Forman Journal of Economic Studies
Vol. 14, 2018 (January–December) pp. 125-141 DOI: 10.32368/FJES.20181406

An Analysis of Income Convergence across Asian Countries

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Abstract

The development process in Asia over past few decades has given rise to widespread income disparities. Present study is conducted to examine the income convergence process for a set of 40 Asian countries for the time period 1980 to 2016.The study has utilized pooled least square methodology with time dummies and cross section weights standard errors (PCSE). Empirical results support the presence of conditional convergence in Asian region which is further established by including population growth, inflation rate, unemployment rate, exports growth and openness as control variables. Disparity level (distance from average steady state) for each Asian country is also assessed by using demeaned values to understand the relative position of each country. Furthermore, the study provides estimates of average speed of convergence (how many years to reach steady state) for each country as well.

Keywords: Convergence Hypothesis, Absolute Convergence, Conditional Convergence, Pooled Least Square, Disparity Level.

JEL Classification: C23, F43, C61, O16

I. Introduction

In recent years focus of Macroeconomics has shifted from short term economic fluctuations to long term economic growth. Greater economic growth augments investment creates more employment opportunities and improves living standards. Economists are now consistently focusing on overall welfare and well-being which is hard to be achieved without adequate economic growth. Business cycles being a short run phenomenon are now considered somewhat less important as compared to long term economic growth regarding welfare consequences. This renewal of interest in economic growth has not only led to the re-examination of traditional neoclassical models but also to the emergence of new growth theories. These approaches being based on differing sets of assumptions provide unalike explanation of the economic growth process and its insinuations.

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Convergence hypothesis, an important inference of classical growth theory is described as a process of narrowing down the gap between per capita incomes of developed and developing countries. Absolute convergence occurs when countries have homogenous features and attain the same level of long-term income growth. Conditional convergence, however, implies that each country in long run will converge to its own steady state in accordance to its factor endowments. Convergence debate was originally initiated by Solow (1956) and further developed and refined by Baumol (1986) and Barro et al. (1991). Barro (2000) resolved that absolute convergence can take place only if all countries have identical factor endowments. Conditional convergence, on the other hand, suggests that economies with similar features are more likely to experience income convergence regardless of their initial condition. These findings were further strengthened by Barro and Sala-I-Martin (1997) and Barro (2000). Murthy and Ukpolo (1999) investigated convergence process in African region for the time period 1960 to 1985 and concluded the occurrence of conditional convergence in the region. Income convergence being an important corollary of neo classical growth model is also considered as an assessment of the Solow (1956) neoclassical growth model in comparison to the endogenous growth model pioneered by Lucas (1988) and Romer (1986). Convergence tests have also been utilized to evaluate the presence or absence of increasing returns to scale in the growth process. Hence, the convergence hypothesis has important implications for modern macroeconomic theory.

Asia is the largest continent containing approximately 60% of the total world population. Some Asian countries have experienced marvelous economic growth during past three decades. However, the dividends of economic growth in Asia are very unequally distributed and resultantly it is still house to more than half of the world's poorest people. It has both the most developed and most deprived areas of the world giving rise to greater income and non-income disparities. Keeping in view the prevailing circumstances of Asia the convergence debate becomes very relevant. It is important to investigate whether the Asian countries lagging will ever be able to catch up the high performers.

The convergence process in Asia has been the subject of many previous empirical studies. Different methodologies adopted by different researchers have given rise to diverse outcomes in terms of conclusions. It is in this background that present study aims at further refining the evidence in this regard by utilizing updated data and latest methodology. The analysis is based on a data set covering 40 Asian countries. The study can be considered a significant addition to the existing literature as it also provides estimates of disparity level for each Asian

country in relation to average steady state. Population growth, inflation rate, unemployment rate, exports growth and openness are incorporated as control variables to evaluate the convergence hypothesis. The analysis is expected to aid policy makers to better apprehend the gaps among countries, nature of convergence, speed of convergence and disparity level for each country.

