

## **Convergence of Real Per Capita GDP within East Asian and Middle East Countries: Panel Unit Root Evidence**

**Abbas Aminifard\***

*Islamic Azad University, Shiraz Branch, Shiraz, Iran*

### **Abstract**

This paper examines convergence of real GDP per capita in the selected East Asian countries and this relationship with selected Middle East countries during the period 1950-2009. The reason behind this refers to the fact that East Asia countries (including China, Hong Kong, Singapore, Malaysia, Indonesia, Thailand, Japan and South Korea) have been involved in achieving success arising from regional cooperation. On the other hand, the Middle East region has been well-known in producing and exporting oil (Iran, Iraq, Kuwait, Qatar, Saudi Arabia and United Arab Emirates). However, these countries have had strong relationship with East Asian countries through trade and investment relations. Overall, the question is whether such strong relationship has led to a reduction in the real per capita gap between the selected countries of the both regions. To find the answer, income departures across countries are evaluated from several panel data unit root tests. We find no evidence supporting the existence of convergence process for the income in the East Asian and Middle East countries. But in each region, convergence within countries can not reject.

**Keywords:** Regional Integration, Convergence, East Asia, Middle East, Panel Unit Root Tests.

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\* aaminifard@yahoo.com

## 1. Introduction

Testing real income convergence, i.e. convergence in per capita output across different economies, remains one of the most challenges in the contemporaneous international economic literature (Islam, 2003). On the whole, there are at least three main reasons that justify the interest of study this subject. Firstly, this exercise can help to discriminate between economic growth models. On the one hand, the neoclassical model predicts that per capita output will converge to each country's steady-state or to a common steady-state, regardless of its initial per capita output level (Solow, 1956). On the other hand, endogenous growth models, by underlining the importance of initial conditions and the possibility of multiple equilibriums, show that there is no tendency for income levels to converge in the long-run (Romer, 1986, 1990).

Secondly, as a consequence of the above remark, whether or not the exogenous or the endogenous version is validated induces a potential for state intervention in the growth process. Thirdly, on the empirical side, strong differences have been observed in per capita output and in growth rates across countries during the last three decades, and especially between many African economies and emerging Asian and developed economies (Maddison, 2001).

Moreover, the wave of regionalism in the 1990s has spurred academic and professional interest towards the economic effects of regional integration agreements (hereafter, RIAs). Among these effects, a RIA is expected to strengthen trade links and hence to facilitate technological spillovers across borders. Then, income levels should converge and the initially poorer member states will catch up with the richer ones.

However, in a recent theoretical article, Venables (2003) states that income dispersion across countries in a RIA will decrease only in the case of North-North integration (or at most North-South). On the contrary, South-South integration could easily lead to income divergence and unequal distribution of welfare gains.

Since the pioneer work of Baumol (1986) and Barro and Sala-i-Martin (1991, 1992), the test of the convergence hypothesis has consisted of fitting cross-country regressions. Convergence is said to occur if a negative correlation is found between the average growth rate and the initial income. However, Quah (1993, 1996) criticizes cross-country growth regression and shows that in order to evaluate

the convergence hypothesis one must exploit the time series properties of the cross-country variances.

Moreover, Bernard and Durlauf (1996) demonstrate that the cross-section growth regressions cannot discriminate between the hypotheses of global or local convergence.

Then, Bernard and Durlauf (1995, 1996) propose to consider convergence as a stochastic process, using the properties of time series, and test the convergence hypothesis from unit root tests. However, time-series unit root testing has been often criticized for its limited power and poor size properties (Haldrup and Jansson, 2006).

The small number of observations available on the time-series dimension would then make the country-by-country analysis of income convergence in RIAs of recent formation particularly problematic. Therefore, Evans (1996) suggests exploiting both the time-series and the cross-section information included in the data of the per capita income in order to evaluate the convergence hypothesis. With this approach, the cross sectional and time-series information are combined, thus inducing a significant improvement in terms of power of the test.

We apply various panel unit root tests to real GDP per capita data for 14 Eastern and Southern Asian countries: first generation tests based on the assumption of independent cross-section units (Levin et al., 2002; Im et al., 2003); and second generation tests allowing for cross-section dependence (Bai and Ng, 2004).

