

Quantitative Tests for Income Level Convergence in Asian Countries

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Received 30 November 2018, Revised 18 March 2019, Accepted 25 March 2019

Abstract

Asian countries have been striving for economic integration for decades. This effort may lead to the convergence of income level through externalities across countries. This paper investigates whether the convergence phenomenon holds for income levels in Asian countries for the periods between 1975-2015 applying the traditional methodology of σ and β convergence. Although the absolute β -convergence of income levels in Asian and ASEAN+3 countries do hold, σ -convergence and conditional β -convergence of income level generally do not exist. This suggests that the benefits of economic integration in Asian countries were not yet realized to be significant. A plausible explanation is that the economies of Asian countries are largely based on low trade openness and a high level of informal economy.

Keywords: σ -convergence, β -convergence, Income Level, Growth, Asian countries

JEL Classifications: O47, O53

I. Introduction

In response to tighter market competition in the globalized world, many economies integrate with the purpose of increasing economic growth among its member-countries and protecting regional stability. For example, an Association of Southeast Asian Nations (ASEAN) was organized with five founding countries, namely Indonesia, Malaysia, Philippines,

Singapore, and Thailand on August 8, 1967. The membership was expanded to include Brunei, Cambodia, Lao PDR, Myanmar, and Vietnam. In order to increase market size and improve trade openness, the leaders of each country agreed the need to further integrate the nations in the Asian region. In December 1997, ASEAN+3 cooperation was established with three neighboring countries (China, Japan, and Korea), strengthening the cooperation of East Asian countries at various levels. On January 15, 2007, the ASEAN+3 extended its cooperation with Australia, India, and New Zealand, and established the ASEAN+6.

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From the viewpoint of economic theory, it is unclear whether regional economic integration leads to the convergence or divergence of income level among regional countries. If Solow model holds, then convergence of income level across countries hypothesizing that the income levels of poor economies will tend to grow at faster rates than those of rich economies given technology level is possible to happen (Solow 1956). In particular, if countries are similar with respect to structural parameters, neoclassical growth models, as developed by Ramsey (1928), Solow (1956), and others, predicted that a country's growth rate tends to be negatively related to its initial level of income.

However, the convergence of income level across countries has not been well supported in the several decades of empirical researches (e.g., Barro, 1991; Barro and Sala-i-Martin, 2003). Furthermore, endogenizing the source (or engine) of growth, such as technological progress (Arrow, 1962; Romer, 1986; 1990; and Lucas, 1988), human capital accumulation (Becker et. al., 1990; and Rebelo, 1991), trade openness (Grossman and Helpman, 1991), R&D (Aghion and Howitt, 1992), government spending (Barro, 1990), and others was attempted to explain the dynamic interaction between capital accumulation and economic growth, which is the central missing element of the neoclassical growth models. In other words, it becomes possible that investments in technology may lead to further increase in the gap of income level between rich and poor countries, resulting in economic divergence.

The purpose of this paper is to re-investigate whether the convergence or divergence of income level in Asian countries using a relatively long periods over 1975-2015. In other words, this study attempts to evaluate whether economic cooperation among Asian countries has contributed to the convergence phenomenon of income level among the regional countries over the past 40 years, applying the traditional methods of σ - and β -convergence. The paper also aims to determine the roles of investment, trade openness, human capital accumulation, government expenditure, and population growth in the economic growth of Asian countries.

II. Theoretical Background and Related Literature

The concept of convergence which is sometimes known as the "catch-up effect" is based on the hypothesis that the incomes of poorer economies' will tend to grow at faster rates than those of richer economies. As a result, all economies should eventually converge in terms of income level. This theory claims that developing countries have the potentiality to grow at faster rates than industrial countries because diminishing returns to capital are not as strong as in capital-rich countries. In addition, developing countries can easily replicate the production methods, technologies, and institutions of

industrial countries.¹⁾

The convergence phenomenon is possible to be quantitatively tested by applying the traditional methodology of σ -convergence and β -convergence. The ' σ -convergence' is defined in terms of cross-sectional dispersion of income level across countries (Barro and Sala-i-Martin, 2003). This type of convergence can be found if the dispersion (inequality) of income level across countries declines over time. The standard deviation of the logarithm of GDP per capita that decreases over time is being used to test the σ -convergence. Sala-i-Martin (1996) explained that the presence of σ -convergence phenomenon suggested an equalization of income level among countries.