2. Literature Review

Evans and Kim (2005) utilized dynamic random variable model for a set of 17 Asian countries using data from 1960 to 1992 to test the convergence hypothesis. The study concluded that these countries converge to their steady states at a rate of 2% per annum. Ismail (2008) used pooled mean group estimator (PMGE) to test convergence hypothesis for ASEAN region and established the incidence of both absolute and conditional convergence. Masron and Yusop (2008) linked convergence in ASEAN region to the degree of economic openness particularly when outer jolts were leading to income inequalities among ASEAN countries. Andres et al (1996) investigated the convergence hypothesis for OECD region by incorporating set of control variables i.e. inflation rate, exports growth and public sector expenditure. The results of the study were however not significantly different from previous ones. Nahar and Inder (2002) analyzed convergence hypotheses for OECD countries in relation to USA for the time period from 1950 to 1998. All countries except Germany, Iceland and Norway indicated strong convergence tendency towards their average income. Milanovic (2003) analyzed convergence hypotheses for a set of 17 developed countries. The analysis found no support for income convergence during the pre-war era of 1870-1913, however it concluded the existence of convergence during inter war period.

Sarkar (1997) utilized dataset of 110 countries and did not find enough evidence to support absolute convergence hypothesis. Ahmad (2008) supported his argument of no-convergence by including corruption as a strong leading indicator in his model. Barro and Sala-i-Martin (1997) supported the absence of convergence based on the lack of technological diffusion. Mazumdar (2002) examined the convergence hypothesis for human development from 1960 to 1995 for a set of 91 countries classified into 3 groups based on their levels of human development. The analysis concluded that the gaps in human development among these countries were not reducing over time. Konya and Guison (2008) examined the convergence hypothesis for the world based on human development index from 1975 to 2004 and concluded that poor countries are growing faster than the

richer ones by improving their human development however; these consequences were rejected for European Union countries.

Ferreira (2000) and Azzoni (2001) analyzed the case of Brazil by testing convergence hypothesis and established a strong empirical support for conditional convergence in Brazil with higher values of coefficients in 1970's as compared to other time periods. Azzoni (2001) concluded a strong convergence after 1970's while it did not exist before 1970's in Brazil. Nagaraj et al (1998) Michelis et al (2004) and Kim (2005) advocated the existence of a strong convergence in Indian and Korean region as compared to the Greek region. Nonneman and Vanhoudt (1996) strongly supported the idea of absolute convergence for a set of homogenous OECD countries. Knack (1996) analyzed the influence of different factors on the speed of convergence and found quality of institutions to be the strongest factor in this regard. Jones (2002) utilized various control variables including government share of GDP, capital per worker, economic openness and living standard to test convergence hypothesis in Sub-Saharan African countries. No sound evidence could be obtained for the convergence of these countries due to the insignificant role of these control variables.

Cho and Graham (1996) tested the convergence hypothesis and concluded that most of the poor economies exceed their steady state levels and resultantly attain their steady state from above. Murthy and Ukpolo (1999) utilized the Solow growth model to test convergence for African countries and concluded that African countries conditionally converge at an overall rate of 1.7% and this slow pace of convergence was subject to the structural problems in the region. Dobson and Ramlogan (2002) used cross section data for different Latin American countries to investigate the hypothesis of convergence for these countries. Surprisingly, they rejected conditional convergence hypothesis for Latin American countries due to the misleading results based on cross section data.

Karras (2010) examined the convergence hypothesis for different regions and provided mixed evidence suggesting convergence for some regions while no convergence for some other regions. Levine and Renallt (1992) applied extreme bounds analysis (EBA) to test the hypothesis of conditional convergence consisting of a data set from 1960 to 1989 and suggested the presence of conditional convergence for Lain American countries. Paci and Pilgliaru (1997) examined the convergence hypothesis for European region for the time period 1980 to 1989 and concluded the absence of convergence in these regions. However, labor productivity was found to converge at the rate of 1.2% per year. Blomstron and Wolf (1994) verified the same results for labor productivity

convergence but did not find sufficient empirical evidence for manufacturing sector convergence in these countries.

An analysis of existing literature suggests that convergence hypothesis has been tested for different regions for different time spans by incorporating various related factors. Some studies have also explored the factors impelling the speed of convergence. It is in this background that the present study intends to test the convergence hypothesis for Asian countries. It also provides estimates of the level/size of disparity and time needed to bridge up these gaps. The research is expected to contribute significantly to the existing literature on economic growth and will help policy makers to design policies to reduce income disparities among countries.

