



CONVERGENCE CLUBS IN CHINA: A COMPARATIVE ANALYSIS OF EAST ASIA AND EMERGING NATIONS

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Abstract- This paper analyzes regional convergence clubs across provinces in China using the polarization index, and compares with their results of East Asia developed countries and Emerging Nations to find peculiar regional convergence to China. β -convergence has some methodological problems, and the empirical results of distribution approach depend on the periods of analysis. We use three polarization indexes which can measure bi-polarization in various years, and these indexes can supplement the distribution approach. China, Russia, and India have been forming two convergence clubs during economic liberalization and the high-growth period. The convergence exists in regional economic growth in Japan, Korea, and Brazil. Economic liberalization and rapid economic growth can affect bi-polarization.

Keywords- Convergence, China, comparative analysis, polarization

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Introduction

Can lower-income regions converge into higher-income regions in a country during a high-growth period? Developed countries have regional convergence across states in the period of economic rapid growth. The United States has clear evidence of regional convergence since the 1840s [1]. There are evidences of regional convergence in the United Kingdom, France, Japan, Germany, Italy, and Spain since the 1950s [2]. Canada has seen regional convergence since the 1960s [3]. And Persson [4] finds convergence in Sweden since the 1910s.

Emerging Nations have experienced rapid economic growth in the 2000s, except for the world recession. China is continuing with more than an 8% growth rate in the 2000s. India experienced 8% or 9% from 2003 to 2010 excluding 2008. Russia achieved more than 4% because of producing and export of natural resources in the 2000s. The annual growth rate of Brazil is 3.3% during the 2000s. These rates are not so high and not so low. As a result, the Emerging Nations' PPP-based GNI accounted for a quarter of the world's in 2010.

Not all regions in a country have experienced high economic growth, because Emerging Nations have large regional disparities in their large, diverse states. BRICs account for a 29% surface area share in the world in square kilometers. And Emerging Nations include some lower-income regions such as the northern region and northeastern region in Brazil, the North Caucasian Federal District of Russia, the eastern region in India, and the western area in China. If lower-income regions tend to grow faster than high-income regions in per-capita terms, the welfare of Emerging Nations and the world economy can increase.

Numerous studies have investigated regional convergence across all the states in Emerging Nations. Azzoni [5] shows that Brazil has β -convergence for the period of 1948 to 1995. Aiyar [6] finds conditional convergence across 19 Indian states since the 1970s. And previous studies find σ -convergence and β -convergence from 1987 to 1993 in China [7,8].

Quah [9] points out problems of β -convergence, which employs a cross-section regression approach. For example, if we have no sigma convergence, we can find results of β -convergence (Galton's Fallacy). Furthermore, β -convergence has the problems of econometrical methodology and data reliability [10]. So Quah [11] proposes a distribution approach that uses kernel density and the Markov transition. Previous studies employ Quah's framework to analyze convergence. Brazilian states, which are surrounded by higher-income states, tend to transit to higher-income classes [12]. Russian federal subjects have one convergence club for the period of 1994 to 2004, and Chinese provinces have two convergence clubs from 1978 to 2004 [13]. Bandyopadhyay [14] shows two convergence clubs using kernel density between 1965 and 1997. Kar, et al. [15] find a tendency towards the two modes in the ergodic distribution using the data of 21 major Indian states for the period of 1993 to 2005.

However, this distribution approach has methodological problems. The empirical results depend on the periods of analysis using the Markov transition, not the robust study from previous studies on Chinese convergences. Sakamoto and Islam [16] study the period from 1978 to 2003 and Herrerias, et al. [17] using data for the period of 1978 to 2005 find one convergence club in China. Herzfeld [13] analyzes the period of 1978 to 2004, He and Zhang [18] focus-

ing on 1985 to 2004, and Bhalla, et al. [19] employing the data period of 1978 to 1997 show two convergence clubs in China.