Several studies examined whether the convergence of income level has occurred across countries. For example, Pritchett (1997) showed the divergence rather than convergence of income level in the world, since the standard deviation of the logarithm of GDP per capita has increased since 1870. That is, the growth rates of developing or non-industrialized countries have been, on average, slower than those of industrial or developed countries, producing divergence in relative incomes. O'Neill (1995) argued that inequalities among industrial countries have reduced, but the inequality between industrial countries and developing (and/or underdeveloped) countries have increased, comparing two periods of 1967 and 1985.

The β -convergence, on the other hand, is based on the Solow (1956) model which predicts that poor and rich countries will converge to the same level of income in the steady state with poor countries grow relatively faster than the rich countries. This type of convergence phenomenon is known as *absolute β -convergence*. Using available cross-country data and applying cross-section analysis, Barro (1991) found that the estimated coefficients of initial income demonstrated negative and statistically significant in the determination of average growth rate, suggesting the presence of absolute β -convergence.

Meanwhile, if the characteristics of each country are allowed, then the analysis should be modified. That is, each country has different steady state positions and parameters, such as investment, human capital accumulation, trade openness, population growth rate, and other policy variables; it is considered a concept of conditional β -convergence, which accommodates the idea that as an economy grows faster the further it is from its own steady state value.²⁾ The β -convergence generally tends to generate σ -convergence, but this process is offset by new disturbances that tend to increase dispersion (Barro and Sala-i-Martin, 2003). Hence, the σ and β -convergence normally used at the same time to examine the issue of convergence.

There exists several studies examined the convergence of income level in Asian

1) On the other hand, Baumol (1986) addressed that the convergence of income level implied the tendency towards convergence of product per work.

2) Refer to Barro and Sala-i-Martin (2003).

countries.³⁾ One of the significant attempts was Lim and McAleer (2004) who examined whether there exist a convergence club for five founding ASEAN member countries (ASEAN-5), as well as ASEAN-5 and the USA. In addition, individual countries in ASEAN were compared with the leader countries, such as Japan and USA. Lim and McAleer (2004) found that ASEAN countries are steadily but slowly converging towards common GDP per capita. This study was supported by Ismail (2008) who found strong evidence of σ - and β -convergence of income level in ASEAN countries. Ismail (2008) tested the hypothesis for absolute convergence using GDP per capita and the second stage where the lagged of GDP per capita as an independent variable measuring the convergence phenomenon and the share of investment in GDP, population growth rate, and time dummy as independent variables were applied to test for conditional convergence.

Another interesting study on the convergence issue is Chowdhary et al. (2011), which applied a log-linear model to estimate the values of β coefficients across the ASEAN countries over the period 1990-2008. Chowdhary et al. (2011) obtained that the low income economies, such as Cambodia, Lao PDR, and Vietnam are catching up with the high income economies, and thus supporting the hypothesis of Solow model (i.e., β -convergence). However, Khorshed (2005) examined the convergence of income level in ASEAN countries during 1960-2001

and found the absence of the σ - and β -convergence. Khorshed (2005) claimed that the low volume of intra-country trade, sluggish growth of exports and imports, and weak governance were the plausible reasons for the GDP per capita dispersion in the region.⁴⁾

The paper attempts to determine the existence of σ -convergence, absolute β -convergence, and conditional β -convergence of income level among 47 Asian countries, using a relatively long periods over 1975-2015. In addition, it is examined the σ -convergence of Asian countries, East Asian countries, South Asian countries, West Asian countries, ASEAN, and ASEAN+3, separately. The β -convergence is also identified using two samples of Asian countries and ASEAN+3 countries.