3. Data Description and Methodology

3.1. Data Description

This research work empirically tests convergence hypothesis for a set 40 Asian economies. [List of these countries is provided in appendix1]. Data sources for present study are World Development Indicator (WDI) and International Financial Statistics (IFS). The analysis is based on the time period from 1980 to 2016. Following is a brief description of the variables used in this analysis.

- GDP Per Capita (constant prices US$2010)
- Population Growth Rate
- Inflation, GDP Deflator (Annual %)
- Unemployment Total (% of Total Labor Force)
- Exports of Goods and Services (Annual % Growth)
- Openness (exports plus imports is used as a measure of openness)

3.2. Methodology

In order to analyze the hypothesis of absolute and conditional convergence Pooled Least Squares methodology with time dummies and cross section weights (PCSE) standard errors is used. Following is a brief description of the econometric methodology used to test absolute convergence, conditional convergence and to calculate disparity level.

The absolute convergence hypothesis can be stated as;

H_0 : $\alpha \geq 0$ (No Absolute Convergence)

H_1 : $\alpha < 0$ (There is Absolute Convergence)

The null hypothesis postulates that growth rate of GDP per capita is not dependent upon the initial level of GDP per capita in a country. The alternate hypothesis however states that growth rate of GDP per capita and initial level GDP per capita are contrariwise related hence resulting in convergence. Following model is estimated to test the null hypothesis:

$$\Delta\ ln\ (Y_{i,t}\ ) = a - \bar{a}\ ln(\ Y_{i,t-1}) + \theta_t + \varepsilon_{i,t} \qquad (1)$$

Where Δ ln ($Y_{i,t}$) is the growth rate of GDP per capita of the country *i* at time *t* , a is the intercept, θt are the time fixed effects. Here

$$\alpha = (\frac{1-e^{\beta t}}{T}) \qquad (2)$$

Speed of convergence is denoted by β[2] in (2). A significant negative value of $\bar{a}$ suggests absolute beta convergence while a positive value indicates non-convergence.

Conditional convergence is termed as the connection between the GDP growth rate of a country and the gap between the actual levels of GDP with regard to its own steady state. Neoclassical growth model advocated that economies having diverse structures will converge to their own steady state. The concept is more realistic to analyze convergence process for a set of countries as it incorporates country specific facets, such as growth rate of population, extent of openness, foreign direct investment and level of technological improvement. For empirical verification of this phenomenon following hypothesis is tested:

H_0 : $\alpha \geq 0$ (No Conditional Convergence)

H_1 : $\alpha < 0$ (There is Conditional Convergence)

Equation (3) defines the model utilized to empirically test the conditional convergence hypothesis.

$$\Delta \ln (Y_{it}) = \mathrm{a} - \overline{a} \ln\left(Y_{i,t-1}\right) + \gamma_t + \theta_t + \varepsilon_t \qquad (3)$$

In (3) Δ ln ($Y_{i,t}$) denotes the GDP per capita growth rate of the country *i* at time *t* , a is the intercept, γ_t represent the country fixed effects ,θt are the time fixed effects. Here again α is described by the relationship stated in [2].

Disparity level for every country is estimated on the basis of demeaned values. Hence instead of using log GDP per capita for each country we have utilized deviations from cross-section mean for each country. This exercise is

[2] $\beta = -\ \frac{1}{10}\ ln\ (1 + \alpha)$

parallel to incorporating time dummies. Present analysis has utilized the following model to calculate income disparity for each country.

$$Dyit = -\beta yit - 1 + \Upsilon i + \varepsilon it \qquad (4)$$

In (4) y_{it} is ln $(\frac{yit}{\bar{y}t})$ and $\bar{y}_t$ is the mean of y_{it} across the country *i* at time *t.* The reverse relation between the time demeaned initial GDP per capita and the mean growth rate are tested**.**

4. Empirical Results

The estimated results of (1) to test convergence hypothesis for Asian countries are summarized in Table 1. The estimated coefficient of $\bar{\alpha}$ is 0.7044712 which is positive and significant (t=4.32). It submits that there is inadequate econometric evidence to discard the null hypothesis suggesting the absence of absolute convergence in Asian region. This outcome can be attributed to the fact that Asian region comprises of economies having very diverse structures with heterogeneous sets of endowments.

