Conference Paper

Verifying β-Convergence for Chosen Regions of Indonesia

Michaella Blaško

University of Economics in Bratislava, Slovakia

Abstract

The convergence in the economy means the process of balancing disparities chosen indicators of homogeneous economic groups. In this article, we verify convergence through the Least Squares Method for 11 chosen regions of Indonesia. Used variables are the real GDP per capita and the average salary per capita in every chosen region of Indonesia between 2012 and 2015. We create dependence between the growth of GDP per capita and logarithm of GDP per capita in 2012. For complete explanation of the model and calculation of consistent, minimal estimator, we use dummies and create a structural parameter, which eliminates shocks and possible disparities between regions.

Keywords: β-convergence, GDP per capita, Least Squares Method

JEL Classification: C12, C21, E23, F62

Corresponding Author:
Michaella Blaško

Received: 8 June 2018
Accepted: 17 July 2018
Published: 8 August 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the 2nd ICVHE Conference Committee.

1. Introduction

The convergence is engaged in balancing of disparities between the various economic indicators in framework of homogeneous economic groups – countries or regions, when this economic groups try to convergence to the same steady state. For verifying of the absolute convergence, called also as β-convergence is typical when poorer, less developed countries tries to catch up with richer, more developed countries and converge to the same level of steady state. Convergence processes lead to a reduction in the difference between two or more variables at a time up to the negligible differences and converges to zero. Therefore it is all about long-run processes. The most important convergence factor is Gross Domestic Product per capita in purchasing power parity (real GDP per capita). A more precise explanation of the convergence concept is engaged in The Theory of Growth, where the concept of convergence has been elaborated by economists R. J. Barro and X. Sala-i-Martin (Barro, Sala-i-Martin, 1991, 1992). This article verifies the absolute β-convergence between 2012 and 2015.

The main feature of the absolute convergence is, it is not conditioned of the existence of the same level of steady state for selected variables. The absolute β-convergence is based on the assumption, where less developed regions, states or countries grow faster than advanced, so GDP per capita increases faster in less developed economy. The conditional β-convergence exists, if parameter of convergence is significant and because of positive speed of convergence we predict a negative partial correlation between growth and its initial level of logarithm GDP per capita.

2. Definition of Methodology

For verification of the β-convergence we use a concept based on the methodology of R. Barro and X. Sala-i-Martin [1] by Least Squares Method.

For testing of absolute β-convergence is used relationship, which is defined as

$$\left(\frac{1}{T}\right) * \ log\left(\frac{y_{iT}}{y_{i0}}\right) = \alpha - \left[\frac{\left(1 - e^{-\beta T}\right)}{T}\right] * log\left(y_{i0}\right) + \ u_{i0,T} \tag{1}$$

where

T – the range of years between 0 – the initial and T – the last observation value,

i – monitored region,

x – the rate of technological progress, we assume the same x for all economies,

β – parameter of convergence,

y_{i0} – real GDP per capita in region i in initial year,

y_{iT} – real GDP per capita in region i in the last year,

$u_{i0,T}$ – the impact of the random shocks in production conditions and preferences

$-\left[\frac{\left(1-e^{-\beta T}\right)}{T}\right]$ – speed of convergence,

$\alpha = x_i + \left(1 - e^{-\beta T}\right)(log\left(y_i^*\right) \ + \ x_i\left(T\right)$ – the level constant, where x_i is the level of technological progress, y_i^* is the steady-state of region i.

In case of verifying of convergence, parameter of convergence β has to be significant. Furthermore, we predict negative result of β, based on formula $-\left[\frac{\left(1-e^{-\beta T}\right)}{T}\right]$, because is predicted positive speed of convergence for Indonesia. In last year's Indonesia has really great economic growth, approximately 5 or 6%, so in case of positive β we may change of used methodology, because Indonesia between 2012 till 2015 did not reach economic growth.

