Regional Income Inequality in China
A Two-Stage Nested Inequality Decomposition Analysis

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Abstract

This study estimates regional income inequality in China over the 1995-1998 period using a Theil index based upon district-level GDP and population data, and conducts a two-stage nested inequality decomposition analysis to explore the factors of regional income inequality. It also performs a regression analysis to explore the possible determinants of within-province income inequality. The decomposition analysis shows that the within-province inequality component accounted for 62 % of overall regional income inequality in 1998, while the between-region component contributed 27 %. According to the regression analysis, cumulative per capita FDI and a dummy variable designating inland border provinces are found to be significant in explaining within-province inequality. It is also found that economic dualism, as denoted by a low ratio of agricultural labor productivity to labor productivity in non-agricultural sectors, is another significant factor contributing to within-province inequality.

Key Words: China, regional income inequalities, two-stage inequality decomposition, foreign direct investment, economic dualism

1. Introduction

Since the promulgation of economic reforms under Deng Xiaoping's open-door policy in 1978, China has achieved an exceptionally high economic growth rate in the last two decades. However, because these reforms have favored the coastal region, they have resulted in growing income disparities between inland and coastal provinces in the 1990s. Moreover, a growth pole strategy, adopted by the Chinese government to promote regional economic development by establishing special economic zones (SEZs) and economic and technological development zones (ETDZs), has facilitated income inequalities not only between provinces but also within provinces, especially within coastal provinces.

There are a number of studies that have examined the relationship between economic development and regional income inequality in China. However, most previous studies employed provincial GDP and population data to measure regional income inequality and were thus unable to measure inequality within provinces. Examples of these include Akita, Yue, and Kawamura (1999), Chen and Fleisher (1996), Tsui (1991, 1996), Wei (1998), Wei and Ma (1996), Ying (1999), and Zheng (1997). This study estimates regional income inequality in China from 1995-1998 using a Theil index based upon district-level GDP and population data, rather than provincial data. As a result, this study analyzes not only between-province inequalities but also within-province inequalities.

This study investigates the factors of regional income inequality in China using the two-stage nested inequality decomposition method, which was developed by Akita (2000). The method is analogous to a two-stage nested design in the analysis of variance (ANOVA) and decomposes the overall regional inequality, as measured by a Theil index based on district-level GDP and population data, into three components: the between-region, between-province, and within-province inequality components.[1] Therefore, the method can analyze the contribution of within-province inequality as well as between-province and between-region inequality to the

overall regional income inequality in a coherent framework.

This study will show that within-province income inequality differs significantly between provinces. This study also conducts regression analysis to explore the possible determinants of within-province income inequality. In the regression analysis, the following three explanatory variables are considered: (1) per capita foreign direct investment (FDI); (2) the ratio of agricultural labor productivity to labor productivity in other sectors, as a proxy for the extent of economic dualism; and (3) a dummy variable identifying inland border provinces that have open cities (i.e., Xinjiang, Yunnan, Inner Mongolia, and Heilongjiang). The reasons are as follows: (1) export-oriented FDI seems to have played a significant role in the economic development of coastal provinces, and together with the establishment of SEZs and ETDZs, facilitated the spatial concentration of productive activities in a few districts within these provinces; (2) economic dualism seems to have raised within-province inequality since non-agricultural sectors tend to be geographically concentrated; and (3) inland border provinces' increasing trade with neighboring countries seems to have promoted the spatial concentration of productive activities in a few districts within these provinces.

This paper is organized as follows. The next section describes the method and data used in this study. Section 3 estimates regional income inequality by a Theil index using district-level GDP and population data and presents the results of a two-stage nested inequality decomposition analysis. Section 4 conducts a regression analysis to explore the determinants of within-province inequality. Finally, Section 5 summarizes the results and discusses the policy implications.

2. Method and the Data

Method: Two-Stage Nested Inequality Decomposition Method

This study estimates regional income inequality using a Theil index based upon district-level GDP and population data; it also conducts a two-stage nested inequality decomposition analysis to

explore the factors of regional income inequality. Theil indices are additively decomposable and satisfy several desirable properties as a measure of regional income inequality, i.e., mean independence, population-size independence, and the Pigou-Dalton principle of transfers (Bourguignon, 1979; Shorrocks, 1980). An inequality index is said to be decomposable if total inequality can be written as the sum of between-group and within-group inequalities. Mean independence implies that the index remains unchanged if every region's income is changed by the same proportion, while population-size independence indicates that the index remains unchanged if the number of people in each region is changed by the same proportion, i.e., the index depends only on the relative population frequencies at each region and not the absolute population frequencies. Finally, the Pigou-Dalton principle of transfers implies that any income transfer from a richer to a poorer region that does not reverse their relative ranks in income reduces the value of the index.

This section presents the two-stage nested inequality decomposition method as an extension of the one-stage inequality decomposition method.[2] There are numerous studies that used the one-stage inequality decomposition method to analyze the factors of income inequality. But most studies applied the method to analyze inter-personal or inter-household income inequality.[3]

We consider the following hierarchical structure of a country: region-province-district as shown in Figure 1. Using a district as the underlying regional unit, overall regional income inequality can be measured by the following Theil index (Theil index T).

$$T_d = \sum_i \sum_j \sum_k \left(\frac{y_{ijk}}{Y} \right) \log \left(\frac{y_{ijk}/Y}{n_{ijk}/N} \right), \qquad (1)$$