Table 1: Absolute Convergence in Asia (1980-2016)

Variable/Regression	**Asian Countries**
Constant	1.2016* (9.19)
Ln Y(-1)	0.70447* (4.32)
Fixed Effects (Period)	
1980	0.7195
1990	0.6878
2000	0.8287
2010	0.8099
R2	0.6664
Adj.R^2	0.6542

Note: *indicates significance at 1% level, t-values are provided in the parenthesis

This heterogeneity and variation among Asian countries justifies the datum that their steady states are dissimilar. The results can also be justified on the basis of wider and increasing disparities prevailing in the region. Another important explanation is that the sample for analysis consists of countries which possess very dissimilar characteristics. The fixed effect (period) from 1980 to 2010 is positive. These results are in line with many previous studies like Mathur (2005), Zulfiqar et.al. (2017).

Equation (3) is estimated to test conditional convergence hypothesis and the results are summarized in Table 2. The estimated coefficient for log of GDP per capita is negative and significant, i.e., -0.0354. This negative value designates the presence of conditional convergence in Asian region. This result suggests that Asian economies are more likely to experience conditional convergence due to their diverse structures. These findings are supported by Kim (2001) & Evans and Kim (2005).

Table 2. Conditional Convergence in Asia (1980-2016)

Variable/Regression	**Asian Countries**
Constant	2.4465* (5.278)
Ln Y(-1)	-0.0354* (-11.39)
Fixed Effects (Period)	
1980	0.6265
1990	-0.1965
2000	-0.2607
2010	0.4303
R^2	0.9723
Adj. R^2	0.9701

Note: * indicates significance at 1% level, t-values in the parenthesis

4.1. Speed of Convergence

The findings of study support the presence of conditional convergence in Asian region. The next logical question is that how long it will take these economies to converge to their respective steady states? The answer to this question is important due to its relevance for welfare. Present study has also calculated the speed of convergence in order to answer this vital question. Following is an illustration of this calculation.

$$(1 - e^{-\beta*10})/10 = -0.0354$$

$$1 - e^{-\beta*10} = 0.354$$

$$e^{-\beta*10} = 0.646$$

By taking logarithm of both sides, $\beta = 0.0436$ (Annual speed of convergence)

We can use half-life computation formula $(0.69/\beta)$[3] to estimate the remoteness from steady state. The findings show that approximately 15 to 17

[3] Half-life computation formula is helps to estimate the time needed by a country to reach steady state and is given by $t = - \ln (0.5) / \beta$.

years are required to bridge up 50% of the actual expanse from the steady state. It implies that many people in current age cohort will be able to observe it. This finding refines the existing empirical evidence which contends that, the time required for substantial convergence is approximately many generations.

4.2. Disparity Level for Each Country

Disparity level for every country is estimated on the basis of demeaned values. The reverse relation between the time demeaned initial GDP per capita and the mean growth rate are tested (Results are based on estimation of equation 4, see Appendix II**).** The slope coefficient has a negative and significant value *i.e.* β = -0.43597, which supports conditional convergence notion and reflects the transitional dynamics as to how every country approaches its steady state. A positive coefficient indicates an above average growth rate, while a negative value shows that the process of approaching the steady state is very slow. Different intercept value for each Asian country reflects that each country has its own unique steady state. In the following analysis we have provided disparity level for each country. This calculation will be helpful in understanding cross- country income and living standard differentials. Disparity level for each country is given as:

$$Dsi = \gamma i / \beta \qquad (5)$$

In (5) D_{si} denotes disparity level for each country. The calculated values for disparity level of each country are provided in Table 3.

The calculated values summarized in Table 3 provide the information whether the country is lying above or below average steady state level. The countries having positive values are placed above average steady state and vice versa. UAE has the highest positive disparity, i.e., 3.05 which submits that UAE is 305% richer than the average country in Asia in terms of GDP per capita. Similarly, Afghanistan has a negative value of -2.6314 suggesting that it is 263% lesser than the average country in Asia.

