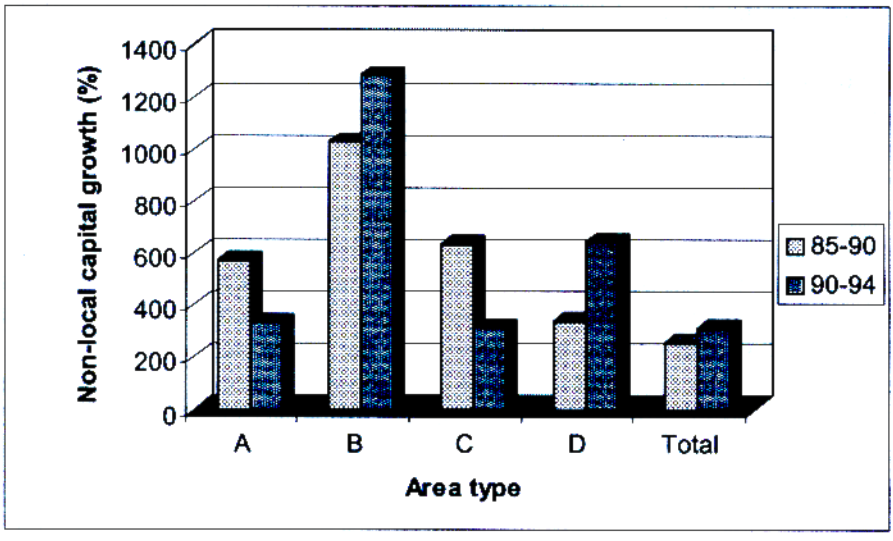

Figure 8. Percentage growth of non-local capital in different area types.

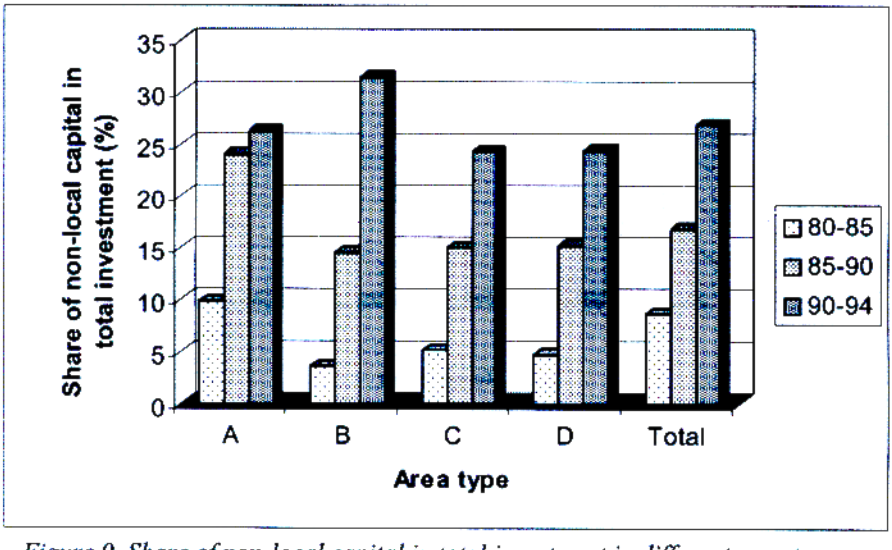

Figure 9. Share of non-local capital in total investment in different area types.

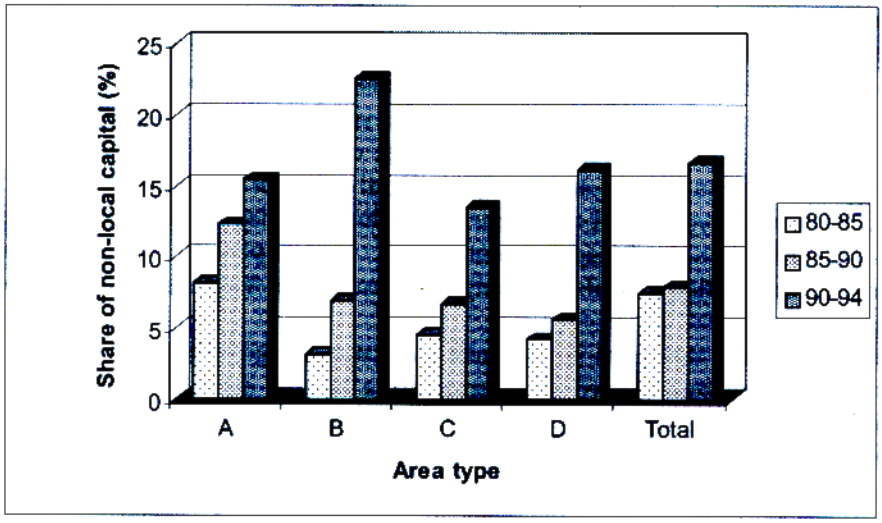

Figure 10. Percentage contribution of non-local capital to GDP growth in different area types.