More precisely, two main issues are investigated: (1) is there an intra-regional convergence process, i.e. relative to the average income level of the area? (2) if not, are there any convergence clubs within the Middle East? Note that the idea of testing for convergence clubs is fundamentally linked to the concept of multiple equilibria, and so to the hypothesis of poverty trap (Kraay and Radatz, 2005). To this end two main criteria were used to test for convergence clubs:

(i) the degree of human and economic development, and (ii) the nature of the export base (oil producers versus non-oil producers).

Note that empirical testing of the convergence hypothesis provides several definitions of convergence, and thus different methodologies to test it<sup>2</sup>. In the convergence debate, two definitions have emerged: the

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<sup>2</sup> See Islam (2003) for a survey on the different definitions and methodologies relative to the concept of convergence.

absolute convergence and the conditional convergence.

The remainder of the paper is organized as follows. Section 2 proposes a survey of the recent empirical works dealing with real income convergence in some Asian countries and Middle East countries. Section 3 briefly displays the econometric strategy retained and the convergence hypothesis considered, and describes the panel unit root tests. Section 4 presents the data and the main findings. Finally, Section 5 concludes.

## **2. The relationship between trade and income convergence**

Convergence in the neoclassical growth model is driven by capital flowing from places where it is abundant (high-income economies) to where it is scarce (low-income economies) to achieve the highest possible returns. In this way, economic integration can bring about growth and income convergence. However, empirical evidence suggests that capital flows from high-income to low-income economies are very modest and much less than predicted by the neoclassical growth model (Lucas 1990). Migration, trade and specialization are other mechanisms that could drive growth and income convergence (see Sinn 2007; Frankel and Romer 1999).

Endogenous growth models emphasize the spill-over of ideas and technological knowledge as a key mechanism driving growth and income convergence. The transfer of scientific knowledge may occur through foreign direct investment (FDI) in low-income economies, bringing with it the skills of investors, or through international trade. Economies may 'learn by exporting' through interacting with foreign customers and learning how to meet higher product standards, or through technology embodied in imports. Keller (2004) surveys the literature on the extent of international technology diffusion and the channels through which technology is spread. He concludes that there is no evidence that international learning is inevitable, or that it is easier for relatively undeveloped economies. Evidence suggests that importing is associated with technological spill-overs, but evidence of benefits associated with exporting is weaker. The literature suggests that there can be spill-overs from FDI but they vary between economies, regions, sectors, and firm structures. Similar conclusions are drawn in the surveys by Greenaway and Kneller (2007) and Wagner (2007).

Traditional and modern growth theories imply that there are potential benefits from 'economic openness' for all economies, not simply the lower-income economies, through specialization, better allocation of skills and other resources, the dynamic interaction of learning, and the two-way spill-over of knowledge. Outward-orientation and strong growth performances have resulted in impressive economic growth in some low-income economies in the APEC region in recent years. Notable examples include China and Vietnam and, earlier, Korea and Singapore. However, progress across the APEC region has been patchy and evidence suggests that convergence mechanisms may not be operating as well as expected in some economies due to barriers at and behind the border. Furthermore, recent thinking suggests that what it takes to achieve growth at lower income levels may be different from what it takes to sustain growth at higher levels of income, and over the long term (World Bank 2007a; Rodrik 2003; Gill and Kharas 2007). This raises the question of not only how to lift performance in the slower-growing economies but also whether, and how, the recent impressive growth performances of some economies in the region can be sustained in the future.

Using a different approach, which captures general equilibrium adjustments and links various economies in the region, Dee (2005) evaluates the economic payoffs from structural policy reform in the East Asian region. This study includes nine APEC economies: China, Japan, Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand and Australia. Dee examines the impact of three scenarios: a regional preferential trade agreement (including trade liberalization and the elimination of regulations that discriminate against foreigners); the successful completion of the Doha round of World Trade Organization (WTO) negotiations; and unilateral regulatory reform. Dee's estimates show that preferential trade liberalization and preferential reform of regulations would add US\$16.6 billion per annum and US\$2 billion per annum respectively to regional income. The successful completion of the Doha round would result in much larger gains of over US\$30 billion per annum. However, by far the largest gains result from unilateral regulatory reform, which is estimated to result in gains of over US\$100 billion per annum for the region.