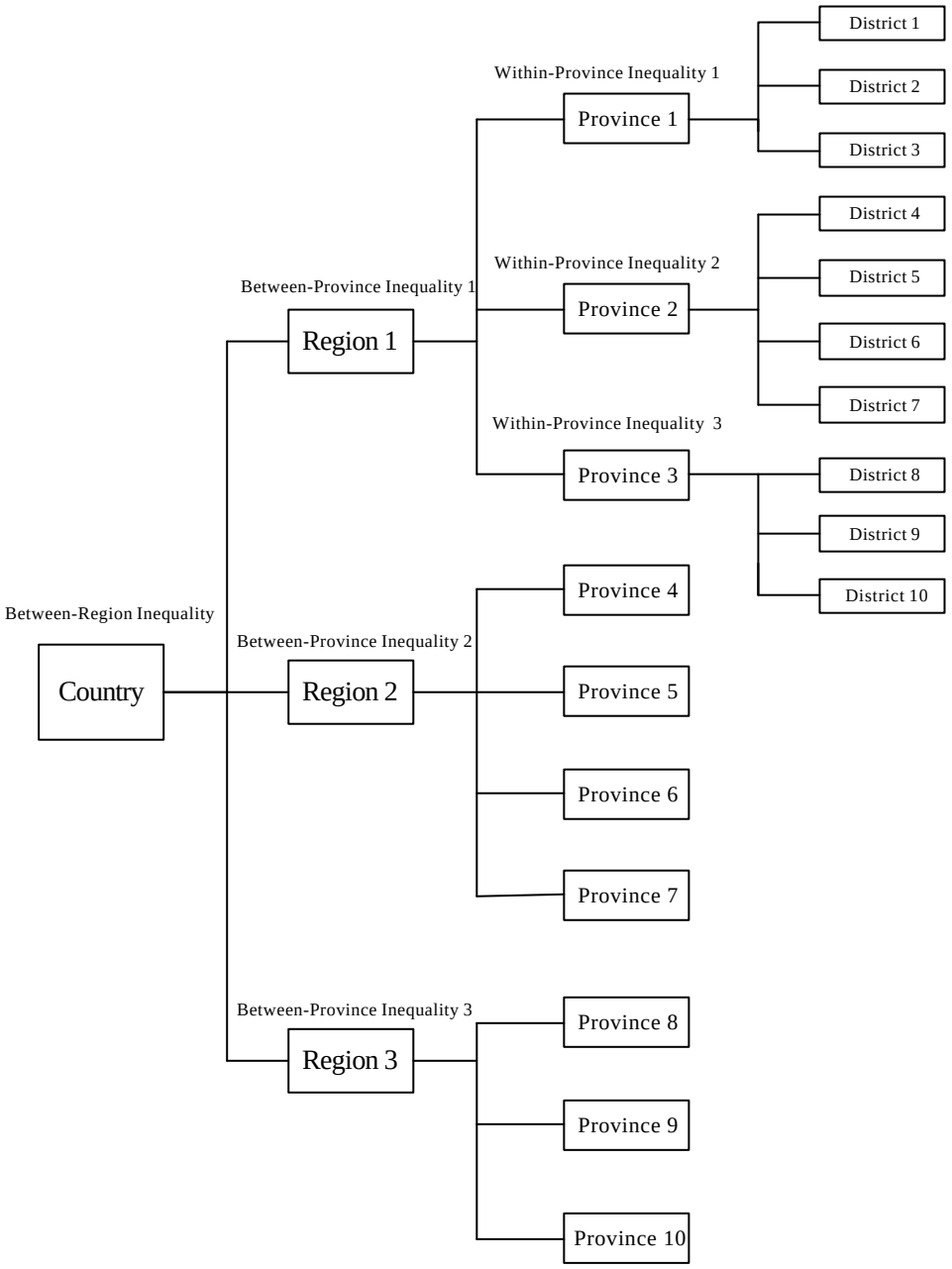
where y_{ijk} is the income of district k in province j in region i,

Y is the total income of all districts $\left(= \sum_i \sum_j \sum_k y_{ijk} \right)$,

n_{ijk} is the total population of district k in province j in region i, and

N is the total population of all districts $\left(= \sum_i \sum_j \sum_k n_{ijk} \right)$.

Figure 1. Three-Level Hierarchical Structure Region-Province-District



If we define T_{di} as follows to measure between-district income inequality for region i,

$$T_{di} = \sum_j \sum_k \left(\frac{y_{ijk}}{Y_i} \right) \log \left(\frac{y_{ijk} / Y_i}{n_{ijk} / N_i} \right), \tag{2}$$

then T_d in equation (1) will be decomposed into

$$\begin{aligned} T_d &= \sum_i \left(\frac{Y_i}{Y} \right) T_{di} + \sum_i \left(\frac{Y_i}{Y} \right) \log \left(\frac{Y_i / Y}{N_i / N} \right) \\ &= \sum_i \left(\frac{Y_i}{Y} \right) T_{di} + T_{BR} \end{aligned} \tag{3}$$

where Y_i is the total income of region i $\left(= \sum_j \sum_k y_{ijk} \right)$,

N_i is the total population of region i $\left(= \sum_j \sum_k n_{ijk} \right)$, and

$T_{BR} = \sum_i \left(\frac{Y_i}{Y} \right) \log \left(\frac{Y_i / Y}{N_i / N} \right)$ measures income inequality between regions.

Therefore, the overall regional income inequality T_d is the sum of the within-region component and the between-region component. Equation (3) is the ordinary one-stage inequality decomposition equation.

Next, if we define T_{ij} as follows to measure within-province income inequality for province j in region i,

$$T_{ij} = \sum_k \left(\frac{y_{ijk}}{Y_{ij}} \right) \log \left(\frac{y_{ijk} / Y_{ij}}{n_{ijk} / N_{ij}} \right)$$

then T_{di} in equation (2) can be further decomposed into

$$T_{di} = \sum_j \left(\frac{Y_{ij}}{Y_i} \right) T_{ij} + \sum_j \left(\frac{Y_{ij}}{Y_i} \right) \log \left(\frac{Y_{ij} / Y_i}{N_{ij} / N_i} \right) \qquad (4)$$

$$= \sum_j \left(\frac{Y_{ij}}{Y_i} \right) T_{ij} + T_{pi}$$

where Y_{ij} is the total income of province j in region i $\left(= \sum_k y_{ijk} \right)$,

N_{ij} is the total population of province j in region i $\left(= \sum_k n_{ijk} \right)$, and

$T_{pi} = \sum_j \left(\frac{Y_{ij}}{Y_i} \right) \log \left(\frac{Y_{ij} / Y_i}{N_{ij} / N_i} \right)$ measures income inequality between provinces in region i.

By substituting T_{di} in equation (4) into equation (3), we obtain

$$T_d = \sum_i \left(\frac{Y_i}{Y} \right) \left[\sum_j \left(\frac{Y_{ij}}{Y_i} \right) T_{ij} + T_{pi} \right] + T_{BR}$$

$$= \sum_i \sum_j \left(\frac{Y_{ij}}{Y} \right) T_{ij} + \sum_i \left(\frac{Y_i}{Y} \right) T_{pi} + T_{BR}$$

$$= T_{WP} + T_{BP} + T_{BR} \qquad (5)$$

Equation (5) is the two-stage nested inequality decomposition equation, in which the overall regional income inequality is decomposed into the within-province component (T_{WP}), the between-province component (T_{BP}), and the between-region component (T_{BR}). The within-province component is a weighted average of within-province income inequalities (T_{ij}), while the between-province component is a weighted average of between-province income inequalities (T_{pi}).

The Data

A two-stage nested inequality decomposition analysis uses district-level GDP and

population data, which are obtained from the database compiled by a Japanese research institute (Soken) under the editorial supervision of the Chinese Statistical Bureau (Soken, 1999, 2000). This study uses nominal GDP figures, since district-level real GDP data are not available. It should be noted however that over the period of the study (1995-98), the inflation rate was less than 5% per annum. Therefore, the results would not be significantly different even if constant price data were used.

In this study, China is divided into the following three regions, as adopted by the Seventh Five Year Plan (1986-90) for the purpose of regional development planning: the Western, Central, and Eastern (or Coastal) Regions. The Western Region includes the provinces of Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. The Central Region includes the provinces of Jiangxi, Shanxi, Anhui, Henan, Hunan, Hubei, Inner Mongolia, Jilin, and Heilongjiang. Finally, the Eastern (or Coastal) Region includes the provinces of Liaoning, Fujian, Guangdong, Hainan, Guangxi, Zhejiang, Jiangsu, Shanghai, Shandong, Beijing, Tianjin, and Hebei. For the purpose of geographical convenience in this two-stage nested inequality decomposition analysis, the following separate administrative units have been subsumed into its contiguous province: Shanghai into Jiangsu province; Beijing and Tianjin into Hebei province; Hainan into Guangdong province; and Chongqing into Sichuan province. With these reclassifications, the Western, Central, and Eastern Regions consist of 9, 9, and 8 provinces, respectively, and 105, 115, and 115 districts, respectively. [4]

During the Seventh Five Year Plan and throughout the 1990s, the Eastern Region was targeted for technological advancement, foreign investment, and export-oriented industries. In contrast, the Central Region was targeted for key energy projects and the production of raw materials, partly processed materials, and foodstuffs. The Western Region was targeted for mineral and animal resource processing (Wang, Li, and Linge, 1997). In this tripartite regional classification, the Eastern Region was expected to serve as a growth center, which, through

interregional multiplier effects, would generate development linkages to inland provinces. These conditions would, in turn, produce a gradual growth momentum that is appropriate for each province's productivity level and comparative advantages (Wang, Li, and Linge, 1997).

