

# Study on Regional Income Inequality and Urbanization Mechanism in China

Akio Onishi, Ji Han, Hidefumi Imura, Yoshihiro Fukushima

## Abstract

China has been very successful at growing its economy since the start of economic reform in 1978. However, this rapid growth has also brought social issues in China. Currently, income inequality among regions is becoming one of the most notable issues. Within this socio-economic change, the release of resident registration system (“Hu-kou system”) has resulted in a great number of population migrations, and has caused the acceleration of urbanization in China. This urbanization must impact on environment, such as water use, energy consumption, land use change and pollution, etc..

This news letter measures the inequality among regions (Eastern region, Middle region, Western region) by using Gini coefficient and Theil index. Also, it estimates factors of inequality between Eastern region and Western region. Furthermore, mechanism of population migration is examined by using both nationwide time-series data and 2000 Census data.

## 1. Introduction

Since the start of economic reform in 1978, China has been experiencing a rapid socio-economic growth, accompanied by a dramatic changes, such as reform and opening-up, participation of WTO, expansion of regional gap, etc.. Within these changes, the release of resident registration system (“Hu-kou system”) has resulted in a great number of population migration, and has caused the acceleration of urbanization in China. The urbanization level grew from 18% to 36% from 1978 to 2000 in China. The total population migration from 1995 to 2000 amounted to over 100 million. The concentration of people in urban areas may contribute to economic growth by providing labors to urban development. On the other hand, this urbanization also has impacts on environment, such as water use, energy consumption, land use change and pollution, etc.. This report just focuses on the impact of human activity on water use, particularly on domestic water use. The regional income inequality and the mechanism of urbanization in China are analyzed in this report.

## 2. Regional Income inequality

Compared with 20 years ago or back to the 1980s, China's economy, measured by per capita GDP, is six times larger than before, and with an average annual growth rate at 9 %. The economy in provinces of eastern region grows much faster than those western inland areas (Figure 1). This spatial unbalanced economic growth has created a gap between regions in China. Generally, industrialization and urbanization are a pattern of

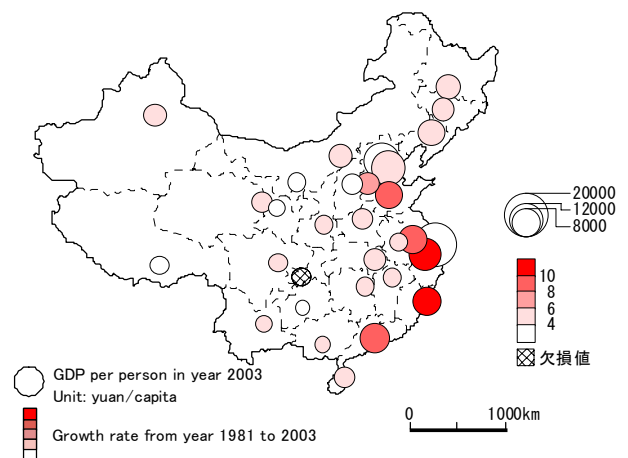


Figure1 GDP per person in 2003 and its growth rate from 1981-2003 in China

Notes: Eastern Region includes: Beijing, Tianjing, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, Hainan. Middle Region includes: Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Shannxi. The rest belong to Western Region.

socio-economic development. Therefore, people migrate to cities to enjoy their development, which

including advanced education, high income, good medical treatment, and etc.. However, it is difficult to absorb all of these migrants because of limitation of jobs, accommodation, resources etc.. By this reason, China has been facing the issue of sustainable urbanization today.

## 2.1 Index of inequality

Gini coefficient and Theil index are classic methods to measure the inequality of income or economy between regions. This section shows results by adopting these methods to understand the fact of regional inequality in China. The Gini coefficient is shown as equation (1) (Gini, 1912). The value of the Gini coefficient lies between 0 and 1, where 0 indicates perfect equality (where everyone has the same income) and 1 indicates perfect inequality (where one person possesses entire income). There are many forms of formula for calculating the Gini coefficient, although the basic principle is the same. The Gini coefficient is calculated by equation (1) when per capita GDP in each province lies in lower values.