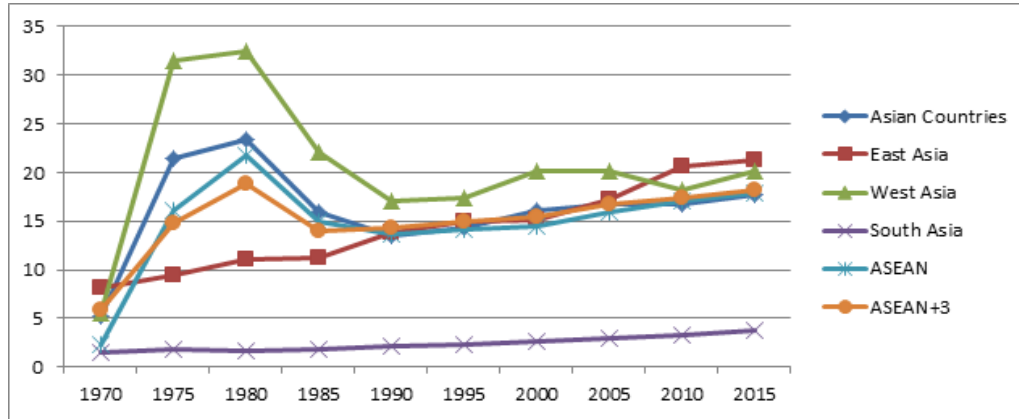
III. σ -Convergence

To assess the existence of σ -convergence in income level among Asian countries, the unweighted cross-sectional standard deviation of the real GDP per capita (henceforth PGDP) has been used. A group of economies are converging in the sense of σ if the dispersion of their income levels tends to decrease over time. Hence, it is used data on the annual PGDP at 2010 constant prices in US dollars obtained from the World Bank for the 47 countries (including Macao and Hong Kong) over the period 1975-2015.

3) A number of studies have been focused on the convergence of GDP per capita in European countries. Refer to Barro and Sala-i-Martin (2003) for the summary of this issue.

4) Meanwhile, Hwang, Jung and Kang. (2009) examined the convergence of social security transfer in OECD countries, and found that both σ - and β -convergence holds. The observation may be explained by the interdependence among OECD countries due to globalization.

Figure 1. Standard Deviation of GDP Per Capita Over Time



Note: A total of 47 countries are included in the sample for Asian countries. Countries such as North Korea and Syrian Arab Republic were excluded from the list due to data limitations. The countries included in East Asia region are China, Japan, South Korea, Mongolia, plus Hong Kong and Macao. The countries covered for the West Asia group include Armenia, Azerbaijan, Bahrain, Cyprus, Iran, Iraq, Israel, Georgia, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Turkey, UAE, and Yemen. Meanwhile, the countries included in the South Asian group include Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The ASEAN members, on the other hand, include Brunei, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Cambodia, and Vietnam. China, Japan, and S. Korea were added to form ASEAN+3. The remaining countries to complete the list include Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan and Timor Leste.

Aside from identifying the convergence of PGDP in Asian countries, additional tests are conducted to examine the existence of convergence phenomenon in several types of sub-samples, such as East Asian countries, West Asian countries, South Asian countries, ASEAN, and ASEAN+3.⁵⁾ The standard deviations of PGDP (in thousand US dollars) among Asian countries over time are shown in <Figure 1> and <Table 1>. It is shown that the standard deviation of PGDP in Asian countries significantly increased from 1970 to 1975 and reached a peak of

23.44 in 1980 and started to decline in 1985. After that, it can be seen that the standard deviation from 1995 and onwards gradually increased but still below 23.44. This pattern is similar to those in West Asian, ASEAN, and ASEAN+3 countries.