This paper analyzes regional convergence clubs across provinces in China using the polarization index, and compares with their results of East Asia developed countries and Emerging Nations. Our paper has two aims. Firstly, we use polarization index to estimate convergence. The polarization index does not use time series data but cross-section data. The polarization index can measure bi-polarization in various years, and this index can supplement the distribution approach. Secondly we find peculiar regional convergence to China. China is the one of the Emerging Nations and East Asian countries. The paper compare with their results of East Asia developed countries and Emerging Nations, such as Japan, Korea Rep., Brazil, Russia, and India.

The paper is organized as follows. Section 2 presents the polarization index methods. Section 3 discusses the data issues. Section 4 provides empirical results. The section 5 offers some concluding remarks.

Methods

The paper uses three polarization indexes: the Esteban and Ray index (ER), the Foster and Wolfson index (FW), and the Tsui and Wang index (TW).

The polarization index measures the “disappearing middle class.” First, there are four income classes, the highest, the higher middle, the lower middle, and the lowest. Second, the higher-middle-income class grows faster than the highest-income class, and these classes converge into the high-income pole. The high-income pole means a balanced growth path for high income class. This convergence means a higher convergence club. And the lowest- and lower-middle-income classes also converge into the low-income pole. The low-income pole is a balanced growth path for low income class. This convergence means a lower convergence club. Finally, these twin poles make the middle class disappear. These two poles means an increase in the value of the polarization index means bi-polarization in a country, when we divide into two groups across areas.

Esteban and Ray [20] say that polarization depends on alienation in society, and that identification influences alienation. The Esteban and Ray index (ER) is defined as follows:

$$ER = \sum_{i=1}^n \sum_{j=1}^n \pi_i^{1+\alpha} \pi_j \left| \mu_i - \mu_j \right| \quad (1)$$

where n is the number of groups; μ_i is the average income of i group, and we normalize average total income to 1; $|\mu_i - \mu_j|$ means dissimilarity; π_i , which means identification, is the population share of i group; and α is sensitivity to polarization, where $0 \leq \alpha \leq 1.6$, and we set α at 1.5.

It is noted that we divide all states into two groups to estimate bi-polarization in a country, $n = 2$. These two groups are the high-economy states group and the low-economy states group.

There remains an unsettled question with regard to the Esteban and Ray index as to how to divide into two groups. Aghevil and Mehran [21] show that a limit of two groups equals the average income of the total population. And the new index advanced by Esteban, et al. [22] divides into two groups based on average income. Therefore, the parameter for dividing into two groups is the average real GRP per capita for all states.

Wolfson [23] & Foster and Wolfson [24] focus on the “disappearing middle class,” and they discuss the relationship between the polarization curve and the Lorenz curve. The Foster and Wolfson [24] index (FW) is defined as follows:

$$FW = 4 \left\{ 0.5 - L(0.5) - \frac{Gini}{2} \right\} / \frac{m}{\mu} \quad (2)$$

where $L(0.5)$ is the income share of the poorest 50% of the population; m is median income; and μ is mean total income. The FW index means twice the area surrounded by the Lorenz curve and tangent line at m .

The paper defines m as the median of per capita income and μ as the mean total per capita income because we analyze bipolarization of GRP per capita across all states.

Wang and Tsui [25] developed the FW index. They generalized the FW index to satisfy the two partial ordering axioms of increased spread and increased bi-polarity. The Tsui and Wang index (TW) is expressed as follows:

$$TW = \frac{\theta}{N} \sum_{i=1}^n \pi_i \left| \frac{\mu_i - m}{m} \right|^r \quad (3)$$

where θ is a positive constant scalar, and we set θ at 1; N is the total population; and $r \in (0,1)$, and the paper sets $r = 0.5$.

Data

The paper focuses on the trend of regional growth bi-polarity across states in China, Japan, Korea Rep., Brazil, Russia, and India. We use the population data and real GRP of the states. GRP data are more reliable and useful than capital stock data.