3. Regional Income Inequality: A Two-Stage Nested Inequality Decomposition Analysis

Table 1 presents the results of the two-stage nested inequality decomposition analysis (see also Figure 2). The overall regional income inequality increased slightly from 0.230 in 1995 to 0.235 in 1997, and then to 0.249 in 1998. The decomposition of the overall inequality into the within-province, between-province, and between-region components reveals that while the within-province inequality component accounted for most of the increase in the overall inequality between 1995 and 1997, the three inequality components contributed equally to the increase from 1997 to 1998.

Within-province inequality accounted for the largest component of overall regional income inequality at 62 %. This was followed by the between-region component at 27 % and the between-province component at 11 %. This contrasts sharply with Indonesia, which had almost the same level of per capita GDP as China in 1997 (in terms of purchasing power parity) and is composed of 27 provinces and 303 districts. According to Akita and Alisjahbana (2001), in Indonesia, the within-province inequality and between-province components contributed 53 and 40 %, respectively, to overall regional income inequality, while the between-region component accounted for only 7 %.

Between-Region Inequality

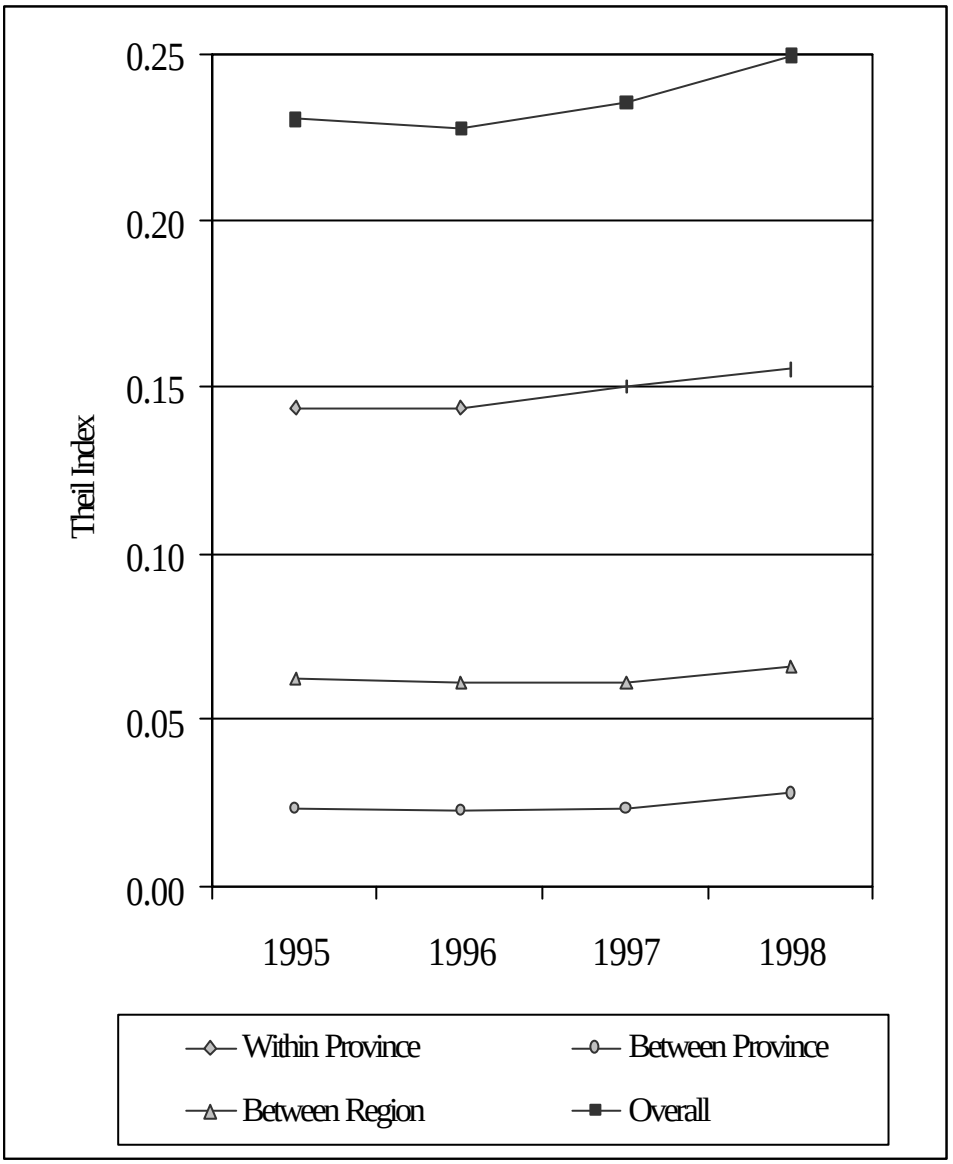
Over the 1995-98 period, the Eastern Region had the largest per capita GDP, followed by the Central Region and the Western Region (Table 2). In 1998, the Central Region's per capita GDP was 54 % of the Eastern Region's, while the Western Region's per capita GDP was an even smaller