In other words, the σ -convergence phenomenon occurred from 1980 to the early 1990s, after that, a rather divergence phenomenon appeared in Asian, West Asian, ASEAN, and ASEAN +4 countries. Moreover, it can be noticed that the standard deviation of PGDP in East Asian and South Asian countries continuously increased with highest of 21.22 and 3.71, respectively, in 2015, suggesting increases in the dispersion of income level (i.e., divergence phenomenon). The sam-

5) As already mentioned, ASEAN countries include Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam, and the four countries, China, Japan, and Korea, were added due to regional integration (ASEAN+3). In addition, the classification of countries by region is based on the World Bank.

ple of East Asian counties (China, Hong Kong, Korea, Japan, Macao, and Mongolia) consisted of both growing and stagnant countries, and thus the income gap steadily increased. In addition, the standard deviation of PGDP in South Asian countries is considerably low, which means that the level of PGDP among countries

in the region is relatively similar. Therefore, it is hard to conclude that the σ -convergence phenomenon of income level occurred in Asian countries for the periods over 1975-2015. Rather, it is plausible to assume that the divergence phenomenon of income level has dominantly appeared.

Table 1. Standard Deviation of GDP Per Capita (in thousand USD)

	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
Asian Countries	5.22	21.48	23.44	15.92	13.49	14.38	16.16	16.73	16.78	17.72
East Asia	8.22	9.46	11.11	11.15	13.86	14.88	15.17	17.26	20.55	21.22
West Asia	5.49	31.50	32.44	22.16	17.08	17.44	20.14	20.07	18.17	20.07
South Asia	1.48	1.77	1.64	1.85	2.22	2.38	2.68	2.91	3.27	3.71
ASEAN	2.32	16.02	21.69	14.87	13.62	14.16	14.53	15.92	17.00	17.80
ASEAN+3	5.89	14.77	18.85	14.02	14.36	15.00	15.51	16.69	17.35	18.22

Note: Refer to the bottom of <Figure 1> for a list of countries in each sub-sample.

IV. β -Convergence

This paper also attempt to test for the existence of absolute and conditional β -convergence using the following data from the World Bank: economic growth rate, gross capital formation, trade share, secondary school enrollment, general government consumption expenditure, and population growth rate. Specifically, the economic growth rate is measured by the average growth rate (%) of PGDP for the 5 periods (1970-79, 1980-1989, 1990-1999, 2000-2009, and 2010-2015). The absolute β -convergence of income level is tested by regressing the following empirical equation:

$$GGDP_{it} = c + \beta_1 \log(PGDP)_{it} + \varepsilon_{it} \quad (1)$$

Here, GGDP is economic growth rate; subscripts *i* and *t* of the dependent variable signify countries and the 5 periods (1970-79, 1980-1989, 1990-1999, 2000-2009, and 2010-2015), respectively; *c* is a constant term; β_1 is the estimated coefficients of $\log(PGDP)$; subscripts *i* and *t* of the explanatory variable denote countries and the 5 years (1970, 1980, 1990, 2000, and 2010), respectively; and ε is an error term. Of particular interest is the sign and statistical significance of the estimated coefficient of β_1 . A negative and significant value for β_1 implies the absolute β -convergence of income levels exists.

Moreover, we use two types of samples, such as Asian countries and ASEAN+3 countries. The regression uses panel analysis with pooled least squares (pooled LS) to increase the number of observations, and fixed effect (FE) or random effect (RE) model to accommodate each country's characteristics. The fixed effect model uses a fixed average value of time ser-

ies and cross-section characteristics, and the random effect model uses an error term for time series and cross-section characteristics. The selection of FE or RE is determined by the result of the Hausman test. <Table 2> presents the results for the existence of absolute-convergence of income level in Asian and ASEAN+3 countries.

Table 2. Estimated Results on the Absolute β -Convergence of Income Level
 Dependent variable: economic growth rate (1970-1979, 1980-1989, 1990-1999, 2000-2009, and 2010-2015)

	Asian countries			ASEAN+3 countries		
	(A) Pooled LS	(B) FE /	(C) RE	(D) Pooled LS	(E) FE	(F) RE
Constant	7.81*** (5.03)	7.95*** (5.81)	8.06*** (5.21)	10.41*** (4.04)	10.64*** (5.93)	9.77*** (4.23)
log (PGDP)	-0.61*** (-3.24)	-0.63*** (-3.79)	-0.64*** (-3.46)	-0.79** (-2.34)	-0.82*** (-3.72)	-0.71** (-2.53)
R2	0.07	0.14	0.06	0.21	0.25	0.11
Observations	180	180	180	57	57	57
[p-value]	-	2.75 [0.08]	2.75 [0.08]	-	0.62 [0.43]	0.62 [0.43]

- Notes: 1. t-statistics are provided in parentheses.
 2. In models using the Pooled LS method, t-statistics are based on the White's heteroskedasticity-consistent standard errors and covariance.
 3. (***) and (**): significant at 1 and 5 percent levels, respectively.