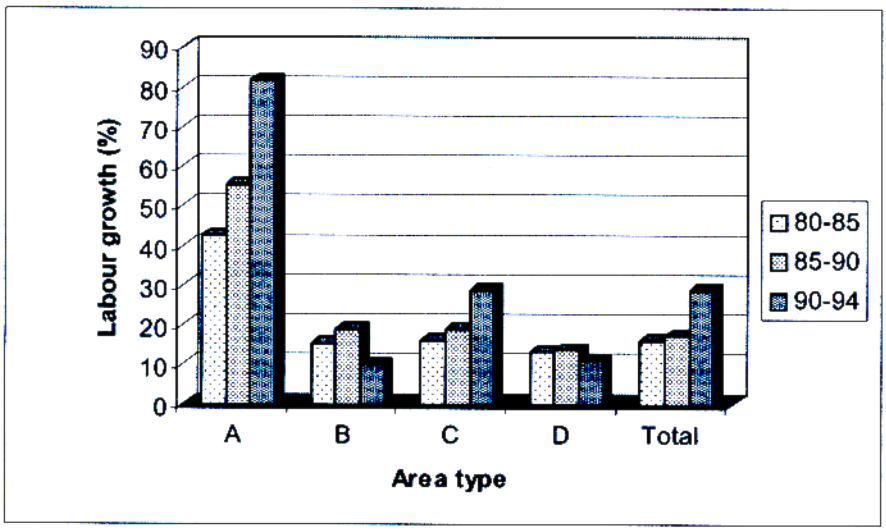

Figure 11. Percentage growth of labour in different area types.

Available data do not allow precise estimation of the contribution of technical progress in various areas; therefore, it is assumed that the same technology was used in all areas. Thus, absolute technical progress was constant in all areas. The percentage contribution of technical progress of an area depends on its overall GDP growth rate, and was smaller in areas with higher GDP growth rate but greater in areas with lower GDP growth rate. This is confirmed by Tables 5-7, which shows that the percentage contribution of technical progress was smaller in more and less developed growing areas (types A and B) than in more and less developed relatively declining areas (types C and D).

According to equation (6), the estimated contribution of scale economy is related to the parameter of returns to scale (a+d) and the labour and capital contributions. The percentage contribution of scale economy is greater if the total percentage contribution of labour and capital is also greater. Since area type A had relatively greater non-local capital and labour contributions, the percentage contribution of scale economy to its economic growth was the greatest, despite slightly smaller percentage contribution of local capital. Area type B had relatively greater local capital contribution in the period 1980-1990 and non-local capital contribution in the period 1990-1994, thus its percentage contribution of scale economy was greater than that in area types C and D.

Although there are variations within each area type, the growth dynamics of the four area types can be summarized as follows. Area type A experienced the most rapid growth among the four area types in the period 1980-1994. This was the result of rapid growth of local capital and labour as well as a significant contribution of non-local capital to total capital growth. The growth of local capital in the first period 1980-1985 was extremely high in Shenzhen and Zhuhai. Thus local capital was the main contributor of economic growth in more developed growing areas although such areas also attracted a large amount of non-local capital.

Area type B experienced rapid economic growth in the period 1985-1994. Its economic growth speeded up after 1985 due to a high growth rate of local capital and a much higher growth rate of non-local capital. In the period 1990-1994, non-local capital accounted for over 31 percent of total capital investment and accounted for 23 percent of the economic growth. Area type B did not experience significant labour growth. Non-local capital played an important role in the growth of the less developed growing areas of type B.

Area type C was more developed but its GDP growth rate was smaller than area types A and B. Local capital growth was above the delta's average in 1980-1985 but was below the average in 1985-1994. Non-local capital growth and its contribution to economic growth were just below the delta's average. Labour growth in area type C was greater than types B and D but much smaller than type A. It is clear that the slowdown of local capital investment in the period 1985-1994 was the main reason for the relative decline of area type C.

Area type D was less developed and its GDP growth rate was below the delta's average in the period 1980-1990. Insufficient local investment was the major reason for type D's relative decline in that period. Local capital growth was well below the delta's verage. The share of non-local capital in total capital investment and its contribution to economic growth were also below the delta's average. Labour growth rate was also below the delta's average since migrants were not attracted to such less developed areas. But in 1990-1994 the GDP growth rate of area type D was above the delta's average due to much faster growth of both local and non-local capitals. In this period, local capital growth was faster than that of area type C and the delta's average while non-local capital growth was faster than that of area types A and C. In total, local capital and non-local capital contributed respectively 50.8 percent and 16.2 percent to type D's economic growth in the period 1990-1994.