Table 1. Two-Stage Nested Inequality Decomposition, 1995-1998

Region	Province	1995		1996		1997		1998	
		Theil T	Contrib	Theil T	Contrib	Theil T	Contrib	Theil T	Contrib
Western Region (105)		0.027	1.6	0.023	1.4	0.025	1.5	0.020	1.1
	1 Sichuan (20)	0.110	2.9	0.111	3.0	0.110	2.8	0.117	2.8
	2 Guizhou (9)	0.143	0.7	0.124	0.6	0.133	0.6	0.136	0.6
	3 Yunnan (17)	0.312	2.8	0.347	3.3	0.326	3.0	0.329	2.8
	4 Tibet (7)	0.246	0.1	0.153	0.1	0.173	0.1	0.130	0.1
	5 Shaanxi (10)	0.090	0.7	0.089	0.7	0.113	0.8	0.117	0.8
	6 Gansu (14)	0.265	1.1	0.268	1.2	0.273	1.2	0.255	1.0
	7 Qinghai (8)	0.185	0.2	0.152	0.2	0.139	0.1	0.145	0.1
	8 Ningxia (4)	0.240	0.3	0.227	0.3	0.253	0.3	0.246	0.3
	9 Xinjiang (16)	0.301	1.9	0.299	1.7	0.308	1.8	0.304	1.5
Central Region (115)		0.017	2.0	0.017	2.1	0.019	2.2	0.021	2.3
	1 Jiangxi (11)	0.072	0.6	0.080	0.7	0.087	0.8	0.092	0.7
	2 Shanxi (11)	0.104	0.9	0.106	0.9	0.100	0.8	0.091	0.7
	3 Anhui (16)	0.052	0.8	0.047	0.7	0.048	0.7	0.067	0.9
	4 Henan (17)	0.074	1.7	0.076	1.8	0.073	1.6	0.073	1.5
	5 Hunan (14)	0.044	0.7	0.051	0.9	0.056	0.9	0.058	0.9
	6 Hubei (12)	0.098	1.8	0.090	1.8	0.093	1.8	0.095	1.7
	7 Inner Mongolia (12)	0.104	0.6	0.100	0.6	0.100	0.6	0.089	0.5
	8 Jilin (9)	0.028	0.2	0.034	0.3	0.039	0.3	0.046	0.4
	9 Heilongjiang (13)	0.159	2.3	0.135	1.9	0.144	2.1	0.142	1.9
Eastern Region (115)		0.026	6.7	0.026	6.6	0.026	6.4	0.033	7.8
	1 Liaoning (14)	0.114	2.6	0.122	2.6	0.136	2.7	0.144	2.7
	2 Fujian (9)	0.090	1.5	0.090	1.5	0.105	1.7	0.109	1.8
	3 Guangdong (22)	0.370	16.0	0.371	17.2	0.398	18.0	0.416	17.9
	4 Guangxi (15)	0.084	1.0	0.073	0.9	0.077	0.9	0.094	0.9
	5 Zhejiang (11)	0.047	1.2	0.053	1.4	0.057	1.5	0.059	1.6
	6 Jiangsu (14)	0.186	10.6	0.187	10.4	0.195	10.5	0.202	10.2
	7 Shandong (17)	0.133	5.0	0.126	4.8	0.131	4.7	0.136	4.7
	8 Hebei (13)	0.109	4.3	0.095	3.8	0.092	3.7	0.094	3.5
Within Province		0.144	62.5	0.144	63.0	0.150	63.8	0.156	62.3
Between Province		0.024	10.3	0.023	10.1	0.024	10.1	0.028	11.2
Between Region		0.063	27.2	0.061	26.8	0.061	26.1	0.066	26.5
Total		0.230	100.0	0.228	100.0	0.235	100.0	0.249	100.0

Notes: (a) 'Contrib' is the contribution to total regional inequality (in %).
(b) Numbers in parentheses indicate the number of districts
Source: Soken with Chinese Statistical Bureau (1999, 2000)

Figure 2. Two-Stage Nested Inequality Decomposition, 1995-1998



42 %. This is in sharp contrast to the situation in 1990 when the Central Region and the Western Region's per capita GDP were 61 and 56 %, respectively, of the Eastern Region's per capita GDP (Akita, Yue, and Kawamura, 1999). Thus, there was a substantial increase in income disparity between the Eastern Region and the Central and Western Regions over the 1990-95 period. According to Akita, Yue, and Kawamura, regional income inequality between provinces, as measured by a Theil index, increased significantly between 1990 and 1995 (from 0.057 to 0.086), but this increase was mostly attributable to a rise in income disparity between the Eastern Region and the Western and Central Regions.[5]

Table 2. Per Capita GDP, 1995-1998

in yuan

Region	Province	1995	1996	1997	1998
Western Region		2,936.9	3,497.6	3,891.2	4,132.6
	1 Sichuan	3,118.8	3,687.7	4,119.2	4,480.9
	2 Guizhou	1,797.1	2,100.0	2,324.7	2,533.5
	3 Yunnan	3,026.4	3,814.6	4,222.3	4,406.4
	4 Tibet	2,333.9	2,695.0	3,158.3	3,322.8
	5 Shaanxi	2,887.8	3,499.5	3,916.3	4,171.3
	6 Gansu	2,270.3	2,894.9	3,132.9	3,276.0
	7 Qinghai	2,839.5	3,128.1	3,394.8	3,757.5
	8 Ningxia	3,320.6	3,716.3	3,979.6	4,287.0
	9 Xinjiang	4,966.4	5,472.0	6,193.5	5,894.9
Central Region		3,700.8	4,498.6	5,031.8	5,360.9
	1 Jiangxi	2,847.3	3,448.5	3,900.3	3,910.3
	2 Shanxi	3,649.2	4,388.1	4,731.0	5,057.7
	3 Anhui	3,328.7	3,864.0	4,370.3	4,609.1
	4 Henan	3,297.6	4,103.9	4,479.3	4,734.5
	5 Hunan	3,390.3	4,110.3	4,626.5	5,000.1
	6 Hubei	4,728.3	5,907.5	6,762.8	7,266.9
	7 Inner Mongolia	3,399.0	4,136.0	4,622.2	5,063.7
	8 Jilin	4,310.8	5,304.3	5,693.9	6,376.3
	9 Heilongjiang	5,147.6	6,077.6	6,991.5	7,420.2
Eastern Region		6,817.5	8,135.1	9,092.1	9,943.5
	1 Liaoning	7,259.5	8,082.6	8,827.7	9,659.2
	2 Fujian	6,664.8	8,119.7	9,268.5	10,895.1
	3 Guangdong	7,566.7	9,516.1	10,674.0	11,610.1
	4 Guangxi	3,533.7	4,242.5	4,667.9	4,204.6
	5 Zhejiang	8,139.2	9,422.6	10,488.3	12,583.8
	6 Jiangsu	8,933.2	10,544.3	11,691.0	12,431.0
	7 Shandong	5,731.2	6,821.2	7,569.8	8,353.7
	8 Hebei	6,087.2	7,343.3	8,393.9	9,103.2
Total		4,817.5	5,772.4	6,448.3	6,974.3

Source: Soken with Chinese Statistical Bureau (1999, 2000)

A relatively large between-region inequality in China seems to have been brought about by export-oriented regional development policies based on comparative advantages, all of which were introduced during the open-door policy initiated by Deng Xiaoping in 1978. In the 1980s, the central government designated several special economic zones (SEZs) and economic and technological development zones (ETDZs) in coastal provinces, particularly in the southeast

