A Brief Survey on Regional Convergence in East Asian Economies

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<Abstract>
This paper surveys existing studies on regional income inequalities in East Asian economies. Existing studies provide various results, with some studies arguing the existence of regional convergence, while others argue the opposite results—even regarding the same country. Since there are several approaches to the convergence hypothesis, we should choose the best approach and examine the hypothesis with data from East Asian economies in order to evaluate this proposition more rigorously.

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1. Introduction

This paper surveys existing studies on regional income inequalities in East Asian economies. Empirical studies on the convergence hypothesis have mushroomed since the mid-1980s. The convergence hypothesis proposes that poor countries tend to catch up with rich ones in terms of the level of per capita income. Many empirical studies examine the hypothesis using cross-country data and find support for it, although they generally add the qualifier “conditional” before “convergence.” Conditional convergence means that poor countries tend to catch up with rich ones in terms of the level of per capita income—as long as they have similar economic characteristics, such as the level of human capital.

East Asian economies seem to represent good examples of poorer countries catching up with richer countries (Graph 1). Is this phenomenon the same among regions within the countries? If market mechanisms intrinsically function to improve income disparities among spatial units, regional income disparities also ought to disappear. There are, however, quite few studies on regional income inequalities in East Asian economies. The present paper surveys the approaches and results of existing studies in order to propose strategies for future research on this issue.

<Graph 1 here>

In the next section, we survey studies on regional income inequality in seven East Asian economies: Japan, Korea, Malaysia, Thailand, the Philippines, Indonesia, and China. In the last section, we summarize the results of these studies and propose
directions for future research.

2. Studies on regional income inequality in East Asia

2.1 Japan

As for regional income inequality, there are more studies on Japan than the other East Asian economies. In accordance with progress of the studies on the convergence hypothesis, the approaches to this issue are divided into three methods: the Barro regression, the Markov transition matrix and classical indexes.

(1) Approaches using the Barro regression

Barro and Sala-i-Martin (1992) initiated empirical studies on the regional convergence hypothesis with data on Japan and the U.S.A. and concluded that regional convergence existed. They proposed two concepts concerning convergence: \( \sigma \) - convergence and \( \beta \) - convergence. In their definition, the existence of \( \sigma \) - convergence means that the dispersion of real per capita income across groups of economies tends to fall over time; that of \( \beta \) - convergence means that there is a negative relationship between the growth rate of income per capita and the initial level of income.

To test \( \sigma \) - convergence, they take the standard deviation of the log of income,

\[
(1) \quad \sigma_t = \sqrt{\frac{1}{N} \sum_{i=1}^{N} \left[ \log y_{i,t} - \mu_t \right]^2}
\]

where \( y_{i,t} \) is the real per capita income for economy \( i \) (\( i = 1, \ldots, N \)) at time \( t \), \( N \) is the number of samples, and \( \mu_t \) is the sample mean of \( \log (y_{i,t}) \). Then, if the values of
\( \sigma \), decrease over time, it means that there exists \( \sigma \) - convergence.

To test \( \beta \) - convergence, the following equation is estimated (this equation is known as the Barro regression).

\[
(2) \quad \frac{1}{T} \log \left( \frac{y_{i,t_0 + T}}{y_{i,t_0}} \right) = \alpha - \left( \frac{1-e^{-\beta T}}{T} \right) \cdot \log(y_{i,t_0}) + u_{i,t_0 + T}
\]

where \( t_0 \) is the initial period and \( T \) is the length of sample period, \( \alpha \) and \( \beta \) are constants, with \( 0 < \beta < 1 \), and \( u_\beta \) is a disturbance term. The condition \( \beta > 0 \) means \( \beta \) - convergence because the growth rate \( \log \left( \frac{y_{i,t_0 + T}}{y_{i,t_0}} \right) \) is inversely related to the \( \log \) (\( y_{i,t_0} \)). If we add some explanatory variables, such as the level of human capital for economy \( i \), in the right hand side of the equation (2), we can test the conditional convergence hypothesis.