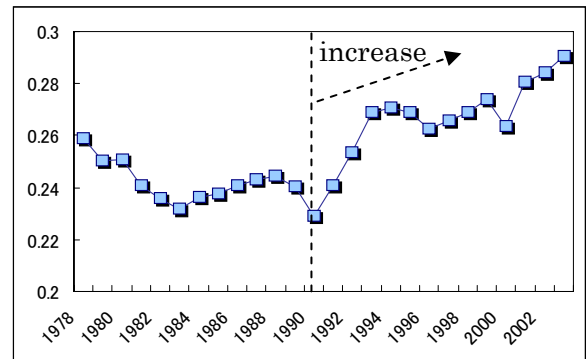
$$G_t = \frac{0.5 - \left[ \sum_{i=1} \frac{p_{i,t}q_{i,t} - (p_{i,t}\gamma_{i,t})}{2} \right]}{0.5} \quad (1)$$

$G$ : Gini coefficient,  $t$ : year (1978-2003),  $i$ : provinces,  $P$ : share of population,  $q$ : cumulated share of the GDP,  $\gamma$ : share of GDP

Result of the Gini coefficient was showed in Figure 2. It indicates that the inequality in China from 1978 to beginning of 1990s did not change dramatically. But after that, the disparity in China increased rapidly.

The Theil index, based on the concept of entropy, is defined by Theil (1967). It shares some characteristics with Gini coefficient, and ranges from 0 to 1. Theil index can show the contribution of intra-region inequality and inter-region inequality to total inequality.

**Figure 2 Trend of income inequality in China (Gini coefficient)**



$$T_p = \sum_i \sum_j \left( \frac{Y_{ij}}{Y} \right) \ln \left( \frac{Y_{ij}/Y}{P_{ij}/P} \right) \quad (2)$$

$Y_{ij}$ : income of  $j$  provinces (autonomous districts) in region  $i$ ,  $Y_i$ :  $\sum Y_{ij}$ , total of income in region  $i$ ,  $Y$ : total of income in China

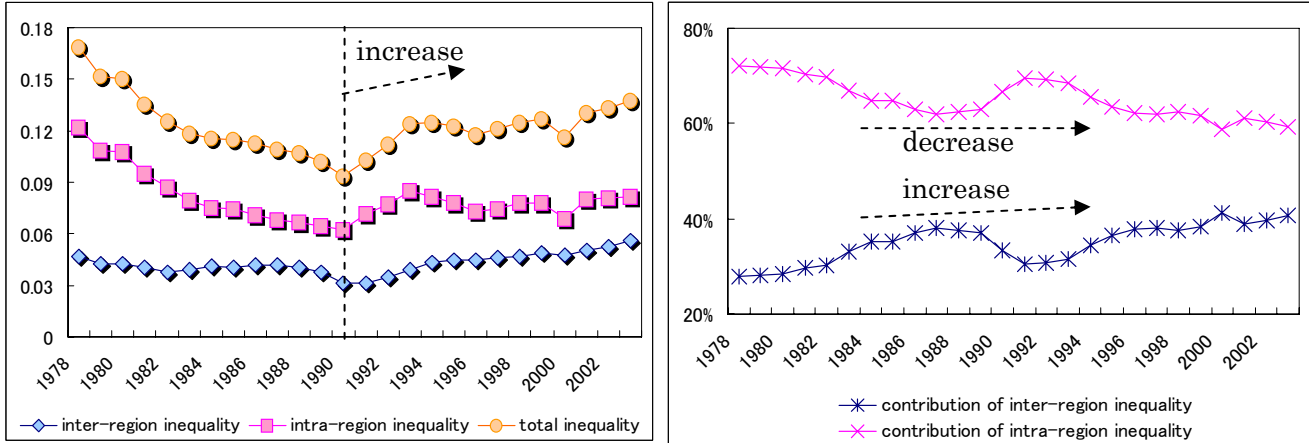
Income inequality in region  $i$  showed as  $T_{pi}$  can be defined by below equation;

$$T_{pi} = \sum_j \left( \frac{Y_{ij}}{Y_i} \right) \ln \left( \frac{Y_{ij}/Y_i}{P_{ij}/P_i} \right) \quad (3)$$