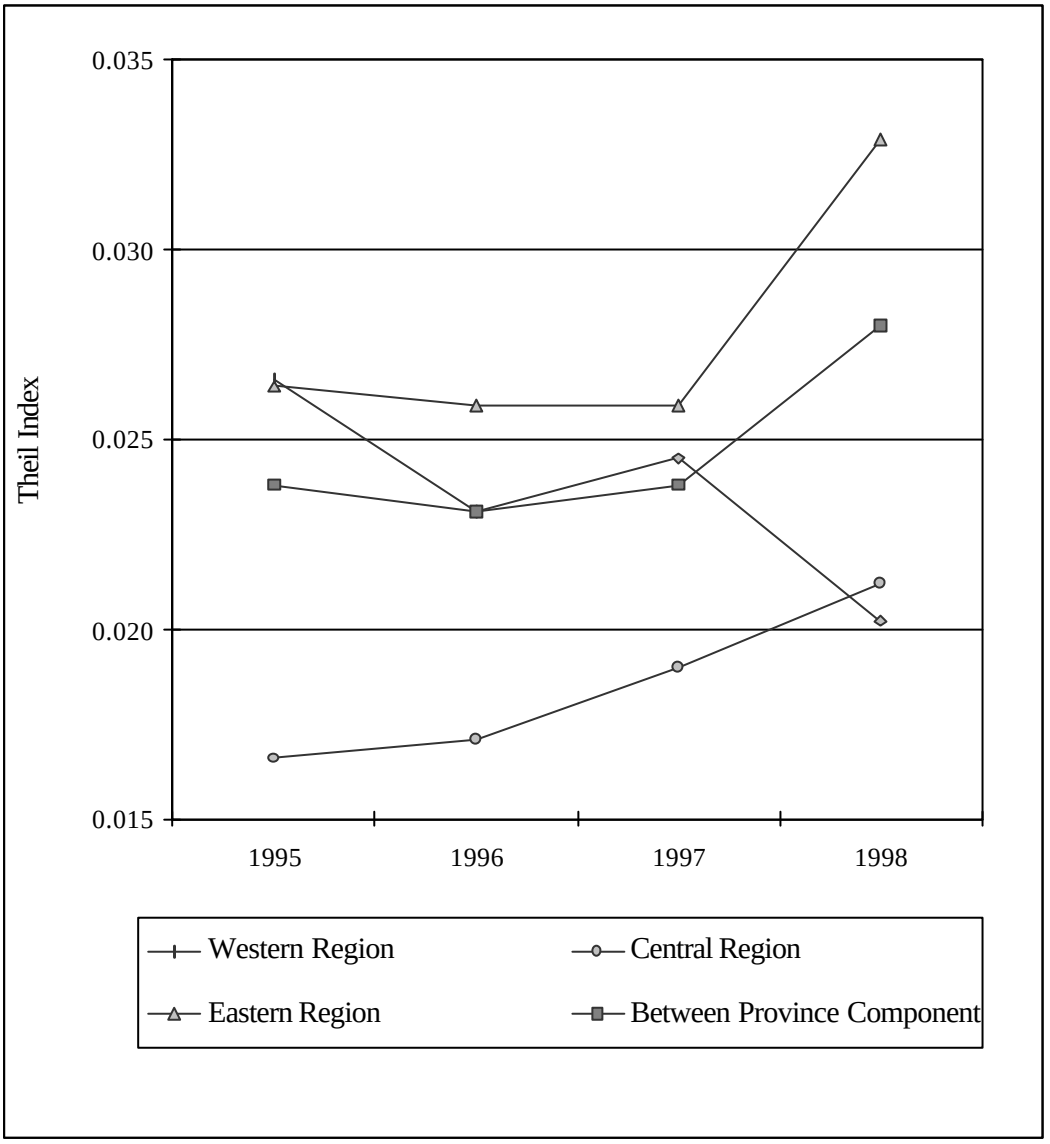
coastal provinces of Guangdong and Fujian. The SEZs and ETDZs were meant to promote economic development through international trade and FDI.[6] Preferential treatment given to these selected areas and the geographical proximity of many of these areas to Hong Kong and Taiwan have led to massive inflows of export-oriented and highly productive FDI into these areas in the 1980s and the 1990s, thus widening regional income disparities between inland and coastal provinces.

Between-Province Inequalities

Overall between-province inequality has been stable between 1995 and 1997 at approximately 0.024, but there was an increase in 1998 to 0.028 (see Table 1). Each region's between-province inequality exhibited distinct trends from 1995-1998 as seen in Figure 3. The Eastern Region had the highest levels of between-province inequality in every year except 1995 when the Western Region had a slightly higher level of between-province inequality. While the Eastern Region's between-province inequality remained constant from 1995-97 at 0.026, it jumped to 0.033 in 1998. The main factor seems to have been much faster growth in per capita GDP in the Eastern provinces of Zhejiang and Fujian *viz.* other provinces in the Eastern Region. In 1998, Zhejiang became the province with the largest per capita GDP in China at 12,584 yuan. Other provinces with high per capita GDP, in descending order, were Jiangsu, Guangdong, and Fujian (see Table 2). Further compounding the high level of between-province inequality in the Eastern Region in 1998 is the large negative growth in per capita GDP in Guangxi, the poorest province of the Eastern Region.

The Central Region recorded increasing levels of between-province inequality during the 1995-98 period; in contrast, the Western Region experienced decreasing levels of between-province inequality. Thus, by 1998, the Central Region at 0.021 had approximately the same level of between-province inequality as the Western Region at 0.020. In the Central Region,

Figure 3. Between-Province Inequality by Region, 1995-1998



Heilongjiang had the largest per capita GDP, followed by Hubei and Jilin; this order remained the same over the 1995-98 period. These three richer provinces' per capita GDP grew faster than the three poorest provinces (i.e., Jiangxi, Anhui, and Henan) over this period; thus, the Central Region's level of between-province inequality rose from 0.017 to 0.021.

The Western Region had the highest levels of between-province inequality in 1995 at 0.027, but this decreased dramatically to 0.020 in 1998. The main reason seems to have been due to much

slower growth in per capita GDP in Xinjiang, the richest province of the Western Region, when compared to the per capita GDP growth rates of other Western provinces. Xinjiang, in fact, recorded negative growth in per capita GDP in 1998.[7] Despite this, Xinjiang still had the highest per capita GDP in 1998 at 5,894 yuan, followed by Sichuan and Yunnan.

Within-Province Inequalities

Overall within-province inequality increased from 0.144 to 0.156 during the 1995-98 period (see Table 1 and Figure 2). But, the increase was due mostly to the rising levels of within-province inequality in the Eastern Region's provinces of Guangdong (from 0.370 to 0.416), Jiangsu (from 0.186 to 0.202), Liaoning (from 0.114 to 0.144), Zhejiang (from 0.047 to 0.059), and Fujian (from 0.09 to 0.109). These provinces' combined contribution to overall regional inequality rose from 32 % in 1995 to 34 % in 1998. Of the remaining twenty-one provinces, eleven experienced an increase in within-province inequality. However, their contribution to the increase in overall within-province inequality was negligible.

Provinces in the Western Region had relatively high levels of within-province inequality as their Theil T indices were all greater than 0.1 in 1998. In 1998, Yunnan had the largest within-province inequality in the Western Region at 0.329, followed by Xinjiang (0.304), and Gansu (0.255). In these provinces, there were a small number of key districts that had per capita GDP levels that were approximately 10 times larger than the per capita GDP levels of the poorest district in each province. These key districts include Yuxi and Kunming in Yunnan, Urumqi and Karamay in Xinjiang, and Lanzhou and Jiayuguan in Gansu. It should be noted that Tibet experienced a significant decrease in within-province inequality (from 0.246 to 0.130) – this was due to narrowing disparities between Lhasa and the other districts.

In contrast to the Western Region, provinces in the Central Region had relatively low levels of within-province inequality. With the sole exception of Heilongjiang, the levels of within-province inequality were all less than 0.1, and the per capita GDP levels of the richest