4.3. Population Growth, Unemployment, Inflation, Exports Growth, Openness and Conditional Convergence in Asia

In this section regression (3) is re estimated after including a set of control variables by utilizing fixed effect panel estimation procedure. In the analysis of conditional convergence, control variables aid to capture the impact of various factors on economic growth. In our analysis of Asian countries five control variables including population growth (P), unemployment (U), inflation (I), export growth (E) and openness (O) are included.

Table 3: Income Disparity in Asia

Country	Disparity Level	Country	Disparity Level
AFG	-2.6314* (0.000)	KWT	2.1288* (0.000)
ARM	0.5172* (0.000)	LBN	-0.6278* (0.001)
AZE	0.1253* (0.000)	MAC	-2.3799* (0.000)
BHR	1.9517*(0.001)	MYS	0.8499* (0.000)
BGD	1.6297* (0.000)	MNG	0.3289* (0.000)
BTN	0.7815* (0.000)	NPL	1.8285* (0.000)
KHM	1.9431* (0.000)	OMN	1.7225* (0.000)
CHN	0.2096* (0.000)	PAK	1.1939* (0.001)
GEO	-0.0053 (0.494)	PHL	-1.4956* (0.005)
HKG	2.0995* (0.000)	PLW	-0.9244* (0.000)
IND	1.2017* (0.000)	QAT	2.3594* (0.006)
IDN	-0.2129* (0.000)	SAU	1.9472* (0.000)
IRN	-0.5809* (0.002)	SGP	2.4076* (0.000)
IRQ	-0.2333* (0.000)	LKA	0.3981* (0.000)
ISR	-2.1795* (0.000)	TJK	1.42963* (0.000)
JPN	2.6238* (0.000)	THA	-0.2113* (0.000)
JOR	-0.0867* (0.000)	TKM	-0.0021 (0.786)
KAZ	-0.5596* (0.000)	UAE	3.0566* (0.000)
KOR	1.5921* (0.000)	UZB	1.1586* (0.000)
KGZ	1.4072* (0.000)	VNM	1.2694* (0.004)

Note: * indicates significance at 1% level and p- values in parenthesis.

The inclusion of these control variables is based on their relevance for economic growth. Population growth if left unchecked can hamper growth process in a country so current analysis postulates an inverse relationship between GDP growth and population growth. As mentioned earlier more than half of world population is residing in Asia and most Asian countries have relatively higher population growth rates. A higher unemployment rate reflects that a country is not efficiently utilizing its resources and has implications for income distribution, poverty and economic growth. Trade openness (O) enlarges the size of market and promotes economic growth. It is an important component of aggregate demand and is also regarded as a proxy of globalization. Similarly export growth (E) can play a vital role in economic growth of a country by increasing income levels and aggregate demand. Inflation (I) can be used to gauge macroeconomic stability of a country.

The results of empirical analysis are summarized in Table 4. The model to test for conditional convergence is re estimated after considering all the five control variables. The slope coefficient associated with log of lagged GDP per capita is negative and significant. i.e. -0.0642, reflecting the presence of conditional convergence after incorporating various control variables. All the control variables have expected signs however only population growth, inflation,

Table: 4 Conditional Convergences Results

Variable/Regression	**Asian Countries**
Constant	7.7488* (10.6)
Ln Y(-1)	-0.0642* (-6.36)
Population Growth	-0.6852* (-6.86)
Inflation Growth	-0.0030* (-2.00)
Unemployment Rate	-0.0017 (-1.21)
Exports Growth	0.0023** (1.97)
Openness (O)	-0.0009 (-1.45)
Fixed Effects (Period)	
1980	0.1532
1990	-0.3415
2000	-0.4889
2010	0.7162
R^2	0.8297
Adj R^2	0.8282

Note: *and ** indicates 1% and 5% level of significance, t-values in parenthesis.

and export growth turn out to be statistically significant. In present analysis unemployment and openness do not seem to effectively contribute towards convergence in Asian countries. Population growth has strong negative implications for economic growth and convergence in Asian region as expected and proposed by economic theory. Export growth however is a significant determinant and it can play a vital role in attaining steady state in these economies.