The Theil index is relatively easy for decomposition (as below) so that the contribution of

intra-region inequality and inter-region inequality to total inequality can be identified;

$$\begin{aligned}
 T_p &= \sum_i \left( \frac{Y_i}{Y} \right) T_{pi} + \sum_i \left( \frac{Y_i}{Y} \right) \ln \left( \frac{Y_i/Y}{P_i/P} \right) \\
 &= \sum_i \left( \frac{Y_i}{Y} \right) T_{pi} + T_{BR} \\
 &= T_{WR} + T_{BR}
 \end{aligned} \tag{4}$$



**Figure 3 Trend of income inequality in China (Theil index)**

Result of the Theil index was showed in Figure 3.

- The total inequality increases after 1990 in China same with the result of Gini coefficient.
- The inter-regional inequality has been increasing.
- On the other hand, the intra-regional inequality has been decreasing.

## 2.2 Factors of inequality

In this section, factors of inequality in China are analyzed by comparing Eastern region with Western region. In this analysis, data was from 1981 to 2000. And the regression model was showed as follows.

$$\ln(Y_{te} - Y_{tw}) = C + \alpha_1 \ln(E_{te} - E_{tw}) + \alpha_2 \ln(S_{te} - S_{tw}) + \alpha_3 \ln(I_{te} - I_{tw}) + \alpha_4 \ln(T_{te} - T_{tw}) + \mu_t \tag{5}$$

$Y_{te}$ : per capita GDP in Eastern region in t year (fixed value of 2000)

$Y_{tw}$ : per capita GDP in Western region in t year (fixed value of 2000)

$E_{te}$ : ratio of employees of the second and third industries in Eastern region in t year

$E_{tw}$ : ratio of employees of the second and third industries in Western coast region in t year

$S_{te}$ : ratio of productions of the second and third industries in Eastern region in t year

$S_{tw}$ : ratio of productions of the second and third industries in Western region in t year

$I_{te}$ : per capita of Investment in Capital Construction in Eastern region in t year (fixed value of 2000)

$I_{tw}$ : per capita of Investment in Capital Construction in Western region in t year (fixed value of 2000)

$T_{te}$ : per capita of total export in Eastern region in t year (US dallor)

$T_{tw}$ : per capita of total export in Western region in t year (US dallor)

$\mu_t$ : errors

- ① To identify the factors of inequality, four factors are selected as following; ① ratio of employees of the second and third industries, ② ratio of productions of the second and third industries, ③ per capita of Investment in Capital Construction, ④ per capita of total amount of

export. These factors suggest following meanings; ① inequality of job opportunity in the second and third industries, or inequality of speed of transformation to the second and third industries, ② inequality of speed of industrial transformation to the second and third industries, ③ inequality of investments which are to provide public services such as, water electricity, transport etc. by decision of governmental policy, ④ inequality of development of market economy.

The result was showed in Table 1.

**Table 1 Factors of inequality by comparing Eastern region with Western region**

Variables	Cochrane-Orcutt regression	
	coefficients	t statistic
<i>Constant</i>	3.91	7.40
$a_1$	0.41	2.72
$a_2$	-0.73	-3.42
$a_3$	0.16	3.05
$a_4$	0.51	6.16
<i>Adjusted R<sup>2</sup></i>		0.94
<i>Durbin-Watson statistic</i>		1.87

This figure indicates below results;