There are 30 provinces, which are Beijing, Tianjin, Hebei, Shanxi, Neimengu, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang, during 1952 to 2012. Hainan is excluded because of missing data from 1952 to 1977. The real GRP is the 1979 value. The data are mainly from the Data of *Gross Domestic Product of China 1952-2004*, and the *China Statistical Yearbook*. The paper modified the population registered by the police (*hukou renkou*) to the residual population (*changzhu renkou*) based on [26]. The population registered by the police does not reflect migration from inland to coastal areas, and GRP per capita has large biases.

Our sample contains all 47 Japanese prefectures from 1955 to 2009. The GRP data are from *Statistical Observations of Prefectures*. We adjust real GRP to 1990 price. And population data are taken from Statistics Japan the *Population Census of Japan* and the *Population Estimates*.

This paper use data of 13 South Korean states from 1985 to 2007. We unify Jeollanam-do and Gwangju Metropolitan city; Chungcheongnam-do and Daejeon Metropolitan city; Gyeongsangnam-do and Ulsan-Metropolitan city. The real GRP are 2000 price. The data was from Statistics Korea. Population from 1986 to 1989 is resident population, population of 1985 and 1990 are census population, population of 1991 includes registered foreigner, and population since 1992 are registered Korean only. The population data are *Korea Statistical Yearbook 1996*, Statistics Korea, and Statistics of Gwangju Metropolitan city.

The sample of Brazil covers 20 states in 1947-66, 70, 75, 80, and 85-2010. The 20 states are Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Goiás and Distrito Federal and Tocantins, Maranhão, Mato Grosso and Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Paraná, Pernambuco, Piauí, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Santa Catarina, São Paulo, and Sergipe. We exclude Acre, Amapá, Rondônia, and Roraima from our analysis because of missing data. The paper unifies Goiás, Distrito Federal, and Tocantins into one state; furthermore Mato Grosso and Mato Grosso do Sul are unified. The population and 2000 real GRP data are obtained from the Brazilian Institute of Geography and Statistics (IBGE).

Data for Russia are 79 federal subjects from 1994 to 2009. The real per capita GRP is defined as the 1994 value price. The data come from the Federal State Statistics Service and *Region Roccii 1998*. The Arkhangelsk Region includes Nenets Autonomous District. And the Tyumen Region includes Khanty-Mansi Autonomous Okrug-Ugra and the Yamalo-Nenets Autonomous District. The Chechen Republic is excluded because of missing data.

Some states were divided in India in the 2000s. The paper unites 21 states from 1980/81-2007/08. The 21 states are Andhra Pradesh, Arunachal Pradesh, Assam, Bihār and Jharkhand, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh and Chhattisgarh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and Uttarakhand, West Bengal, Delhi, and Puducherry. Haryana, Jammu and Kashmir, Jharkhand, Mizoram, Nagaland, Sikkim, Tripura, A and N Islands, Chandigarh, D and N Haveli, Daman and Diu, and Lakshadweep are excluded because of lacking data for the period of 1980/81-2007/08. We use the 1993/94 value real GRP. The data come from the Ministry of Statistics and Programme Implementation.

Results

This study calculated the three polarization indexes, ER, FW, and TW, from East Asian developed countries' and all the Emerging Nations states' GRP per capita data sets: China (1952-2012), Japan (1955-2009), Korea (1985-2007), Brazil (1947-66, 70, 75, 80, and 85-2010), Russia (1994-2009), and India (1980-2008).

We now show regional σ -convergence across all the states in Emerging Nations and East Asian developed countries [Fig-1]. σ -convergences are calculated from the standard deviation.