7. Conclusion and Policy Implications

This study has empirically tested the convergence hypothesis for a large sample of Asian countries. Empirical results provide strong evidence of conditional convergence in Asian region. The hypothesis of absolute convergence is rejected which might be attributed to huge cross-country income and non-income differentials. The findings reveal that unemployment and openness do not proficiently add towards convergence in Asian countries. Population growth has

strong negative implications for convergence while export growth is an important source of income convergence. On the basis of findings, it can be suggested that countries in Asian region need to adopt effective policies to moderate population growth rates. Similarly, a policy shift towards export growth can also be helpful in reducing income disparity in Asian region. Income disparity level from mean steady state level and speed of convergence is also calculated for each country which explains their relative position.

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Appendix

Table 1: List of Countries

Serial No	Country Name/ Abbreviation	Serial No	Country Name/ Abbreviation
1	Afghanistan (AFG)	21	Lebanon (LBN)
2	Armenia (ARM	22	Macao (MAC)
3	Azerbaijan (AZE)	23	Malaysia (MYS)
4	Bahrain (BHR)	24	Mongolia (MNG)
5	Bangladesh (BGD)	25	Nepal (NPL)
6	Bhutan (BTN)	26	Oman (OMN)
7	Cambodia (KHM)	27	Pakistan (PAK)
8	China (CHN)	28	Korea, Rep. (KOR)
9	Georgia (GEO)	29	Philippines (PHL)
10	Hong Kong (HKG)	30	Palau (PLW)
11	India (IND)	31	Qatar (QAT)
12	Indonesia (IDN)	32	Saudi Arabia (SAU)
13	Iran (IRN)	33	Singapore (SGP)
14	Iraq (IRQ)	34	Sri Lanka (LKA)
15	Israel (ISR)	35	Thailand (THA)
16	Japan (JPN)	36	Tajikistan (TJK)
17	Jordan (JOR)	37	Turkmenistan (TKM)
18	Kazakhstan (KAZ)	38	United Arab Emirates (UAE)
19	Kuwait (KWT)	39	Uzbekistan (UZB)
20	Kyrgyz Republic (KGZ)	40	Vietnam (VNM)

Table 2: Conditional Convergence for Asian Countries: Elimination of Dummies and Country Fixed Effects

Country Name	Country Effect	Country Name	Country Effect
B	-0.4359 (-5.405)	KGZ	-0.61354 (-17.615)
AFG	1.1472 (2.8502)	KWT	-0.928098 (2.5184)
ARM	-0.2254 (-63.27)	LBN	0.273739 (7.787)
AZE	-0.0546 (-15.31)	MAC	1.037582 (3.0125)
BHR	-0.85091 (-2.488)	MYS	-0.37057 (10.839)
BGD	-0.71054 -207.96)	MNG	-0.143396 (-41.85)
BTN	-0.34073 (-99.39)	NPL	-0.79722 (-2.3353)
KHM	-0.84714 (-2.334)	OMN	-0.75098 (2.1959)
CHI	-0.09139 (-26.26)	PAK	-0.52055 (-15.258)
GEO	0.002342 (0.68)	PLW	0.403054 (11.276)
HKG	-0.91536 (2.6793)	QAT	-1.02865 (2.6374)
IND	-0.52391 (-15.90)	SAU	0.84893 (2.48.88)
IDN	0.092842 (27.17)	SGP	-1.04968 (3.0678)
IRN	0.253279 (74.26)	LKA	-0.17359 (-50.72)
IRQ	0.101751 (29.79)	TJK	-0.62328 (-17.922)
ISR	0.950222 27.854)	THA	0.092123 (26.92)
JPN	-1.14394 (3.3520)	TKM	0.000954 (0.27)
JOR	0.037822 (11.09)	UAE	-1.33261 (3.9086)
KAZ	0.243982 (6.857)	UZB	-0.505146 (-14.43)
KOR	-0.69411 (2.0209)	VNM	-0.553453 (-15.96)