Regional Convergence in Knowledge-based Economy

Maryam Fattahi[*]
Department of Economics, University of Tarbiat Modares, Tehran, Iran
Sajad Barkhordari
Department of Economics, University of Tarbiat Modares, Tehran, Iran

Abstract

Nowadays, the world economies are rapidly moving towards being more Knowledge-based Economy (KBE) and supporting the force of knowledge as a vital component of economic growth. This recent acceleration in the transition to Knowledge-based Economy in the world, has affected regional economic performance. In this paper, we surveyed the regional convergence in Knowledge-based Economy for selected Asia and pacific countries. We used a growth model in Barro and Sala-i-Martin framework (1995) for the period of 1995-2009. It includes a panel data set consisting of the annual growth rate of GDP per capita for selected Asia and pacific countries and a group of indicators that define the situation of Knowledge-based Economy in countries. The empirical results indicate that the absolute and the conditional convergence are not rejected for selected countries. The investigation on robustness of the model results confirms the existence of regional convergence for studied countries.

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[*] Correspondent Author, Email: maryam.fattahi@modares.ac.ir

1. Introduction

Nowadays, the world economies are rapidly moving towards being more knowledge based Economy and supporting the force of knowledge as a vital component of economic growth. Four important influences can be identified as actors in increasing the pace of change. Firstly, revolutionary changes in Information and Communication Technology (ICT) have a striking impact in the overall productivity performance of individual countries. Secondly, more rapid scientific and technological advance emerged through large increases in the resources devoted to R&D from both enterprises and the government. Thirdly, competition is becoming more global as a result of falling tariffs, liberalisation of capital controls and lower transportation and transaction costs. Finally, changing demands and increased income are both potentially important drivers of the knowledge economy. (Coates and Warvick, 1999)

Recent acceleration in the transition to Knowledge -based Economy in the world, has affected regional economic performance. Thus, the aim of this paper is to examine regional convergence in Knowledge-based Economy for selected Asia and pacific countries. According to these aim, the question has been planed that "whether studied countries in terms knowledge-based Economy are converging?" corresponding with this paper question, paper hypothesis is that studied countries in terms knowledge-based economy are converging.

The remainder of the paper is organized as follows: sections (2) and (3) respectively, review the literature on regional convergence and knowledge-based economy. Section (4) illustrates the methodology and data used in the study, while section (5) discusses the empirical results. Finally, section (6) provides a summary and reports the conclusions and the policy implications for the findings.

2. Regional Convergence

The issue of economic convergence has become the centre of attraction in the growth literature during the last decade. A large literature tests for the convergence of real income per capita, beginning with Baumol (1986) and extending through Barro (1991), Mankiw et al. (1992) and Barro and Sala-I-Martin (1995).

The neo-classical growth models each imply convergence of real income per capita. In the convergence debate, two definitions have emerged: the absolute convergence and the conditional convergence. The various empirical tests for convergence fall under two categories––tests of unconditional (absolute) or conditional convergence. Absolute convergence means that each country moves toward the same steady-state real GDP per capita. Conditional convergence suggests that each country possesses its own steady-state real GDP per capita to which it is converging. The steady state in each country is conditioned on the state of its economy. Two types of convergence exist in the literature, β convergence and σ-convergence. Convergence of the β-type considers whether the growth rates of countries exhibit a negative correlation with the level of real GDP per capita. That is, β-convergence implies that countries with low-real GDP per capita possess faster growth rates than countries with high-real GDP per capita. Convergence of the σ-type considers whether the dispersion of real GDP per capita diminishes over time. That is, σ-convergence implies that the distribution of real GDP per capita across countries gets tighter over time, thus reducing some measure of dispersion. Existing tests for β-convergence regress the growth rate of real GDP per capita onto the initial value of real GDP per capita to test for absolute convergence and onto the initial value of real GDP per capita and other control variables (e.g., investment to GDP) to test for conditional convergence.

According to theories of convergence, relatively less productive countries in a certain sector should catch up with the relatively more productive countries due to the spread of knowledge and technology from one country to another. Another reason is the increased competition that motivates firms to increase their efficiency (Bernard and Jones, 1996).