In Barro and Sala-i-Martin (1992), the authors estimated that the \( \beta \) coefficient is 0.0279 (s.e. = 0.0031) for Japan over the period 1930-1987. They also show that the values of \( \sigma \), decreased dramatically from 1940 to 1980. With these results, they argue that regional convergence existed in Japan. Sala-i-Martin (1996) also confirms this argument.\( \Box \) The Barro regression has been applied widely in analyses of the convergence hypothesis. Some examples include Koo (1998) for regional convergence in Korea, and Hosono and Toya (2000) for regional convergence in the Philippines.

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\(^1\) Sala-i-Martin (1996) argues the existence of regional convergence in the U.S.A., Japan, and five European nations with the same approach.
(2) Approaches using the Markov transition matrix

Quah (1993) criticizes approaches using the Barro regression and proposes an analysis using the Markov transition matrix, an alternative approach to test the convergence hypothesis. His criticism is as follows: Quah (1993) argues that the Barro regression is valid as long as the average growth rate is meaningful and covariation between the growth rate and the initial level of income indicate something stable. He argues that an average growth rate does not make sense when the growth rate shows high fluctuation over time and/or there are some shocks after the initial period. Quah (1996) also doubts a remarkable clustering of $\beta$ estimates around a 2% rate of convergence. This same value arises from very diverse geographical and time samples.\(^2\) He suggests that this uniformity might be born by unit root stochastic processes.

Analysis by the Markov transition matrix uses the following equation. $F_t$ denotes the distribution of income across regions at time $t$. $M$ maps one distribution into another. Then, the law of motion follows the Markov chain process as equation (3).

\[
F_{t+1} = M \cdot F_t
\]

Iteration such as $F_{t+s} = (M \cdot M \cdot \ldots \cdot M) \cdot F_t = M^s \cdot F_t$ yields future cross-section distributions. Taking the following equation to the limit as $S \to \infty$, one can obtain the likely long-run distribution of cross-section incomes. The distribution is termed an ergodic distribution. The calculation does not necessarily imply the existence of an

\(^2\) In Sala-i-Martin (1996), estimated $\beta$ coefficients for the U.S.A., Japan, and five European nations are from 0.010 (Italy) to 0.030 (UK).
ergodic distribution, but shows the characterization of tendencies that were actually realized. Convergence might be manifest in \( \{ F_{r,t} \} \) tending towards a point mass.

As for Japan’s regional convergence, Kawagoe (1999) and Braun and Kubota (1998) adopt this approach. Kawagoe (1999) uses data for gross prefectural production per capita from 1955 to 1991 and calculates ergodic distribution with five classes. The relative frequency of the ergodic distribution obtained is (0.15, 0.19, 0.20, 0.23, 0.22). He concludes that this ergodic distribution is close to a uniform distribution and offers evidence against the regional convergence hypothesis in Japan.\(^3\)

Braun and Kubota (1998) use data on prefectural per capita income from 1955 to 1994 and calculate ergodic distribution with eight classes. Other than the number of classes, their method is slightly different from Kawagoe’s.\(^4\) Kawagoe takes each prefecture’s per capita GDP relative to Japan’s average. On the other hand, Braun and Kubota (1998) take each prefecture’s per capita income relative to the income of Tokyo. The relative frequency of the ergodic distribution obtained is (0.00402, 0.01195, 0.05236, 0.1299, 0.2999, 0.3506, 0.1026, 0.04863). The mean of the ergodic distribution is 0.62 to Tokyo’s income. With this result, they conclude that there are two convergence clubs in Japan: Tokyo and others.

(3) Approaches using classical indexes

The above two approaches to the convergence hypothesis are relatively new. There are other approaches that have been used for a long time in studies of regional income inequality, such as the Theil’s measure and the coefficients of variation.

\(^3\) Strictly speaking, Kawagoe (1999) also uses a time-series econometric analysis to conclude the argument.