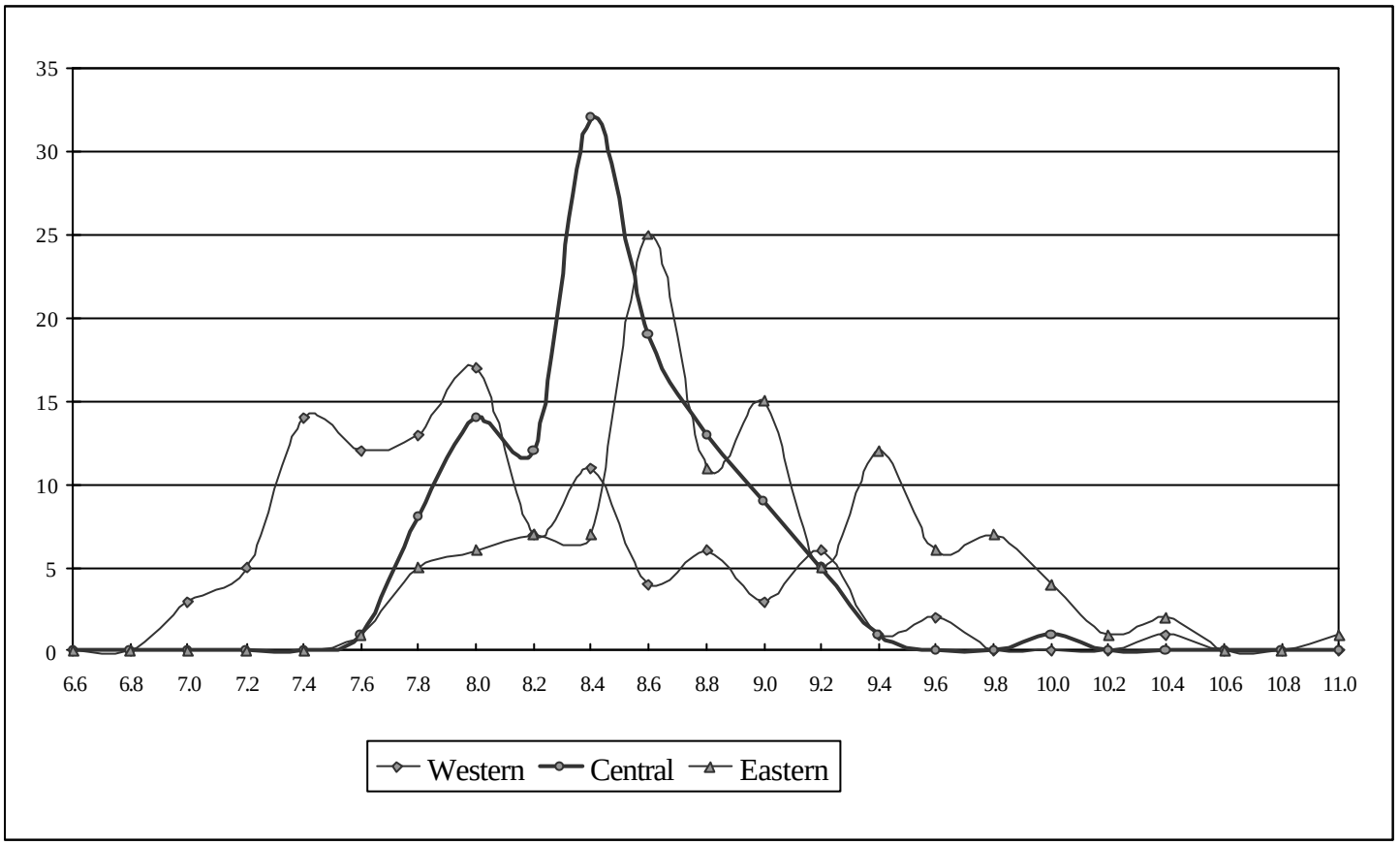
districts in each province were only four times larger than the poorest districts in 1998. Overall, Heilongjiang had the largest within-province inequality in the Central Region at 0.142 in 1998, followed by Hubei (0.095), Jiangxi (0.092), and Shanxi (0.091). The Central Region has thus far been the most successful in maintaining balanced regional development, not only across provinces but also within provinces.

In the Eastern Region, all but Hebei experienced an increase in within-province inequality over the 1995-98 period. There is much variation in within-province inequality in the Eastern Region. Guangdong registered the largest within-province inequality at 0.416 in 1998, accounting for 18 % of overall regional inequality. At less than half the level of Guangdong's inequality, Jiangsu had the second highest level of within-province inequality at 0.202, which accounted for 10 % of overall regional inequality. The next highest provinces were Liaoning (0.144), Shandong (0.136), and Fujian (0.109). Guangdong, in fact, had the highest level of within-province inequality in China.[8] In contrast, Zhejiang registered 0.059 in 1998, which was one of the lowest levels of inequality in China. At the district level in Guangdong, Shenzhen had the largest per capita GDP at 112,500 yuan in 1998, which was more than 40 times as high as Heyuan, the district with the smallest per capita GDP at 2,500 yuan. In Jiangsu, a similar comparison yielded a much less extreme divergence between the district with the largest per capita GDP and the district with the smallest: Shanghai's per capita GDP at 25,200 was 7.7 times greater than Suqian's per capital GDP at 3,200 yuan. This is roughly comparable to conditions in the provinces of Liaoning and Shandong, which generated ratios of 7.0 and 8.7, respectively, when comparing the district with the highest per capita GDP with the lowest. In Liaoning, Panjin district recorded a per capita GDP of 19,400 yuan versus Chaoyang district's 2,700 yuan. In Shandong,, the district of Weihai had a per capita GDP of 21,600 yuan in comparisons to Heze district's 2,500 yuan. Finally, in the province of Zhejiang, the ratio of the district with the highest per capita GDP to the district with the lowest was only 3.9: the district of Hangzhou recorded a per capita GDP of 18,600 yuan versus Lishui's 4,700 yuan. These observations suggest that each province in the Eastern Region had its

own distinct pattern of economic development as engendered by the economic reforms in the past two decades.

Figure 4 presents the frequency distributions of the per capita GDP (using the log scale) of each region's districts in 1998. From a comparison of the distributions, it is apparent that the Central Region had a much lower level of within-region inequality than the Western and Eastern Regions (within-region inequality is defined as the level of inequality between the districts within a region). In the Central Region, the mode of the distribution fell in the 8.2 to 8.4 range, which corresponds to a per capita GDP range of 3,650 to 4,450 yuan. Furthermore, about 80 % of the Central Region's districts was concentrated in the 8.0 to 8.8 range (corresponding to a per capita GDP range of 3,000 to 6,650 yuan). In contrast, the mode of the Western Region fell in the 7.8 to 8.0 range, which corresponds to a per capita GDP range of 2,450 to 3,000 yuan. This is noticeably smaller than the comparable figure in the Central Region, and interestingly, the frequency of the Western Region's mode was much smaller than the Central Region's. Consequently, another range had almost as large a frequency as the mode: this is the 7.2 to 7.4 range, which corresponds to a per capita GDP range of 1,350 to 1,650 yuan. This bimodal frequency distribution suggests that there exist two distinct sub-distributions in the Western Region with different statistical characteristics. It is likely that these two sub-distributions are accounted for by the different patterns of economic development experienced by border provinces versus non-border provinces. Finally, the Eastern Region's frequency distribution is situated to the right of the Central Region's. Its mode fell in the 8.4 to 8.6 range, which corresponds to a per capita GDP range of 4,450 to 5,450 yuan. This is only somewhat larger than the Central Region's mode. However, unlike the Central Region, the Eastern Region's distribution has a long tail on the right side of the distribution, thus indicating the existence of a significant number of very rich districts in the Eastern Region. In fact, about 45 % of the districts had per capita GDP greater than 6,650 yuan, and about 30 % of the districts had per capita GDP greater than 10,000 yuan.