The majority of studies provides evidence which supports the hypothesis of conditional convergence, where the initial per capita income or productivity level, the physical and human capital accumulation and innovation activities are found to be the most significant conditioning factors[1]. Table (1) show summary of regional convergence studies in Asia and pacific countries.

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[1] For example see Soukiazis & Castro(2005)

Table 1: Summary of regional convergence studies in Asia and pacific countries

Economies	Studies	Sample Period	Results	Methodological Approaches
Asia and pacific region	Park(2003)	1960-2000	Convergence	Theil inequality
Japan	Barro and Sala-I-Martin(1992)	1930-1987	Convergence	Barro regression
	Yamamura and Shin(2008)	1995-1998	Convergence	
Korea	Koo, Kim and Kim (1998)	1967-1992	Convergence	Barro regression
Malaysia	Togo(2000)	1970-1995	Divergence	σ convergence
Indonesia	Takeda and Nakata (1998)	1976-1995	Divergence after 1985	Coefficient of variation
China	Zhang and et.al(2001)	1952-1997	Convergence	Barro regression
Philippines	Hosono and Toya (2000)	1975-1997	Conditional convergence (human capital)	Barro regression
		1975-1986	Convergence	

Source: Authors

The investigations show that there are a few empirical analyses about regional convergence in knowledge- based economy. For example, Karagiannis (2007) is investigated and confirmed the existence of conditional convergence in knowledge- based economy for European Union.

3. Knowledge-based Economy

It has become commonplace to say that today we have entered a new phase of global economic development in which "Knowledge-based Economies" are the most significant centers of growth and dynamism (Cooke, 2002). The term "knowledge-based economy" results from a fuller recognition of the role of knowledge and technology in economic growth. The knowledge-based economy has become an engine of progress in every country. If a country is developed, it has a developed knowledge-based economy, if a country is lagging behind; a knowledge-based economy constitutes just a small fraction of its economy (ECE, 2002).

This section is concerned with the definition of knowledge- based economy and the indicators of knowledge-based economies. In 1962 American economist, Fritz Marklupu, first proposed the notion of "knowledge-based economy" based on the social production development and industry structure in the United States. Since 1980s, especially 1990s, knowledge had a large amount in the global economic production and economic society. The term knowledge-based economy was first defined by the Organization for Economic

Cooperation and Development (OECD, 1996) as "economies which are directly based on the production, distribution and use of knowledge and information". The Asia-Pacific Economic Cooperation (APEC, 2000) then extended this idea to state that in a knowledge-based economy "the production, distribution and use of knowledge are the main drivers of growth, wealth creation and employment across all industries".

In economic literature, economists outlined numerous indicators for a knowledge-based economy. On the base of KAM approach (World Bank 2010), the knowledge-based economy have four pillars; EIR (Economic Incentive and Institutional Regime), Innovation, Education and ICT (Information and Communication Technology). So the indicators for measuring of KBE status in countries are KEI, EIR, Innovation, Education and ICT that are computed in 0-10 range.

4. Model Specification

In order to survey the regional convergence in knowledge-based economy in panel data regressions, we use the empirical framework suggested by Barro and Sala-I-Martin (1995). This framework relates real per capita growth rate to initial levels of state variables and to control variables.

We can write the model of output per capita growth rate for our panel data set as:

$$\frac{y_{it} - y_{i,t-1}}{y_{i,t-1}} \approx \alpha + \beta y_{i,t-1} + \gamma X_{it} + \varepsilon_{it} \qquad (1)$$

If we assume that $\frac{y_{it} - y_{i,t-1}}{y_{i,t-1}} \approx Ln(y_{it} / y_{i,t-1})$ we can

approximate equation (1) as:

$$Ln(y_{it} / y_{i,t-1}) = \alpha + \beta Ln y_{i,t-1} + \gamma Ln X_{it} + \varepsilon_{i_t} \qquad (2)$$

Where, y_{it} is per capita gross domestic product (GDP) in member-country i ($i=1,...,20$) during the period t ($t=1995,...,2009$), $y_{i,\,t-1}$ is the (initial) per capita GDP in country i in period $t-1$, a is constant and β is the coefficient to be estimated. Xit, is a row vector of control variables in country i during period t with associated parameters β and ε_{it} is the model's error term.