\(^4\) The number of sample regions in Braun and Kubota (1992) is also different from Kawagoe (1999). They exclude Okinawa prefecture from their sample due to issues of data availability.
Fujita and Tabuchi (1997) calculate the Theil’s measure of Japan’s interregional per capita income differential from 1955 to 1988. The Theil’s (unweighted) measure $T$ is defined by

$$T = \sum_{i=1}^{m} \frac{y_i}{\bar{y}} \log \frac{y_i}{\bar{y}}$$

where $y_i$ is the per capita income in region $i$ and $\bar{y}$ is the national average of the per capita income.

They conclude that regional income inequality in Japan shows bell-shaped curves for the period 1955-75: increasing in the first stage (1955-1961), and then decreasing in the second stage (1961-1975). They also found that interregional income inequality increases in the third stage (after 1975). They say that this trend is also observed by calculating the coefficient of variation.5

They explain this process as follows: in the first stage, the larger cities often experience high rates of economic growth, and so interregional income inequality tends to increase over time. Interregional movements of factors and products during the second stage gradually integrate regional factor markets; the regional income differential will be reduced. In the third stage, Japan experienced structural change. The high-tech and service industries became the leading sectors in Japan. Agglomeration economies comprise not only scale, localization, and urbanization, but also economies of interregional networks in transportation and communications. The authors show that the headquarters of Japanese firms became concentrated in Tokyo.

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5 The coefficient of variation is calculated by dividing the standard deviation by mean.
using data from 1985. They also point out that Japanese firms invested in foreign countries to build mass-production factories and established research and development facilities in Tokyo and Osaka. With these observations, Tokyo’s monopolarization and succeeding regional divergence after 1975 was the result of the concentration of knowledge intensive activities in core regions promoted by development of telecommunications and high-speed transportation.

Let us summarize the results of these empirical studies on the regional convergence hypothesis for Japan. Studies using the Barro regression, such as Barro and Sala-i-Martin (1992), argue that there exists regional convergence for Japan. On the other hand, studies using the Markov transition matrix, such as Kawagoe (1999) and Braun and Kubota (1998), provide some evidence against the regional convergence hypothesis in Japan. Fujita and Tabuchi (1997) show the fluctuation of the Theil’s measure about Japan’s regional income. Since their sample periods are almost the same, we cannot accept these various conclusions on Japan’s regional income. As the Theil’s measure is the basic index that represents regional income disparity, we have to accept the fact of fluctuation in Japan’s regional income inequality. In other words, there is no regional convergence in Japan.

2.2 Korea

Koo, Kim and Kim (1998) apply the Barro regression to the regional convergence hypothesis in Korea. The data used for this analysis are annual observation of per capita real regional products for the ten Korean provinces over the period 1967-1992: Seoul, Kyunggi, Kwangon, Chungbuk, Chungnam, Chonbuk, Chonnam, Kyungbuk,
Kyungnam (including Pusan), and Cheju. According to them, Korea’s regional income data are not available; they constructed regional product data from various sources.6

Koo, Kim and Kim (1998) estimate the Barro regression by the nonlinear least squares method. Their estimated $\beta$ coefficient is 0.0456 (s.e. =0.0087) for the period 1967-1992. They also show that the value of $\sigma$, declined from 0.31 in 1967 to 0.11 in 1992. With these results, they conclude that there exists regional convergence in Korea.

We have to be careful with their conclusion for the following three reasons: First, their sample observation is very small; there are only ten observations. Second, when they estimate the Barro regression for the five sub-periods of 1967-72, 1972-77, 1977-82, 1982-87, and 1987-92, the values of the estimated $\beta$ coefficient show large fluctuation and sometimes become statistically insignificant. Third, the value of $\sigma$, does not decline monotonically for the sample period. If we exclude the period of 1967-70 and 1992, the value of $\sigma$, does not give us the impression of declining.

2.3 Malaysia


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Melaka, Johor, Sarawak, and Sabah. He shows that the value of $\sigma$, increased monotonically from 1970 to 1985. With this result, he concludes that the dispersion of regional per capita GDP increased in Malaysia after 1975.

In order to find the background of this phenomenon, Togo (2000) observes the various data of each state. Then, he finds that the states having high per capita GDP, such as Selangor, achieved high growth rates of GDP with a substantial concentration of population and capital.