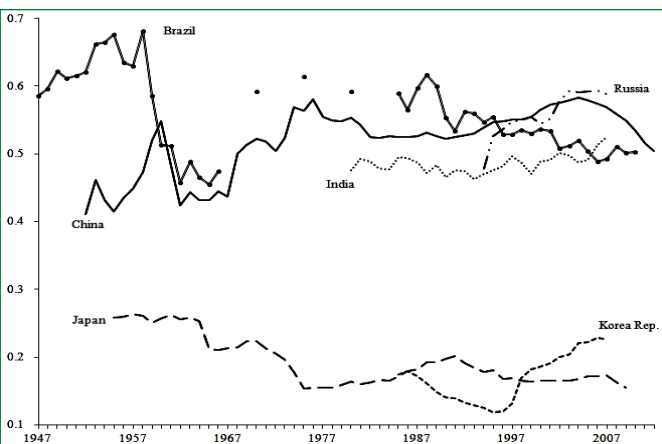


Fig. 1- σ -Convergence in Emerging Nations and East Asian developed countries

Note: We use the natural logarithm of per capita GRP.

We find that only Brazil has σ -convergence among Emerging Nations. Brazil has a downward trend for the period of the 1960s, 1990s, and 2000s. Russia rose sharply in the second half of the 1990s. Russia has σ -divergence. India stabilized in the 1980s and 1990s, and then went up during the late 2000s. China has had an overall upward trend since the 1950s. In particular, China increased sharply and steadily in the period of the Cultural Revolution and the 1990s. It is noted that China has declined steadily since 2005.

These results suggest that Brazil has probably not bi-polarized, and that Russia, India, and China have bi-polarized.

On the other hand, we can see that Japan has an overall downward trend since 1955. Korea Rep. has a U-shape trend. Japan and Korea Rep are East Asian developed countries. Previous studies show that developed countries have regional growth convergence across all states during the period of economic high growth. But Korea Rep has been diverging since 1996.

[Fig-2] shows that the three polarization indexes, ER, FW, and TW, have an overall upward trend in China from 1979. China definitely had bi-polarized during economic transition.

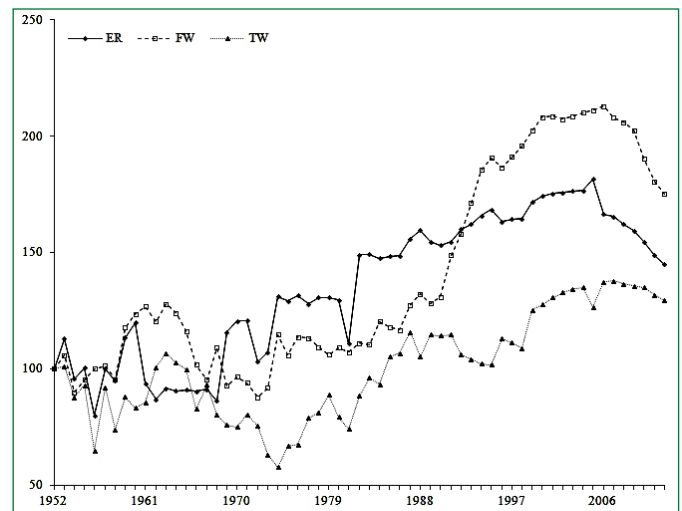


Fig. 2- Bi-polarization in China

Note: 1952=100.

China launched the Reform and Opening Up policy in 1978. The developing provinces in coastal area which are Jiangsu, Zhejiang, Fujian, Guangdong and Hainan have converged into developed provinces such as Beijing, Shanghai, and Tianjin. In the early of 1980s, specialized economic zone established in Guangdong, Fujian, and Hainan. These areas were designed to process and export goods. Especially, many manufacturing enterprises had been accumulated in Guangdong. Furthermore, Jiangsu and Zhejiang enjoyed economic development in Shanghai. These two provinces provided low wage labor and materials to Shanghai. Some foreign companies invested to these two provinces. In coastal area, regional disparities decreased.

On the other hand, most inland areas have experienced low economic growth. Inland area has poor natural and economic geographical condition. Many inland rural laborers have immigrated to coastal urban area. Senior citizens and children remain there, because registered household system have obstructed free population movement. Therefore, China has been forming two convergence clubs during economic transition.