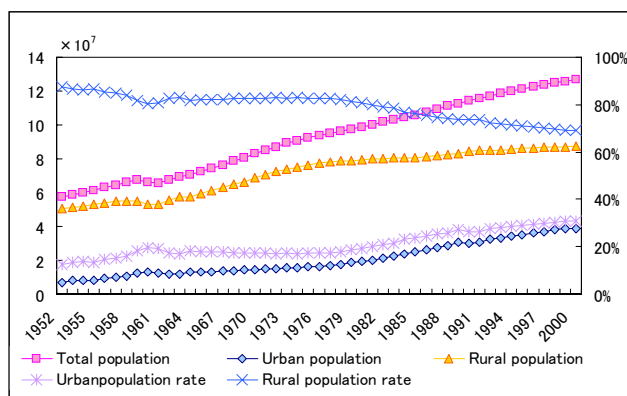
- The factors to show East-West inequality are meaningful in statistics.
- The development of the market economy is a high contributor for inequality. The market of Eastern region has been more opened to foreign trade, compared with Western region.
- The job opportunity in the second and third industries is a significant factor for inequality.
- On the other hand, the gap of industrial transformation has been smaller between East-West. This result shows that industrial change in Western region has been smoothly ongoing. However, the shift of labors from agriculture to industry and service sections has not directly followed by industrial transformation. It is the one of the key point to solve the inequality whether the local industry can absorb employees in the second and third industries or not.
- The investments which are set as an index of governmental policy are a significant factor for inequality. After start the free trade, government has invested intensively to the Eastern region. This policy may have enhanced the inequality in China.

### 3. Characteristics of Population Migration and Urbanization in China

#### 3.1 Scales and contribution of rural-to-urban migration to urbanization

The Figure 4 shows that urban population has been increasing and its rate become more than 30% of total population. On the other hand, rural population has been decreasing by less than 70% of total population (compare with 1952, it used to be 88%).

In order to see the contribution of migration to urbanization from 1983 to 2003, the urban population growth was decomposed into two parts: natural growth and net migration. As showed in table 2, the contribution of rural-to-urban migration to urban growth was 77% in 1983-1989, 67% in 1990-1995 and 86% in 1996-2003. It is obvious that the rural-to-urban migration turns out to be the dominant source of Chinese urban growth.



**Figure 4 Population change in Urban and rural**

**Table 2 Contribution of rural-to-urban migration to urban population growth**

Period	Annual growth of total urban pop. (million)	Annual natural growth of pop.		Annual net migration	
		Number (million)	Share (%)	Number (million)	Share (%)
1983-1989	11.52	2.69	23.3	8.83	76.7
1990-1995	9.39	3.08	32.8	6.31	67.2
1996-2003	21.50	2.96	13.8	18.54	86.2
1983-2003	14.71	2.90	19.7	11.81	80.3

Source: calculated from China Statistical Yearbook (NBS, 2000, 2004) and China Population Statistics

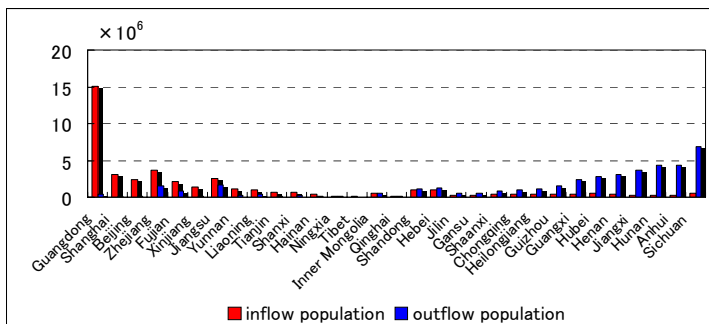
### 3.2 Spatial patterns of population migration