**Table 1: comparative growth rates – Middle East and Selected East Asian Economies, 1970-2009 (Annual % change in real GDP per capita)**

	1970-1979	1980-1989	1990-1999	2000-2009
East Asia:				
China	0.037	0.047	0.057	0.092
Hong kong	0.079	0.055	0.021	0.032
Indonesia	0.067	0.037	0.027	0.037
Japan	0.040	0.031	0.010	0.006
Korea	0.070	0.061	0.056	0.036
Malaysia	0.073	0.034	0.049	0.023
Singapore	0.078	0.049	0.050	0.033
Thailand	0.050	0.059	0.029	0.032
Middle East:				
Iran	0.013	-0.020	0.025	0.035
Iraq	0.087	-0.035	0.023	0.029
Kuwait	na	na	0.029	0.022
Qatar	Na	na	0.037	0.087
Saudi Arabia	Na	na	0.002	0.033
United Arab Emirates	Na	Na	-0.002	0.037

Source: Author

### 3. The panel data framework

Nowadays, the increasing application of the panel data techniques to the determination of time-series stochastic properties has led to the development of a wide range of new proposals in the econometric literature. The combination of the information in the time and cross-section dimensions to compose a panel data set of individuals, i.e. countries or regions, onto which performs the analysis of the stochastic properties has revealed as a promising way to increase the power of these tests. The emergence of new econometric methods has led economists to focus on the convergence debate (Gaulier, Hurlin and Jean-Pierre, 1999; Carmignani, 2007; Guetat and Serranito, 2007; Lima and Resende, 2007).

#### 3.1. The income convergence hypothesis: absolute versus conditional convergence

Several researchers have focused on the definition of the convergence concept in a stochastic framework (e.g., Carlino and Mills, 1993; Bernard and Durlauf, 1996; Evans, 1996; Evans and Karras, 1996; Guetat and Serranito, 2007). Islam (2003) showed that this definition is relatively unambiguous for a two-economy situation.

However, things are different when convergence is considered in a sample of more than two economies. Then, some authors based their analysis of convergence on deviations from a reference economy although others authors opted for deviations from the sample average. Following the work of Evans and Karras (1996) and Guetat and Serranito (2007), we choose the second viewpoint.

Consider a sample of economies 1, 2, ...  $N$  that have access to the same body of

technological knowledge. For each economy, the convergence hypothesis implies that a unique steady state exists, that any deviation of the state variables from their long run values is temporary, and hence that initial values of the state variables have no effects on their long run levels. The common technical knowledge assumption further implies that the balanced growth paths of the  $N$  economies are parallel: the state variables can differ only by constant amounts. Conversely, the  $N$  economies diverge if the deviations from the steady state are permanent, and hence the initial values impact in the long run their levels.

#### 3.2. Panel unit root tests

In this study, we apply two first generation tests proposed by Levin et al. (2002) and Im et al. (2003) which are homogeneous and heterogeneous panel unit root tests, respectively, based on the assumption of independent cross-section units. In Levin et al. (2002), the alternative hypothesis is that no series contains a unit root (all are stationary) while in Im et al. (2003) the alternative allows unit roots for some (but not all) of the series.<sup>8</sup> However, the cross-unit independence assumption of the first generation tests is quite restrictive in many empirical applications and can lead to severe size distortions (Banerjee et al., 2005; Breitung and Das, 2008).

Therefore, we also consider a second generation unit root tests that allow cross-unit dependencies with the tests developed by Bai and Ng (2004). The simplest way consists in using a factor structure model. The idea is to shift data into two unobserved components: one with the characteristic that is cross-sectionally correlated and one with the characteristic that is

largely unit specific. Thus, the testing procedure consists in two steps: in a first one, data are de-factored, and in a second step, panel unit root test statistics based on de-factored data and/or common factors are then proposed. The issue is to know if this factor structure allows obtaining clear cut conclusions about stationary of macroeconomic variables.