### 2.4 Thailand

Dixon (1999) observes the data on regional per capita GDP for the period from 1960 to 1993. The number of regions observed is seven: Bangkok Metropolitan Region (BMR), Centre, East, West, South, North, and North East. Although he does not show any statistical indexes or estimated results, he concludes that there is a divergence in per capita regional GDP in Thailand over the period under observation.

Dixon (1999) argues that the most significant disparity is between the BMR and the rest of Thailand. He also suggests that the extremely high level of regional income inequality in Thailand reflects long-established trends that government policy has done little to halt. Dixon (2000) reminds us that we cannot ignore the effect of government policy on regional income inequality when we examine the regional convergence hypothesis.

### 2.5 The Philippines

Hosono and Toya (2000) apply the Barro regression to the regional convergence

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7 Strictly, Kuala Lumpur is not a state but a federal territory.
hypothesis in the Philippines. They use data on per capita real GRP (gross regional product) for thirteen regions over 1975-1997. The thirteen regions are Metro Manila, Ilocos Region, Cagayan Valley, Central Luzon, Southern Tagalog, Bicol Region, Western Visayas, Central Visayas, Eastern Visayas, Western Mindanao, Northern Mindanao, Southern Mindanao, and Central Mindanao. They use the pooled OLS to test the convergence hypothesis, and estimate several kinds of regression. We here introduce some of their interesting results.

First, their estimated result rejects the trend of regional convergence for the whole sample period. In their estimation, the dependent variable is the growth rate of GDP per capita over 1975-1986 and 1986-1997 for 13 regions. Thus, the number of observations for this estimation is only 26. Second, their estimated results accept the hypothesis for the sub-period 1975-1986, but not for 1986-1997. In this estimation, the number of observations is only 13. Third, their estimated result accepts the conditional convergence for the whole sample period. They add the human capital indexes, such as the number of universities and higher education enrollment rates in engineering and technology, as explanatory variables in the Barro regression. The human capital indexes are positive and statistically significant. The degree of freedom for this estimation is at most 22 because they include a constant and a dummy variable for 1975-1986.

Since their sample is very small, we have to be careful with their results. The above second point, however, suggests an important factor that might affect regional income disparity. Their result denies the convergence hypothesis for 1986-1997. President Marcos lost his position and the Philippines started to open its domestic market in 1986—a result that indicates the possibility that globalization might
increase regional income inequality.

2.6 Indonesia

Takeda and Nakata (1998) study regional disparities in Indonesia. They use data on GDP per capita in 27 provinces. The interesting point of their study is that they calculate two different versions of the coefficient of variation of GDP per capita: including and excluding petroleum and gas production.

Their graph on the coefficient of variation from 1985 to 1996 clearly shows that the provincial disparities of GDP including petroleum and gas are consistently declining, and the provincial disparities of GDP excluding petroleum and gas are expanding. They indicate that this is due to petroleum and gas price fluctuations.

2.7 China

There are several studies on regional income disparities in China. Wei (2000) is one of the latest and arguably most comprehensive studies on this issue. Although his sample period is from 1952 to 1996, his study focuses primarily on the period after the economic reform in 1978. Wei (2000) calculates the coefficients of variation of GDP per capita for three (Eastern, Central, and Western) regions and 29 provinces respectively for the period 1978-96. His conclusion is as follows: Interregional inequality in China increased for the period 1978-96. The most rapid increase in interregional inequality was recorded in 1991-95. On the other hand, inter-provincial inequality declined for the period 1978-91 and stagnated for 1992-96.

Regional income disparity in China thus seems to be a highly complex issue. Wei

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8 The number of 29 provinces includes the three directly administered municipalities such as Beijing, Tianjin, and
(2000) explains the background of this phenomenon as follows: The decline of inter-provincial inequality is due to the fact that traditional leading provinces of Shanghai, Beijing, Tianjin, and Liaoning experienced slower growth, while the emerging coastal provinces such as Jiangsu, Guandong, Shangdong, Zhejiang, and Fujian experienced higher growth. He indicates tight control by the central state and difficulty in adjusting to the emerging economies as the reasons behind slower growth of the above four traditional leading provinces. The growth of rural enterprises, domestic and foreign investments, and international trade are indicated as the reasons for higher growth of the above five emerging coastal provinces (Wei 2000: 32). The increases of income in these coastal provinces naturally contribute to the increase of income in the Eastern region. This fact seems to bring about the increase of interregional inequality.