#### (A) Intra-provincial migration

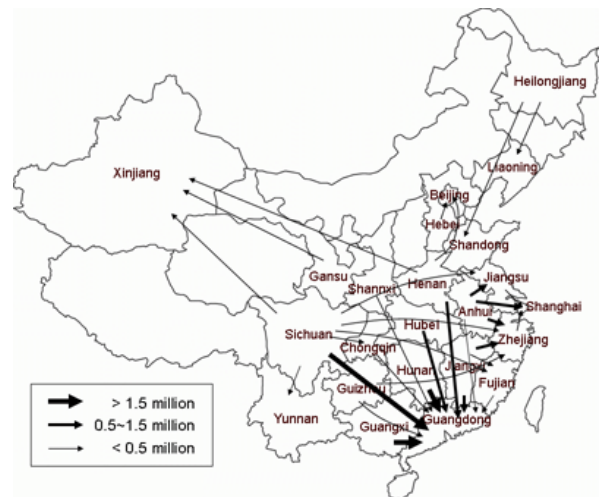
According to the 5<sup>th</sup> National Census in 2000, within the total 128 million migrants, 73% were identified as the intra-provincial migrants, while 27% belonged to inter-provincial migration.

#### (B) Inter-provincial migration

For inter-provincial migration, as showed in Figure 5 and 6, the migration was primarily from the middle and western regions toward the eastern region. Guangdong, Shanghai, Zhejiang and Beijing became the concentrated centers. While Sichuan, Hunan, Anhui, Jiangxi were the largest senders of emigrants.



**Figure 5 Provincial-level net in and out population migration (Unit: million)**



**Figure 6 The 31 largest inter-provincial migration flow in 1995-2000 in China**

#### (C) Migration between rural and urban areas

The total population migration can be divided into 4 categories in terms of the type of origin and destination. They are “rural-to-urban”, “rural-to-rural”, “urban-to-rural” and “urban-to-urban”. Among them, “rural-to-urban” was the largest one which shared 40.7% of the total migration. The second was “urban-to-urban” migration, which shared 37.2% of the total. The third was “rural-to-rural” migration, which shared 18.2% of the total. And “urban-to-rural” was the smallest, which only accounted for 3.9% of the total migration (Cai –Wang, 2003). In short, the primary population migration in China was the flow from rural areas to cities.

### 4. Analyses of the Mechanism of Population Migration

#### 4.1 Analysis of time-series data

As discussed in the theories of development economy (Harris-Todaro, 1970), rural-to-urban migration should be a consequence of economic development. The following model of national

migration with time-series data in 1983-2003 was used to validate the theoretical assumption in China.

$$\ln M_t = C + a_1 \ln Y_t + a_2 \ln G_t + a_3 \ln U_t + a_4 \ln R_t + a_5 \ln T \quad (6)$$

where, subscript  $t$  denotes year;  $M$  is net rural-to-urban migration;  $Y$  is urban/rural per capita income ratio;  $G$  is per capita GDP;  $U$  is unemployment rate in cities;  $R$  is rural population per arable land;  $T$  is time dummy;  $C$  is constant.

In order to eliminate the effect of multicollinearity among variables, stepwise estimation method was adopted. Table 3 shows the results with and without stepwise estimation.

**Table 3 Determinants of rural-to-urban migration in China 1983-2003**

Variables	Full model		Model with stepwise estimation	
	coefficients	$t$ statistic	coefficients	$t$ statistic
<i>Constant</i>	-16.44	-1.43	-21.74***	-4.87
<i>Y</i>	-1.63	-1.59		
<i>G</i>	4.32***	4.39	4.72***	6.12
<i>U</i>	-1.42*	-1.93	-1.82**	-2.66
<i>R</i>	-1.32	-0.38		
<i>T</i>	-2.61**	-2.41	-3.38***	-5.24
Adjusted $R^2$	0.76		0.75	
$F$ statistic	13.64***		21.18***	

\*Level of significance: 10%; \*\*Level of significance: 5%; \*\*\*Level of significance: 1%.

Economic level (measured by  $G$ ) has a significant and positive effect on rural-to-urban migration.