Conclusion

This paper has analyzed the regional growth in the Zhujiang delta in the period 1980-1998. China's economic reforms and open door policies have been implemented on a large scale since the late 1970s. The delta region is in the forefront of the economic reforms and open door program in China. Regional differential within the region increased initially but an "σ convergence" occurred in the early 1990s. Significant spatial transformation has occurred in the region, with the rapid rise of Shenzhen and relative decline of Guangzhou. Four types of areas are identified based on their economic performance in the period 1980-1998.

A causal analysis using the production function approach has been conducted to examine the contributions of various factors such as local capital, non-local capital from outside mainland China, labour force growth and technical progress to regional economic growth. Government policy, institutional changes and social networks have substantial impacts on regional development. Since they may facilitate capital investment and improve the efficiency of the regional economy, their contributions are partly accounted for by capital growth. The factor of technology is interpreted in a broad sense, including the effects of government policy and institutional factors. Due to data limitations, no attempt is made in this paper to estimate explicitly the contributions of government policy, institutional changes and social networks. In future research, it would be useful to analyze the relationships between government policy and institutional changes on one hand and the capital growth and factor productivity on the other.

The results of this paper shed light on the forces and processes of rapid regional development in the Zhujiang delta region. For example, in the period 1990-1994, 27.3 percent of the regional economic growth in that region was due to technical progress, 2.18 percent due to scale economy, 45.3 percent due to local investment, 8.5 percent due to increased labour force, and 16.7 percent due to NLI. It is clear that local investment has been the most important contributor to economic growth, although the region has also attracted a large amount of NLI. Technical progress was also a significant factor. The importance of internal capital accumulation may also be found in other developing countries and regions in the world.

The estimated results of factor contributions can be used to trace the reasons of why one area's economy has been growing or declining. Although there are variations among various areas in the same area type, the general growth dynamics of the four area types can be identified. Area type A experienced the most rapid economic growth due to the rapid growth of local capital and labour as well as a significant contribution of non-local capital to total capital growth. Local capital was the main contributor of economic growth in more developed areas, although such areas also attracted a large amount of non-local capital. Economic growth in area type B speeded up after 1985 due to a high growth rate of local capital and a much higher growth rate of non-local capital. Non-local capital played an important role in the growth of the less developed areas of type B.

Local capital growth in area type C was above the delta's average in the first period 1980-1985 but was below the average in the period 1985-1994. Non-local capital

growth and its contribution to economic growth were also modest. The slow- down of local capital investment in the period 1985-1994 was the main reason for the relative decline of area type C. Similarly, insufficient local investment was the major reason for the relative decline of area type D in the period 1980-1990. The economic growth in area type D speeded up in the period 1990-1994 due to much faster growth of both local and non-local capitals.

Many studies have emphasized the role of external factors, such as international capital and FDI, in developing countries. According to the results of this research, it is clear that the importance of domestic/local factors should also be recognized, although the importance of NLI has been increasing steadily. In the absence of internal mobilization of capital and labour, it may be difficult to achieve rapid economic growth. Even in Shenzhen and Zhuhai, two special economic zones that are in the forefront of Chinese open door policy, NLI contributed only less than 18 percent of economic growth in the period 1980-1994. Different economic growth rates in various areas are determined by the different growth rates of factor inputs. Migration has been a very important factor underlying the rapid growth of Shenzhen and Zhuhai. Although local capital accounted for about 70 percent of economic growth in Shenzhen and Zhuhai in the initial period 1980-1985, by 1985-1994 labour force growth accounted for over 23 percent of their growth, a contribution similar to that of local capital. On the other hand, NLI as an additional source of capital is still useful in capital-deficient developing areas. Furthermore, NLI is often associated with the introduction of advanced technology and management practice in the destination areas and may have significant indirect impact on the efficieny of the local economy.

It is clear that regional development is a result of various factors. Capital, labour quantity and quality, and technology are all important for rapid economic development. Development is also a self-sustained process that can both generate local capital and improve the quality of local labour force. NLI can help relieve the shortage of capital and transfer advanced technology to developing areas. The experience of the Zhujiang delta region shows that local capital still contributes more to its economic growth than NLI, although the latter's importance has been increasing.

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Foototes

1. The term FDI (foreign direct investment) usually refers to the capital flow from foreign countries. As the majority of the so-called FDI to mainland China comes

from Hong Kong, this paper uses the terms NLDI (non-local direct investment) and NLI (non-local investment) to refer to all capital flows from Hong Kong, Macau, Taiwan and other foreign countries to mainland China. Correspondingly, local capital or local investment, referring to capital investment from within Mainland China, is adopted to replace the term "domestic capital".

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