In the β-convergence is necessary to count with geographical and political disparities between chosen regions, which may have a strong impact for explanation of dependence, so we have to add to model (1) dummies. Model without dummies is

not completely specified, what has impact for random variable, so in model without dummies exist treatment of breach of the presumption of randomness. We create 6 dummies, exactly according to economic group of regions (Java, Sumatra, Kalimantan, Nusa Tenggara, Sulawesi and Papua), so every monitored region became similar. The model can incorporate k-1 variants, so a new model is explained as

$$\left(\frac{1}{T}\right) * log\left(\frac{y_{iT}}{y_{i0}}\right) = \alpha - \left[\frac{\left(1-e^{-\beta T}\right)}{T}\right] * log\left(y_{i0}\right) + \gamma_i J_{it} + \varepsilon_i SA_{it} + \vartheta_i K_{it} + \pi_i SI_{it} + \tau_i P_{it} + u_{i0,T} \quad (2)$$

where

$\gamma_i Java_{it} + \varepsilon_i Sumatra_{it} + \vartheta_i Kalimantan_{it} + \pi_i Sulawesi_{it} + \tau_i Papua_{it}$ – used dummies according to political and geographical differences. Others variables are with the same explanation as model (1).

Except specification in second model is in place still question whether is this formulation of relationships complete, another written, whether the random variable $u_{i0,T}$ (which represent the impact of unexpected shocks and changes) is in each period independent on the initial level of GDP per capita and on the previous random shocks. In the real economy, there are unforeseen events, which can affect only a subset of economies, for example cause of shocks from economic activities (extremely dry for regions strong oriented in agriculture). In this case is correlation between the explanatory variables and a random shocks and random variable violates the assumption of independence and parameter of convergence β is distorted. To avoid distortion of this parameter, we have to add model (2) by structural variable, which may aggregated to reflect the economic nature of region. This structural variable is constructed as a weighted sum of the average growth in salary per worker in the various sectors of the economy. Weights are the shares of individual economic structure of the region on the overall economy of comparisons in values of salary per capita in the initial period. In our article we calculate with six economic departments (Agriculture, Industry, Construction, Trade and services, Education, IT and Finance) and structural parameter is expressed as

$$s_{it} = \sum_{j=1}^{6} \omega_{ij,T-0} * \left[log\left(\frac{\frac{y_{iT}}{y_{j0}}}{T}\right)\right], \quad (3)$$

where

T – sample – number of monitored period,

i – monitored region,

y_{iT} – average salary per capita in particular department i in the last year,

y_{i0} – average salary per capita in particular department i in the initial year,

$\omega_{ij,T-0}$ – weight of economic structure for region i on whole monitored economy.

The new model with dummies and structural variable is possible to write as

$$\left(\frac{1}{T}\right) * log\left(\frac{y_{iT}}{y_{i0}}\right) = \alpha - \left[\frac{\left(1-e^{-\beta T}\right)}{T}\right] * log\left(y_{i0}\right) + \gamma_i J_{it} + \varepsilon_i SA_{it} + \vartheta_i K_{it} + \pi_i SI_{it} + \tau_i P_{it} + \varphi_i s_{it} + u_{i0,T} \quad (4)$$

where

$\varphi_i s_{it}$ – structural variable. Others variables are with the same explanation as model (2). The structural variable S_{it} reveals how much region would grow if each of used sectors grew at the national average rate. If region i specializes in the production of textile and that the aggregate textile sector does not grow over the period between T and 0, so low value of structural variable S_{it} for this region indicates that it should not grow very fast because of the textile industry has suffered from the shock.

For each model we test basic assumptions of the model in order to ensure a minimum consistent least squares estimator. Autocorrelation we do not solve, because in whole work we work with panel data. In case of violation of homoscedastic residuals we apply the Weighted Least Squares Method.

3. Results

Verification of β-convergence for chosen regions of Indonesia (11 regions) is tested by Least Square Method based on previously formulas (1) (2) and (4) between 2012 and 2015. Results of β parameters and others explanatory parameters for each model are shown in Table 1 together with their T-statistics and p-value of parameters, coefficient of determination, F-statistic of whole model with its p-value.

Source of used data is internet and after downloading were processed by using of Excel, which they were established individual explanatory variables as it is explained by formula (1).

The first model of β-convergence described dependence of logarithmic growth of real GDP per capita on initial logarithmic GDP per capita what is explained by formula (1). Parameter of convergence β is equal –0.02071 (is negative, so we expect positive speed of convergence) but is no significant also the level constant is no significant. Coefficient of determination R^2 is just 0,07197, so the model of β-convergence explains just 7.2% of the total variability of growth of real GDP per capita over the period and model as whole is also no significant. Because no parameters are significant in used model, we can constant, there is no verified convergence between 2012–2015 for 11

Table 1: Results of β-convergence.