- Urban unemployment has a significant and negative effect on rural-to-urban migration.
- The variables of urban/rural income ratio and rural population per arable land were supposed to have positive effect on rural-to-urban migration. But during the period 1983-2003 in China, the ranges of urban/rural income ratio (1.9-3.2) and rural population per arable land (8.0-9.1) changed little, causing a migration that did not respond significantly to these two variables.
- The significant and negative coefficient of  $T$  indicates a downward time trend in the level of migration. This may result from the administrative controls on the rural-to-urban migration.

#### 4.2 Analysis of cross-section data

In order to further describe the patterns and mechanisms of population migration, an analytical model is established based on the cross-section data of 2000 Census.

$$\ln M_{ij} = C + \alpha_1 \ln(Y_j / Y_i) + \alpha_2 \ln(GDPR_j / GDPR_i) + \alpha_3 \ln(M_{ij} / \sum M_{ij}) + \alpha_4 \ln(DIS_{ij}) + \alpha_5 \ln(U_j / U_i) + \alpha_6 \ln(S_j / S_i) \quad (7)$$

where,  $M_{ij}$  is migration from province  $i$  to  $j$ ;  $Y$  is provincial per capita income;  $GDPR$  is annual growth rate of provincial GDP;  $M_{ij}/\sum M_{ij}$  is migration stock (measured by the proportion of emigrants from province  $i$  to each immigration province  $j$ . It implies the influence of old migrants on new migrants who plan to move);  $DIS_{ij}$  is distance between province  $i$  and  $j$  (measured by the shortest railway length between capital cities of two provinces);  $U$  is urban unemployment rate;  $S$  is share of the 2nd and 3rd industrial employment.

Table4 shows the results. And the major findings are as follows.

- In the eastern region, income gap is the most important determinant affecting migration.
- In the middle region, the share of second and third industrial employment is the most important

determinant affecting migration.

- In the western region, GDP growth rate is the most important determinant affecting migration.
- In whole China, income gap and migration stock have significant and positive effects on migration, while distance has a significant and negative effect on migration.
- In sum, the most important determinants of inter-provincial migration are income gap, migration stock and distance. Income gap and migration stock encourage migration while the distance discourages migration.

**Table 4 Determinants of inter-provincial migration in China (with stepwise estimation)**

Independent variables	Eastern Region		Middle Region		Western Region		Whole China	
	Coefficients	<i>t</i> statistic	Coefficients	<i>t</i> statistic	Coefficients	<i>t</i> statistic	Coefficients	<i>t</i> statistic
<i>Y</i>	0.84***	10.58			0.43**	2.39	0.62***	9.53
<i>GDP</i>					2.90***	7.17		
<i>Mstock</i>	0.77***	20.84	0.72***	21.52	0.66***	12.55	0.64***	23.89
<i>DIS</i>	-0.28***	-3.42	-0.42***	-5.00	-1.13***	-7.96	-0.83***	-13.17
<i>Unemploy</i>								
<i>S</i>			0.92***	6.59				
<i>Constant</i>	5.25***	9.98	6.69***	11.81	10.50***	11.63	8.74***	20.56
Adjusted <i>R</i> <sup>2</sup>	0.77		0.82		0.61		0.65	
<i>F</i> statistic	385.06***		433.87***		107.40***		567.27***	

\*Level of significance: 10%; \*\*Level of significance: 5%; \*\*\*Level of significance: 1%.

### Expected results for Next Steps

In this report, we showed the situation of regional income inequality and urbanization mechanism in China. The main findings are as follows;

- The inter-regional inequality has been increasing.
- This inequality has been created by inequality of job opportunity, miss leading of government policy, process of development of market economy.
- By this reason, after the release of resident registration system, people are inclining to migrate to more wealthy provinces, especially urban areas, in Eastern region.

Furthermore, we found some tasks to consider for next step;

- To more carefully identify inter-regional inequality, we should analyze what factors determine this inequality.
- To understand the impact of human activities such as migration and urbanization etc.on domestic water use.
- To more carefully identify other factors of migration.
- To expand socio-economic analysis to well understands the relationship between human activities and resources.

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