All estimated coefficients of log (PGDP) in <Table 2> have negative signs and statistically significant, implying that absolute β -convergence of income level holds, regardless of the estimation methods and sample selections. That is, a country with a low level of initial income shows a relatively large increase in PGDP. For example, a one unit increase in log (PGDP) is negatively associated with the economic growth rate by about 0.61 points in Model (A). However, the results in <Table 2> did not consider other explanatory variables that could affect the economic growth rate. The analysis will

be proceeded to examine the existence of conditional β -convergence of income level that includes various explanatory variables affecting the economic growth rate. Thus, the conditional β -convergence can be tested by estimating the following equation:

$$GGDP_{it} = c + \beta_1 \log(PGDP)_{it} + \sum_{j=1}^5 \gamma_{jt} X_{it} + \varepsilon_{it} \quad (2)$$

Equation (2) is identical to Equation (1), except that a series of explanatory variables X are included (i.e., γ_j ($j=1 \dots 5$) are the estimated coefficients of X). That

is, a series of variables, such as gross capital formation, secondary school enrollment, trade share, general government consumption expenditure, and population growth rate in addition to PGDP are controlled to estimate the Equation (2). Specifically, the gross capital formation (henceforth GCF) and secondary school enrollment (henceforth SSE) reflect the investment in physical capital and human capital, respectively, which are the major components of economic growth (Barro and Sala-i-Martin, 2003). Data on GCF is measured by the percentage of expenditure on gross capital formation in GDP, and SSE represents total enrollment in secondary education, regardless of age, divided by the population of the official secondary age.

In addition, the economic growth literature suggests that trade openness, government activity, and population growth rate may affect the growth rate. The traditional measure of trade openness, the share of trade in GDP (henceforth OPEN), is considered. It is generally accepted that free trade promotes economic growth by specializing in comparative advantage, adopting a new technology through investment and exposure to new goods, exploiting increasing returns from the larger markets, and so on (e.g., Frankel and Romer, 1999; Grossman and Helpman, 1991). Government activity is denoted by the percentage of general government consumption to GDP (henceforth GOV). Theoretically, it is unclear whether GOV affects growth because of the existence of a tradeoff between tax distortions and direct benefits from GOV. Finally, the population growth rate

(henceforth POPG) is considered as another explanatory variable, and it is anticipated a negative impact on economic growth (Solow, 1956).

Regression results on the conditional β -convergence of income level among Asian and ASEAN+3 countries are summarized in <Table 3>, in which two different samples and estimation methods are considered to induce robust results. Regardless of the estimation methods, the estimated coefficients of $\log(\text{PGDP})$ have negative signs but statistically insignificant in Asian countries, implying that conditional β -convergence of income level does not hold. The estimation result in the sample of ASEAN+3 countries depends on estimation methods. That is, the negative coefficient of $\log(\text{PGDP})$ is statistically significant at the 5% significance level in Model (C) using Pooled LS. However, the estimated coefficient of $\log(\text{PGDP})$ in Model (D), taking into account the characteristics of each country, is statistically insignificant at the traditional significance level.

Therefore, it is possible to conclude that conditional β -convergence of income level does not hold in Asian countries. In addition, the conditional β -convergence of income level is not established in ASEAN+3 countries when considering each country's characteristics. The estimation coefficients of other explanatory variables are observed to be statistically insignificant except for some coefficients. That is, the estimation coefficients of GCF and OPEN are positive and statistically significant in Model (C), which means that investment and trade openness can play a major role in the economic growth.