Results	1. model	2. model	3. model
Bo	0.06767	0.05715	0.05251
T_stat_Bo	1.84395	0.97675	0.57588
P_T_stat_Bo	0.09830	0.38400	0.62290
B1	−0.02071	−0.02094	−0.01468
T_stat_B1	−0.83543	−0.46209	−0.04902
P_T_stat_B1	0.42510	0.66800	0.96540
gama		0.00350	−0.00282
T_stat_gama		0.06630	−0.02882
P_T_stat_gama		0.95030	0.97960
epsilon		0.02104	0.01761
T_stat_epsilon		0.38333	0.16762
P_T_stat_epsilon		0.72100	0.88230
teta		0.01901	0.01751
T_stat_teta		0.33537	0.14291
P_T_stat_teta		0.75420	0.89950
pi		0.02195	0.02123
T_stat_pi		0.46290	0.21313
P_T_stat_pi		0.66750	0.85100
tau		0.00196	−0.00018
T_stat_tau		0.03935	−0.00223
P_T_stat_tau		0.97050	0.99840
fi			−0.00123
T_stat_fi			−0.00542
P_T_stat_fi			0.99620
F_stat	0.69795	0.17286	0.07663
P_F_stat	0.42510	0.97047	0.99565
R2	0.07197	0.20591	0.21149

Source: Own summarization from Eviews.

monitored regions in Indonesia. This economic group do not reach the same steady

state and each region has probably own steady state. Basic assumptions of model is not necessary to verify because model is not significant. Next explanation is excluded.

Second model is modification of the model (1), where dummies – artificial variables were added, following this, monitored regions are incorporated in to six individual groups of region according to their geographical and political division – JAVA (Banten, DKI Jakarta, Central Java) SUMATRA (North Sumatra, Lampung), KALIMANTAN (East Kalimantan, West Kalimantan), NUSA TENGGARA (East Nusa Tenggara) SULAWESI (Gorontalo, North Sulawesi) and PAPUA (Papua). Parameter of β is again negative, equals –0.02094, but the level constant and dummies of are not significant. It may conclude, that dummies significantly do not influence the explanation of β-convergence and because again parameter of convergence is not significant we can say that second model also verify the same results – there does not exist convergence into the same steady level of GDP per capita between monitored regions in Indonesia. This conclusion is also supported by low coefficient of determination, which is equal 0,2059, what means the model of β-convergence explains just 20.6% of the total variability of growth of real GDP per capita over the period and increasing value of *p*-value of *F*-statistic so this model definitely refuses hypothesis of convergence.

Third model is an extension of the second model, is explained by formula (4). This modification is with incorporation of structural variable S_{it}, which consist of six sectors (Agriculture, Industry, Construction, Trade and services, Education, IT and Finance). Parameter of β is for last model also negative, equals –0.01468, and others variable – the level constant, dummies and structural parameter are not significant. Interpretation for last model is very similar to previous two. Again parameter of convergence is not significant we can say that third model also verify the same results – there does not exist convergence into the same steady level of GDP per capita between monitored regions in Indonesia what is again supported by very low coefficient of determination, which is equal just 0,02115, what means the model of β-convergence explains just 21.2% of the total variability of growth of real GDP per capita over the period and increasing value of *p*-value of *F*-statistic so this model definitely refuses hypothesis of convergence.

4. Discussion

In article was explained definition of β-convergence and application of mathematical and econometric methods for verifying of this concept of convergence. In practice life

is often this concept called as absolute convergence and explanation is very easy. The hypothesis that poor region tent to grow faster per capita than rich ones.

We have to sum up, that based on results from three different models, there was not proved concept of absolute convergence between 2012 and 2015 for chosen regions of Indonesia. For us the leading indicator is the parameter of convergence, which is always no significant, so we can constant convergence to the same level of GDP per capita in followed sample. Because convergence is not proved, is useless to look for another specification of models and test basic assumptions of models – homoscedastic residuals and normal distribution and definitely is useless to verify conditional convergence, which is called also σ-convergence, because the basic assumption for testing of this concept of convergence is verifying of absolute convergence.

In future, we want to use another methodology for verifying of convergence between this regions and extend database for each region of Indonesia and for longer period. On the other hands, there is still a high probability, that convergence to the same steady level of GDP per capita is not existing between regions of Indonesia, so this question is open for next research at area of convergence.

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