Absolute convergence is commonly tested by a regression equation of the form

$$Ln(y_{it} / y_{i,t-1}) = \alpha + \beta Ln y_{i,t-1} + \varepsilon_{it} \qquad (3)$$

Absolute convergence occurs when β is negative and significant. Infact, a significantly negative β coefficient in equation (3) shows that regions with the smallest per capita GDP in the initial year experienced the fastest growth rates in the period. This result is consistent with the decreasing returns to capital assumption of neoclassical convergence models.

A common form of the conditional convergence model is:

$$Ln(y_{it} / y_{i,t-1}) = \alpha + \beta Ln y_{i,t-1} + \gamma Ln X_{it} + \varepsilon_{i_t} \qquad (4)$$

Economic growth has been explained by many components. Regarding this study we use three control variables suggested by Barro and Sala-I-Martin (2004), which can be viewed as important factors in the economic growth. This three control variables are international openness (Open), domestic investment (INV) and government consumption (Gov). International openness is ratio of export plus import to GDP and applied in its natural logarithm form. Domestic investment is the natural logarithm of the ratio of real gross domestic investment (private and public) to real GDP. Government consumption is the natural logarithm of the ratio of government

consumption to GDP, as a proxy of the government role in the growth of the economy. In order to answer the question of this paper, we estimate the three control variables with the groups of Knowledge-Based Economy indicators. Various measures have been used in the literature to proxy for the Knowledge-Based Economy (KBE). For this study, we use education as a proxy for Knowledge-Based Economy (KBE). In the robustness of the results step, we use four indicators to measure KBE. These indicators are KEI, EIR, Innovation and ICT that are computed in 0-10 range.

We use per capita gross domestic product as a proxy to measure convergence between the 20 Asia and pacific countries[1] for the period 1995–2009. The source of the dependent and control variables data is the World Development Indicators 2009 (WDI) database and we collected proxy measures KBE from KAM (2010).

5. Empirical Results

Before entering the discussion and interpretation of results in the case of regional convergence in knowledge–based economy is necessary to test whether the studied countries are homogeneous or not? In this test that is done by F-test, the null hypothesis indicates using panel data and reject the null hypothesis suggests using pooled least squares. The test results that are shown in table (2), indicates rejection of the null hypothesis and the panel data method is used for the studied countries.

In the next step must be selected one of the two methods of estimating the panel data, fixed effect and random effect. For this purpose, hausman test is used. In hausman test, rejecting the null hypothesis is represented using fixed effect method. The test results that are shown in Table (2), indicates rejection of the null hypothesis and therefore the fixed effect method is used for the studied countries.

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[1] Bahrain, China, Hong Kong, India, Indonesia, Iran, Japan, Jordan, Korea, Kuwait, Lebanon, Malaysia, Oman, Philippines, Qatar, Saudi Arabia, Singapore, Thailand, United Arab Emirates and Yemen.

Table (2): GDP per capita convergence in the selected Asia and pacific countries, panel data regressions.

Variables	Absolute Convergence	(Conditional	Convergence)				
	1	2	3	4	5	6	7
Constant	0/27(4/63)*	2/53(3/49)*	2/52(2/85)*	3/06(3/49)*	1/49(1/87)***	2/98 (3/36)**	2/72(3/28)**
GDP initial	-0/13(-4/39)*	-0/14(-2)**	-0/20(-2/19)**	-0/20(-2/20)**	-0/08(-0/80)	-0/13(-1/56)	-0/19(-2/31)**
INV		0/01(0/07)	0/16(0/62)	0/13(0/54)	0/16(0/45)	0/05(0/02)	0/20(0/90)
Gov		-0/86(-4/09)*	-0/73(-2/85)*	-0/85(-3/37)*	-1/08(-2/44)**	-0/86(-3/36)*	-1/06(-4/11)*
Open		0/39(2/17)**	0/47(2/06)**	0/43(1/95)***	0/32(1/40)	0/28(1/24)	0/37(2/06)***
EDU		0/29(3/84)*					0/45(4/03)*
KEI			0/47(1/72)***				
INO				0/22(1/75)***			
EIR					0/19(1/02)		
ICT						0/11(1/48)	
R^2	0/55	0/73	0/62	0/62	0/75	0/61	0/93
F	2/63*	3/62*	2/08**	2/08**	2/14***	1/97***	4/97*
Hausman (χ^2)	15/51*	27/36*	16/01*	15/49*	14/08*	14/51*	25/31*
Total observation	283	50	50	50	50	50	33