Figure 4. Frequency Distributions of District-Level Per Capita GDP by Regions' (Log Scale)



4. Determinants of Within-Province Inequalities

As observed in the previous section, there is significant variation between the provinces in terms of their within-province income inequality: the highest level of within-province inequality was 0.416 (Guangdong) in 1998, and the lowest was only 0.046 (Jilin). The inland border provinces and coastal provinces tend to have higher levels of within-province inequalities, whereas the inland non-border provinces tend to have lower levels of within-province inequalities. To explore the determinants of within-province income inequality, we conducted a regression analysis in which the following three explanatory variables are considered: (1) per capita FDI; (2) the ratio of

agricultural labor productivity to labor productivity in other sectors, as a proxy for the extent of economic dualism; (3) and a dummy variable designating inland border provinces with open cities, i.e., Xinjiang, Yunnan, Inner Mongolia, and Heilongjiang.

It is widely believed that export-oriented and highly productive FDI has played a prominent role in the rapid growth of the Chinese economy in the 1990s. During 1990-98, FDI grew from US$3.5 billion to US$45.5 billion. Over the same period, China achieved a real GDP growth rate of 10.8 % per annum. China has thus become one of the largest recipients of FDI since 1993, second only to the U.S. In this period, the level of exports generated by foreign-invested enterprises also expanded significantly. According to Zhang and Song (2000), foreign-invested enterprises' share of exports was 12.6 % (US$7.8 billion) in 1990; by 1998, this had risen to 44.1 % (US$81.0 billion).

It should be noted that FDI inflows were concentrated in the Eastern Region, especially in the coastal provinces of Guangdong, Jiangsu, Fujian, and Hebei. These four provinces alone accounted for 72 % of China's total FDI during 1986-98 (see Table 3) (Zhang and Song, 2000). The massive inflows of export-oriented and highly productive FDI to the coastal provinces were facilitated through preferential treatment given to SEZs and ETDZs in these coastal provinces as well as their geographical proximity to Hong Kong and Taiwan. Furthermore, China's export promotion regime allowed foreign-invested enterprises to operate under institutions and regulations that are entirely different from those that govern most domestic enterprises (Zhang and Song, 2000).

Table 3. GDP, Population, and FDI (% Share)

in %

Region	Province	GDP 1995	GDP 1998	Population 1995	Population 1998	FDI 1986-1998
Western		14.1	13.7	23.1	23.2	3.4
	1 Sichuan	6.1	6.0	9.5	9.3	1.6
	2 Guizhou	1.1	1.1	2.9	3.0	0.1
	3 Yunnan	2.1	2.1	3.3	3.4	0.4
	4 Tibet	0.1	0.1	0.2	0.2	0.0
	5 Shaanxi	1.8	1.8	2.9	2.9	1.0
	6 Gansu	1.0	1.0	2.0	2.1	0.1
	7 Qinghai	0.2	0.2	0.4	0.4	0.0
	8 Ningxia	0.3	0.3	0.4	0.4	0.1
	9 Xinjiang	1.4	1.2	1.4	1.4	0.1
Central Region		27.2	27.2	35.4	35.4	8.9
	1 Jiangxi	2.0	1.9	3.4	3.4	0.8
	2 Shanxi	2.0	1.9	2.6	2.6	0.3
	3 Anhui	3.5	3.3	5.0	5.0	0.9
	4 Henan	5.2	5.1	7.6	7.6	1.3
	5 Hunan	3.8	3.8	5.4	5.3	1.5
	6 Hubei	4.2	4.5	4.3	4.3	1.8
	7 Inner Mongolia	1.4	1.4	1.9	1.9	0.1
	8 Jilin	1.9	2.0	2.2	2.1	0.9
	9 Heilongjiang	3.3	3.3	3.1	3.1	1.2
Eastern Region		58.7	59.1	41.5	41.4	87.7
	1 Liaoning	5.2	4.6	3.4	3.4	4.5
	2 Fujian	3.7	4.2	2.7	2.7	10.0
	3 Guangdong	10.0	10.7	6.3	6.4	30.7
	4 Guangxi	2.8	2.3	3.8	3.8	2.0
	5 Zhejiang	6.1	6.6	3.6	3.6	3.2
	6 Jiangsu	13.2	12.6	7.1	7.1	21.0
	7 Shandong	8.7	8.7	7.3	7.3	6.2
	8 Hebei	9.1	9.4	7.2	7.2	10.2
Total		100.0	100.0	100.0	100.0	100.0

Sources: Soken with Chinese Statistical Bureau (1999, 2000).
Zhang and Song (2000).

In China's agricultural sector, there exists substantial surplus labor relative to available farmland (Bramall, 2000; Peng, 1999). This is reflected in the large gap in labor productivity between agricultural and non-agricultural sectors. In 1998, the ratio of agricultural labor productivity to labor productivity in non-agricultural sectors was 0.2;

which is quite low in comparison to most developed countries. This is indicative of economic dualism, which has been shown in other studies to be a contributing factor to income inequality (Fields, 2001). According to Bramall (2000), the magnitude of this productivity gap between the agricultural and non-agricultural sectors has, in fact, increased during this period of rapid economic development. Furthermore, the productivity gap varies between provinces, reflecting the varying degrees of economic dualism among them. Table 4 shows the ratio of agricultural labor productivity to labor productivity in non-agricultural sectors by province in combination with per capita FDI during 1986-1998. Provinces in the Central Region, with relatively low levels of inequality, had relatively larger ratios, whereas provinces in the Western Region, with relatively higher levels of inequality, had relatively smaller ratios. Within-province inequality seems to have been negatively correlated with the ratio of agricultural labor productivity to labor productivity in non-agricultural sectors.

In the regression analysis, we tested the following three hypotheses: (1) provinces with larger per capita FDI tend to have larger within-province inequalities, since larger inflows of FDI into provinces seem to have facilitated the spatial concentration of productive activities in a few districts within these provinces; (2) provinces with a higher degree of economic dualism in labor productivity between agricultural and non-agricultural sectors tend to have larger within-province inequalities, since non-agricultural sectors are also geographically concentrated; and (3) inland border provinces tend to have larger within-province inequalities since these provinces' international trade with neighboring countries seems to have led to the spatial concentration of productive activities in the few districts that were convenient to international borders.[9] In agglomeration economies, the spatial concentration of productive activities within a province results in higher levels of within-province inequality as measured by per capita GDP.

Table 4. Per Capita FDI and Labor Productivity Ratio

Region	Province	Per Capita FDI 1986-1998 (in US $)	Labor Productivity in 1998 Agriculture (in Yuan)	Non-agriculture (in Yuan)	Ratio
Western Region		31.2	3,001	16,324	0.184
	1 Sichuan	36.8	3,287	15,399	0.213
	2 Guizhou	9.2	1,900	10,451	0.182
	3 Yunnan	22.9	2,425	23,647	0.103
	4 Tibet	0.0	3,506	19,313	0.182
	5 Shaanxi	69.2	2,687	14,703	0.183
	6 Gansu	15.1	2,920	13,818	0.211
	7 Qinghai	5.2	2,950	15,912	0.185
	8 Ningxia	24.3	3,197	17,441	0.183
	9 Xinjiang	19.2	7,504	28,182	0.266
Central Region		52.5	4,417	17,765	0.249
	1 Jiangxi	51.2	4,034	14,124	0.286
	2 Shanxi	28.2	3,216	18,490	0.174
	3 Anhui	39.1	3,684	15,062	0.245
	4 Henan	36.0	3,636	16,002	0.227
	5 Hunan	60.2	4,136	14,888	0.278
	6 Hubei	77.8	5,824	22,199	0.262
	7 Inner Mongolia	16.0	6,296	16,755	0.376
	8 Jilin	88.1	7,591	20,283	0.374
	9 Heilongjiang	81.7	5,603	27,129	0.207
Eastern Region		449.7	5,698	27,240	0.209
	1 Liaoning	280.2	8,078	25,753	0.314
	2 Fujian	789.2	7,763	32,530	0.239
	3 Guangdong	1,010.8	6,547	30,917	0.212
	4 Guangxi	111.3	3,538	15,672	0.226
	5 Zhejiang	187.0	5,692	28,252	0.201
	6 Jiangsu	631.3	6,596	34,833	0.189
	7 Shandong	181.6	4,865	21,324	0.228
	8 Hebei	303.3	5,360	24,431	0.219
Total		211.1	4,476	22,214	0.202

Sources: Soken with Chinese Statistical Bureau (2000). Zhang and Song (2000).