It is noted that China has a downward trend since 2006. Several studies show that provincial GRP per capita disparity has been decreasing since the second half of 2000s. China launched regional development programs in the 2000s. Chinese government and enterprises have invested to Inland area. And Inner Mongolia has produced natural resources. In the second half of 2000s, economic growth rates of many inland provinces are higher than those of coastal provinces.

[Fig-3] indicates that Japan has a downward trend from 1955 to 1975. Japan had uni-polarized and converged across all prefectures in the rapid economic growth period. Enormous previous studies analyze evidences of regional convergence in developed countries in the period of high growth rate. Many labor forces moved to Tokyo. Japanese government invested infra structure to all prefectures. Thus regional disparity decreased in Japan in the period of rapid economic growth.

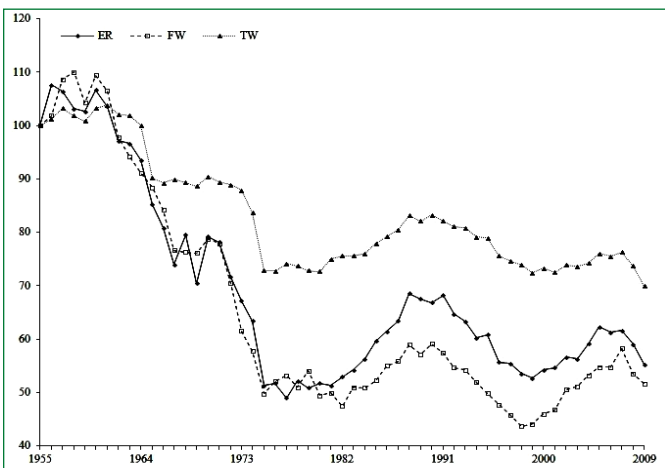


Fig. 3- Bi-polarization in Japan

Note: 1955=100.

The bi-polarization trend increased until bubble economy. In this period, Japanese Yen was very strong, and capital flowed into Japanese land market. Japanese asset price had accelerated rapidly. Regional disparity gradually increased. After burst bubble economy, Japan faced "Lost Two Decades". The bi-polarization trend has blipped somewhat.

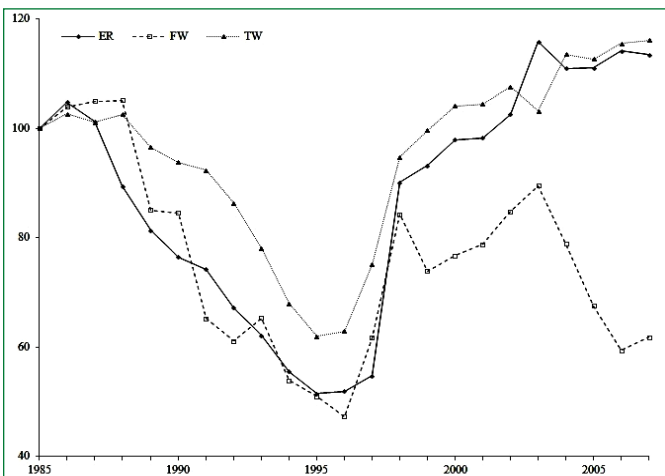


Fig. 4- Bi-polarization in Korea Rep.

Note: 1985=100.

Korea Rep. has a U-shaped bi-polarization trend [Fig-4]. Rapid economic growth started in the 1960s in Korea Rep. Korea Rep. has a convergence across states in this period. However, after 1997 Asian financial crisis, regional disparities and income inequalities have increased. It is important for Korea rep. to bi-polarize, because Korea rep. has traditional regional conflict.

[Fig-5] shows that the three polarization indexes, ER, FW, and TW, have an overall downward trend in Brazil. Since the 1950s, Brazil converged and uni-polarized across all the states in the 1990s and 2000s. Why did Brazil have one polarization?