#### 4. Testing the income convergence Hypothesis: Applications to East Asia

##### 4.1. The data

The data of the study consists of annual real per capita GDP data from peen table

(www.peentable.com) database for 8 economies in East Asia and 6 economies in Middle East adjusted dollars, and spans from 1960 to 2009.

Using panel data and Eviwes-6 computer software, we investigate income convergence Hypothesis by testing for unit roots in the real per capita GDP of the selected countries. Our hypothesis is that if real per capita GDP are stationary, income convergence Hypothesis holds when tested in panel data (Banerjee et al. 2005). Table 2 reports panel unit root tests for real gdp (8 selected Asian countries), based on individual effects.

**Table 2: Panel Unit Root Tests for Real income for East Asia, Based on Individual Effects**

Panel unit root test: Summary				
Date: 10/09/11 Time: 08:20				
Sample: 1950 2009				
Exogenous variables: Individual effects				
User specified lags at: 0				
Newey-West bandwidth selection using Bartlett kernel				
Method	Statistic	Prob. **	Cross-sections	Obs
<u>Null: Unit root (assumes common unit root process)</u>				
Levin, Lin & Chu t*	9.23268	1.0000	7	373
Breitung t-stat	3.44257	0.9997	7	366
<u>Null: Unit root (assumes individual unit root process)</u>				
m, Pesaran and Shin W-stat	12.5786	1.0000	7	373
ADF - Fisher Chi-square	1.12660	1.0000	7	373
PP - Fisher Chi-square	0.79577	1.0000	7	373
<u>Null: No unit root (assumes common unit root process)</u>				
Hadri Z-stat	13.3304	0.0000	7	380

\*\* Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Source: Author

**Table 3: Panel Unit Root Tests for Real income for Middle East, Based on Individual Effects**


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Panel unit root test: Summary  
Date: 10/09/11 Time: 08:30  
Sample: 1950 2009  
Exogenous variables: Individual effects  
User specified lags at: 1  
Newey-West bandwidth selection using Bartlett kernel

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Method	Statistic	Prob.**	Cross-sections	Obs
<u>Null: Unit root (assumes common unit root process)</u>				
Levin, Lin & Chu t*	1.16230	0.8774	6	179
Breitung t-stat	-0.40097	0.3442	6	173
<u>Null: Unit root (assumes individual unit root process)</u>				
Im, Pesaran and Shin W-stat	1.69832	0.9553	6	179
ADF - Fisher Chi-square	6.85049	0.8673	6	179
PP - Fisher Chi-square	5.52766	0.9380	6	185
<u>Null: No unit root (assumes common unit root process)</u>				
Hadri Z-stat	6.83869	0.0000	6	191

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Source: Author

**Table 4: Summarizes panel unit root tests for real income convergence for 14 Asia countries.**


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Panel unit root test: Summary  
Date: 10/09/11 Time: 08:36  
Sample: 1950 2009  
Exogenous variables: Individual effects  
User specified lags at: 1  
Newey-West bandwidth selection using Bartlett kernel

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Method	Statistic	Prob.**	Cross-sections	Obs
<u>Null: Unit root (assumes common unit root process)</u>				
Levin, Lin & Chu t*	3.61851	0.9999	14	603
Breitung t-stat	4.19410	1.0000	14	589
<u>Null: Unit root (assumes individual unit root process)</u>				
Im, Pesaran and Shin W-stat	6.98126	1.0000	14	603
ADF - Fisher Chi-square	8.30269	0.9999	14	603
PP - Fisher Chi-square	6.32472	1.0000	14	617
<u>Null: No unit root (assumes common unit root process)</u>				
Hadri Z-stat	14.3637	0.0000	14	631

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Source: Author

## 5. Conclusion

Real income convergence is usually studied as an “all or nothing” proposition. Either the unit root hypothesis is rejected and evidence of REAL INCOME is found, or the unit root hypothesis is not hold and evidence of REAL INCOME is found. In this paper, we used panel unit root tests to investigate REAL INCOME for 8 selected East

Asian countries and 6 Middle East. Accordingly, we did several panel unit-root tests, which were based on individual unit root process holding for the REAL INCOME hypothesis. Basically, we concluded that REAL INCOME for all countries depends on the country characteristics in ways that are consistent with economic theory.

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