Only the estimated coefficients of POPG are negative and statistically significant without the selections of sample and estimation method, which is consistent with the Solow model.

We can summarize the above empirical results as follows. Although it is observed the absolute β -convergence of income level in Asian and ASEAN+3 countries for the periods over 1975-2015, it is easily disputed by considering each country's characteristics. In other words, the σ

-convergence of income level does not occur since the mid-1990s, but rather divergence phenomena appears in East Asia, West Asia, South Asia, ASEAN, and ASEAN+3 as well as Asian countries. Moreover, the conditional β -convergence of income level does not hold in most estimation. The results are partially consistent with Khorshed (2005), but in disagreement with Ismail (2008) and Lim and McAleer (2004).

Table 3. Estimated Results on the Conditional β -Convergence of Income Level

Dependent variable: economic growth rate (1970-1979, 1980-1989, 1990-1999, 2000-2009, and 2010-2015)

	Asian countries			ASEAN+3 countries		
	(A) Pooled LS	(B) FE	(C) RE	(D) Pooled LS	(E) FE	(F) RE
Constant	6.18*** (3.35)	5.61*** (3.58)	7.45*** (3.83)	12.89*** (6.83)	8.47*** (3.45)	11.55*** (3.99)
log (PGDP)	-0.21 (-0.91)	-0.23 (-1.03)	-0.32 (-1.10)	-1.04** (-2.54)	-0.11 (-0.13)	-0.67 (1.41)
GCF	0.053 (1.43)	0.03*** (2.68)	0.03 (1.05)	0.10*** (3.37)	-0.01 (-0.14)	0.06 (1.62)
SSE	-0.02 (-1.53)	-0.02 (1.43)	-0.02 (-1.22)	-0.03 (-1.00)	-0.04 (-1.54)	-0.04** (-2.03)
OPEN	0.01 (1.60)	0.001 (1.40)	0.001 (0.24)	0.01** (2.56)	-0.01 (-0.79)	0.01 (1.04)
GOV	-0.04 (-1.49)	-0.04 (-1.44)	-0.03 (-1.00)	0.04 (0.41)	-0.03 (-0.20)	0.02 (0.17)
POPG	-0.66** (-2.12)	-0.56 (-2.84)	-0.56*** (-2.86)	-1.24* (-1.79)	-0.59** (-2.17)	-0.90** (-2.39)
R2	0.20	0.27	0.12	0.53	0.84	0.42
Observations	119	119	119	40	40	40
[p-value]	-	8.07 [0.23]	8.07 [0.23]	-	14.18 [0.03]	14.18 [0.03]

Notes: 1. t-statistics are provided in parentheses.

2. In models using the Pooled LS method, t-statistics are based on the White's heteroskedasticity-consistent standard errors and covariance.

3. (***), (**), and (*): significant at 1, 5, and 10 percent levels, respectively.

Therefore, it is hard to conclude that income levels in Asian countries are converging for the periods over 1975-2015. This suggests that many Asian developing countries are not significantly enjoyed the benefits of economic integration in the region. Alternatively, the precondition for economic integration in Asian countries is not practically in progress. The plausible reasons why income levels among Asian countries do not converge are presumably from the fact that many Asian countries have relatively low trade openness, weak governance, large shadow economy, and low physical and human capital accumulations, which hindering the economic growth.

V. Conclusion

Since the late 1960s, economic cooper-

ation among Asian countries has been steadily strengthening, and hence increasing interdependence of economic activity. This paper empirically examined whether the convergence of income level holds, based on panel data in Asian countries over the period 1975-2015. It is found that σ -convergence of income level does not exist, as its standard deviation has increased among Asian countries since the mid-1990s. In addition, the initial level of GDP per capita has statistically insignificant impacts on the economic growth rate after controlling several explanatory variables, leading to conditional β -convergence of income level does not appear. Therefore, it is identified that there was not much influence of externalities due to economic integration among countries in Asian region. It can be assumed that Asian countries are largely based on low trade openness and a high level of informal economy.

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