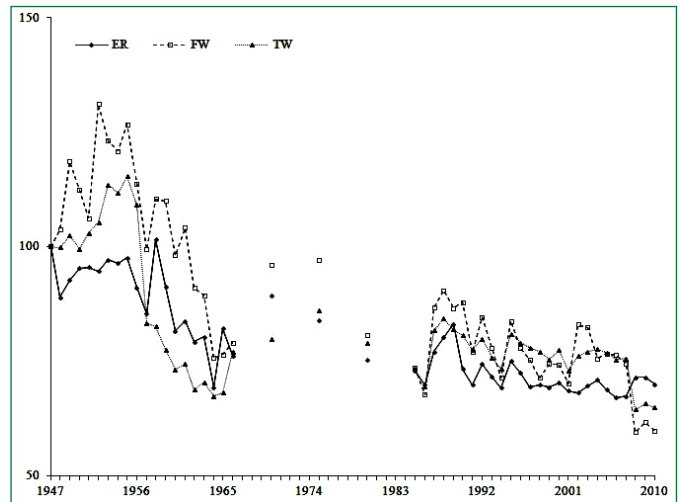


Fig. 5- Bi-polarization in Brazil

Note: 1947=100.

Brazil is different from other Emerging Nations, such as Russia, India, and China in growth rate terms [Table-1]. Brazil started regional development program and tax preference system since the 1960s. Brazil had a high economic growth rate of 8.5% in the 1970s. The poor northern area converged into the rich southern area in Brazil from the 1980s. The growth rate of Brazil is 3.3% in the 2000s. "Avanca Brazil" plan reformed rural-urban gap, labor, culture, environment and so on. The relationship between the convergence and growth rate of Brazil is similar to that of developed countries.

Table 1- Average annual GDP growth rate

	1960s	1970s	1980s	1990s	2000s
Japan	10.42%	4.07%	4.36%	1.45%	0.53%
Korea, Rep.	8.19%	8.26%	7.62%	6.15%	4.37%
China	1.96%	7.31%	9.70%	9.95%	10.28%
Brazil	5.85%	8.42%	2.89%	1.66%	3.30%
Russia	5.10%	3.50%	1.70%	-4.90%	5.37%
India	3.85%	2.85%	5.67%	5.71%	6.91%

Source: The figures are based on the World Bank website: (<http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/countries/1W?display=default>). The data of Russia in the 1960s, 1970s, and 1980s are based on Kuboniwa and Ponomarenko [27].

Note: The figure is a percentage of the arithmetic mean annual real GDP growth rate. The figure for Russia in the 1960s is the arithmetic mean of this rate from 1962 to 1969.

In Russia, the three polarization indexes rise rapidly from 1994 to 1997 [Fig-6]. And the three indexes show an overall upward trend in the 2000s. Russia bi-polarizes during economic transition and the period of rapid economic growth.

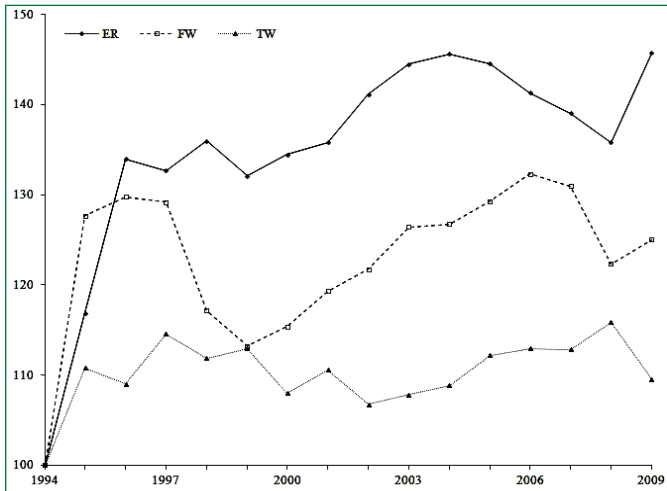


Fig. 6- Bi-polarization in Russia.

Note: 1994 = 100.