The regression equation consists of the following: Y is defined as the level of within-province income inequality in 1998; X_1 is the level of per capita FDI from 1986-98 (in US$1,000); X_2 is the ratio of agricultural labor productivity to labor productivity in non-agricultural sectors in 1998; and D is a dummy variable designating

inland border provinces (the inland border provinces of Yunnan, Xinjiang, Inner Mongolia, and Heilongjiang are assigned a value of 1 for this variable). Based on the aforementioned three hypotheses, we expect the coefficients of $X_1, X_2,$ and D to be positive, negative, and positive, respectively.

The following is the OLS estimate of the regression equation:

$$Y = 0.2452 + 0.1630X_1 - 0.6244X_2 + 0.1136D$$
$$(4.3120) \quad (2.8829) \quad (-2.6493) \quad (2.8622) \qquad n = 26 \quad \overline{R}^2 = 0.4061$$

where n is the number of observations (provinces), the values in parentheses are t-statistics, and $\overline{R}^2$ is the adjusted R-squared.

According to the regression result, all the explanatory variables display the expected sign and are significant at the 5% significance level in explaining the variation of within-province income inequality.[10] The result confirms all three hypotheses: (1) provinces with larger per capita FDI tend to have higher levels of within-province inequalities; (2) provinces with smaller ratios of agricultural labor productivity to labor productivity in non-agricultural sectors also tend to have higher levels of within-province inequalities; and (3) inland border provinces also tend to have higher levels of within-province inequalities. In sum, the central government's economic reforms in the 1980s and 1990s appear to have facilitated the geographical concentration of productive activities through increasing FDI inflows and international trade. This resulted in increasing the level of inequality not only between regions but also within some coastal and inland border provinces. At the same time, these policies have also maintained and, in some cases, intensified the dualistic structure of regional labor markets, thus also leading to higher levels of within-province inequalities.

5. Conclusion

The ratio of per capita GDP in the Eastern Region to the Western Region was 2.5 in

1998, thus confirming the widely held view that large economic disparities exist between the coastal and inland provinces. However, a two-stage inequality decomposition analysis based on district-level data revealed that the within-province inequality component accounted for 62 % of overall regional income inequality, while the between-region component contributed 27 %. Thus, within-province inequalities are more significant than between-region inequalities. Moreover, the rich coastal provinces of Guangdong, Fujian, Zhejiang, Jiangsu, and Liaoning recorded increasing levels of within-province inequality during 1995-98, thus amplifying the within-province component of overall inequality. These findings imply that the reduction of within-province inequalities (rather than between-region inequalities) would have the greatest efficacy in reducing overall regional income inequality, as measured by district-level GDP data.

There are, however, large variations in within-province inequality: whereas the highest level of within-province inequality was 0.416 in 1998, the lowest level was only 0.046. The inland border provinces and coastal provinces tend to have higher levels of within-province inequalities, whereas the inland non-border provinces tend to have lower levels of within-province inequalities. According to the regression analysis, cumulative per capita FDI and a dummy variable designating inland border provinces are found to be significant in explaining within-province inequality, thus indicating that the central government's economic reforms in the 1980s and the 1990s have facilitated the geographical concentration of productive activities through increasing FDI inflows and international trade. It was also found that economic dualism, as denoted by a low ratio of agricultural labor productivity to labor productivity in non-agricultural sectors, is another significant factor contributing to within-province inequality. As a result, in order to reduce within-province inequality, the government should strengthen industrial linkages between foreign-invested urban enterprises and rural enterprises, especially

rural township and village enterprises that have emerged during the second half of the 1980s as a major economic force in the Chinese economy. Given the restrictions on labor mobility between the rural and urban sectors, these industrial linkages would draw surplus rural labor away from the agricultural sector into rural manufacturing or service enterprises, thereby raising labor productivity in agriculture.[11] According to the regression results, this would, in turn, reduce within-province income inequalities.

Endnotes

[1] For a two-stage nested design in ANOVA, see, for example, Montgomery (1984).

[2] For the one-stage inequality decomposition method, see Anand (1983)

[3] See, for example, Akita, Lukman, and Yamada (1999), Akita and Szeto (2000), Anand (1983), Ching (1991), Estudillo (1997), Glewwe (1986), Ikemoto (1985), Jenkins (1995), Mookherjee and Shorrocks (1982), Tsakloglou (1993), and Tsui (1993).

[4] Table 1 presents the number of districts in each province.

[5] Akita, Yue, and Kawamura (1999) used provincial GDP, rather than district-level GDP, to estimate regional income inequality over the 1985-97 period.

[6] The central government has so far established 5 SEZs and 39 ETDZs mainly during the economic reforms in the 1980s.

[7] According to provincial GDP data from the China Statistical Yearbook, Xinjiang had a per capita GDP of 6,229 yuan in 1998, while Qinghai, the second richest province in the Western Region, had a per capita GDP of 4,367 yuan. There seems to be data inconsistency between provincial data and district-level data in the Western Region. If we use 6,229 yuan for Xinjiang and 4,367 yuan for Qinghai, then the Western Region's resulting level of between-province inequality would have been much higher than 0.02.

[8] Government-compiled population statistics based on the family register system do not reflect the actual population since they exclude those who do not have family registers in the district; however, the output of the excluded groups are included in the production statistics of the district. It is often assumed that such rapidly growing districts near Hong Kong as Shenzhen, Zhuhai, Guangzhou, Foshan, Dongguan, and Zhongshan in Guangdong province have, in fact, 50-100 % greater population than indicated in official population statistics. If, in fact, Shenzhen had 100 % greater population than its official population statistic, while Zhuhai, Guangzhou, Foshan, Dongguan, and Zhongshan had 50 % greater population than their respective official population statistics, Guangdong's within-province inequality would have been 0.258 in 1998. Though it is significantly lower than 0.416, this is still the highest level of inequality in the Eastern Region.

[9] In Xinjiang, Yunnan, Inner Mongolia, and Heijongjiang, there are, respectively, 3, 3, 2, and 2 open border cities, which were opened up for foreign investment and trade by the central government after 1979.

[10] Several other variables were tested, including the share of agriculture in output, the share of manufacturing in output, transport density, etc. However, none of these other explanatory variables were significant.

[11] Zhang, Findley, and Watson (1995) advanced a theoretical model that explains the relationship between the rural agricultural sector and the rural enterprise sector, given the current restrictions on labor mobility between the rural and urban sectors.

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