*, ** and ***indicates that the estimated coefficient is statistically significant at 1%, 5% and 10% significance level.
Source: Authors

Table (2) reports the results obtained from the estimations of the convergence equation by using panel data for the 20 Asia and pacific countries for the period 1995–2009. The second column of table (2) provides the results of the absolute convergence estimation by using fixed effects estimation technique. The next columns give the results of the conditional convergence estimation following a fixed effect procedure and display the results of panel estimation in knowledge- based economy for period 1995-2009 and in the final, the last column presents the estimated results obtained from conditional convergence in knowledge- based economy by fixed effect estimation for period 2000-2009.

The initial specification of the convergence equation in per capita income is consistent with the standard neo-classical growth model including only the convergence factor, the initial level of per capita income. This first specification tests the hypothesis of absolute convergence, assuming that countries' per capita incomes converge to the same steady state point.

The coefficient of the initial per capita GDP variable is negative in all estimations, as expected, suggesting that convergence is conditional and absolute as the neo-classical

theory assumes. The neo-classical hypothesis of absolute convergence in GDP isn't rejected as the results of the second column of Table 2 show. The convergence coefficient is negative and statistical significance, as expected. When conditional convergence is tested by controlling the variables suggested by Barro and Sala-I-Martin (2004) and KBE variable, the convergence coefficient is negative, as indicate in models 2–6 of Table 2. The effect of the government consumption is negative, as it is usually expected, but investment and openness affected positively economic growth behavior.

Evidence of convergence is shown in all methods of estimations, and the convergence factor is statistically significant in all cases except 4 and 5 cases. Finally, the negative effect of the government consumption and the positive effects of the investment and openness are consistent with the main theoretical argument. Our findings are similar to those of Barro and Sala-i- Martin(1995).

In order to check the robustness of our findings, in one step, we estimate model with other KBE indicators. Estimation results are indicated in the models 3-6. The convergence coefficients are negative and conditional convergence hypothesis is not rejected for

studied countries. Thus, results are not sensitive to the KBE indicators and remain robust to alternative specification of the model. In the next step of results robustness, we estimate model for the time period 2000-2009. Estimation results are reported in the column (7) table (2). Model (7) is of the same formulation with (2), with the difference that it contains the specification for the period 2000-2009. We estimated this in order to assess the sensitivity of our findings to the time period. The absolute convergence and conditional convergence hypothesis is not rejected during the second period 2000–2009 for selected Asia and pacific countries. All coefficients have the expected sign; therefore results are not sensitive to the time period.

6. Conclusions and policy implications

Economic theory suggests that regional economic performance is likely to be influenced by both the amount of existing knowledge and the flow of new knowledge available in the region. In this paper, we investigate regional convergence in knowledge–based economy for selected Asia and pacific countries. We obtained data from the World Bank Development Indicators, CD-ROM and the KAM for the time period 1995-2009. The empirical results indicate that the absolute and the conditional convergence are not rejected for selected Asia and pacific countries. Then, our results show that there is an evidence of convergence in the per capita income of the countries in the sample. The investigation on robustness of the model results confirms the existence of regional convergence in knowledge–based economy for studied countries. Therefore, our results are not sensitive to the KBE indicators and time period and our results remain robust. So, the cooperation between Asia and Pacific countries must be considered by policymakers. This decreases the lag of economic growth and increases the speed of convergence between these countries.

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