Wei (2000) also indicates that the central government decreed the coastal development strategy in 1988, which was designed to enable China to compete in the global market through the development of the coastal region. Thus, the coastal region has enjoyed various policies since then. This surely affects interregional inequality.

In my view, one of the reasons why inter-provincial inequality decreased in China is market integration. Markets for goods, labor, and capital seemed to be segmented before the reform in 1978. Markets are now getting integrated gradually, with prices for goods, labor and capital converging toward uniform prices. This process contributes to the decrease in inter-provincial inequality.

3. Summary and proposal for future research

Table 1 summarizes the results of existing studies on regional convergence in the
Countries for which studies support the convergence hypothesis are limited to Korea, the Philippines, and China. However, we should be careful with these results for the following reasons: Most studies just focus on the values of GDP per capita in regions, or some indexes representing income inequality. The values of GDP per capita in regions are affected by both policy and market mechanisms. Very few studies distinguish the two factors.

Inter-provincial inequality has been decreasing in China. However, the government implemented various policies to favor the coastal provinces. Then, the convergence of income among provinces might be the result of the government policies. Or, it might have been achieved by the market mechanism itself without government policies. This argument also applies to the other six countries.

Our interest is whether market mechanisms intrinsically function to improve income disparities among spatial units. Thus, we have to differentiate the effect of market mechanisms and the effect of government policies. If market mechanisms function to improve regional income inequality, this portends well for the future. If market mechanisms inherently tend to exacerbate divergences in regional income and policies to prevent such divergence are of limited effectiveness, our future looks bleaker.

Conventional approaches to the convergence hypothesis are varied: the Barro regression, the Markov transition matrix, and classical indexes. The Barro regression has the advantage of differentiating the effects of government policies and those of
market mechanisms. By introducing explanatory variables such as the amount of
public investments and dummies for regional policies into the right-hand side of the
Barro regression, we can distinguish the effect of market mechanisms from superficial
phenomenon. However, we have to remember the shortcomings of the Barro
regression that Quah (1993) criticized. Finally, the Markov transition matrix and
classical indexes can provide basic information about regional income inequality, but
they cannot differentiate between the effects of market mechanisms and those of
policies.

Therefore, I would like to propose the following steps to examine the convergence
hypothesis. First, we should pay attention to factor movements across regions. If
factors are not allowed to move freely across regions due to regulations or insufficient
transportation or communications, it means that markets do not function well. Then,
superficial income inequality could be the result of segmented markets, not the result of
market mechanisms.

Second, we should investigate the record of government policies. When labor and
capital can move freely across regions and regional incomes diverge, it might be the
result of market mechanisms or government policies. If the government does not
implement any regional policies (such as in the case of Thailand, as Dixon (1999)
argues), regional inequality is just the result of market mechanisms.

Third, we check the characteristics of regional policies as to whether they
ameliorate or exacerbate income inequality. If regional policies are designed to counter
inequality, and regional inequality still exists, it means that market mechanisms will
bring about further regional income inequality, outweighing government policies. If
regional policies are made without regard to issues of inequality and regional income
diverges, we have to differentiate two factors: government policies and market mechanisms. Further research must conduct econometric analyses, such as the Barro regression, with careful attention to these distinctions.
Graph 1:

Source: Summers=Heston Data Set
Table 1: Summary of regional convergence studies in East Asia

<table>
<thead>
<tr>
<th>Economies</th>
<th>Studies</th>
<th># of regions</th>
<th>Sample periods</th>
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<td>Barro and Sala-i-Martin (1992)</td>
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<td>1930–1987</td>
<td>Convergence</td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td>1988–1997</td>
<td>No convergence</td>
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* They also test σ convergence.
References