Russia initiated radical economic transition and faced economic crisis during the 1990s. Highest-economy federal subjects and lower-middle-economy federal subjects were damaged by this transition and crisis. In the 2000s, some high-income areas such as Khanty-Mansi and Yamalo-Nenets have increased with the output of oil and gas. However, the middle-income area did not converge into the high-income area. As a result, Russia has been forming two convergence clubs.

India has clearly bi-polarized [Fig-7]. The three polarization indexes increased sharply from 1991. India started economic liberalization in 1991. The southern area, with its accumulation of IT and finance industry, has converged into the western area. But the northern and eastern area has remained a poor economy. India has been forming two convergence clubs during the economic liberalization policy.

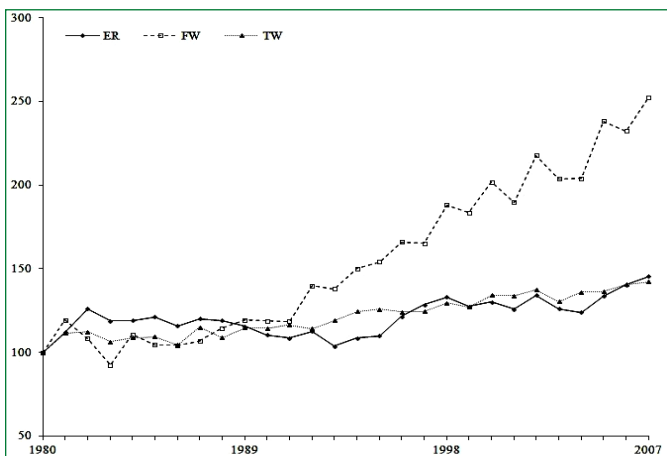


Fig. 7- Bi-polarization in India.

Note: 1980=100.

We find characteristic of convergence clubs in China. China, Japan, and Korea Rep have different trend of bi-polarization. China bi-polarized in the period of rapid economic growth, while Japan, Korea Rep., and Brazil had uni-polarized (converged) in the period. China, Russia, and India have steadily bi-polarized and have been forming two convergence clubs during economic transition and the high-growth period.

Especially China and India definitely bi-polarized in the period. China and India conducted open economy policy, and have received foreign direct investment and high technology. China and India developed the next highest economy region such as Guangdong, Fujian, Hainan, Jiangsu, and Zhejiang in China. These the next highest economy region grows faster than the highest economy region. Most low-income states have experienced low economic growth, because these states do not enjoy sufficient economic transition policy or economic liberalization policy. Thus economic transition and rapid economic growth make bi-polarization across states in a country.

Conclusion

This paper analyzes regional convergence clubs across provinces in China. In order to find characteristic Chinese regional convergence clubs, we compare the result of China with the results of Eastern Asian developed countries and Emerging Nations. And this paper uses three polarization indexes to reform methodological problems. β -convergence has some methodological problems, and the results depend on the period of analysis using the Markov transition. We use three polarization indexes, which are the Esteban and Ray index (ER), the Foster and Wolfson index (FW), and the Tsui and Wang index (TW).

The empirical results are as follows: (1) China definitely bi-polarized during economic transition. The coastal area has converged into developed areas such as Beijing, Shanghai, and Tianjin. Most inland areas have experienced low economic growth. (2) Russia and India also have steadily bi-polarized and have been forming two convergence clubs during economic liberalization and the high-growth period. The convergence exists in regional economic growth in Japan, Korea, and Brazil in their high economic growth periods. Thus, economic liberalization and rapid economic growth can affect bi-polarization.

Emerging Nations do not have a common trend of regional convergence. Brazil is different from Russia, India, and China in growth performance. Brazil launched rapid economic growth in the 1970s and its growth rate stabilized from 1% to 6% in the 2000s. Russia, India, and China cannot diminish their large regional disparities. Bi-polarization means the creation of twin peaks and two convergence clubs in a country.

In neoclassical growth model, club convergence could be generated in medium term, and technological progress increases in technological level, two convergence clubs could transit to one convergence club. Chinese government should launch technological progress and diffusion policy.

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