An Analysis of Convergence of Income Inequality in Developed and Developing Countries

Gelişmiş ve Gelişmekte Olan Ülkelerde Gelir Eşitsizliği Yakınsama Analizi

Hatice AKDAG, Adnan Menderes University, Turkey, hatice.kucukkaya@adu.edu.tr

Orcid No: 0000-0002-9938-9794

Mustafa OZER, Anadolu University, Turkey, muozer@anadolu.edu.tr

Orcid No: 0000-0001-9852-8441

Abstract: Even though income inequality one of the most commonly analyzed topics in economics, there are few studies aiming to examine the convergence in income inequality. By using a balanced panel of 98 countries over the period of 1995 and 2015, we provide empirical evidences of the beta convergence that explains why there is a decrease in inequality levels in countries that have high inequality levels at the start of the study period and an increase in inequality levels for countries that have low inequality levels at the first year of the sample period. The results of the study support the convergence hypothesis in inequality and provide some explanation of the reasons and the tendencies of income inequalities in countries. Thus, it is possible to derive important implications from the results of the study which contributes the convergence/divergence debate.

Keywords: Income Inequality, Beta Convergence, Panel Data Methods

JEL Classification: D630, C180, C10

Öz: Gelir eşitsizliği iktisatta en çok analiz edilen konulardan biri olmasına rağmen, gelir eşitsizliğindeki yakınsamayı incelemeyi amaçlayan az sayıda çalışma bulunmaktadır. 1995-2015 dönemi 98 ülkeden oluşan dengeli bir panel kullanarak, çalışma döneminin başında yüksek eşitsizlik düzeylerine sahip ülkelerde eşitsizlik düzeylerinde bir düşüş, örnekleme döneminin ilk yılında düşük eşitsizlik düzeyine sahip ülkelerde eşitsizlik düzeylerinde artış olduğunu açıklayan beta yakınsamasının ampirik kanıtlarını sunuyoruz. Çalışmanın sonuçları, eşitsizlikte yakınsama hipotezini desteklemekte ve ülkelerdeki gelir eşitsizliklerinin nedenleri ve eğilimlerine ilişkin bazı açıklamalar sağlamaktadır. Böylece, yakınsama/ıraksama tartışmasına katkıda bulunan çalışmanın sonuçlarından önemli çıkarımlar elde etmek mümkündür.

Anahtar Kelimeler: Gelir Eşitsizliği, Beta Yakınsaması, Panel Veri Yöntemleri

JEL Sınıflandırması: D630, C180, C10

1. Introduction

Interest in the issue of income inequality can be linked to changes in both the context of economic and policy arenas in which research is carried out. With a closer examination of income inequality trends of countries reveals the fact that the convergence in income inequality between developed and developing countries are very important issue to investigate. Thus, in this study, we try to examine the beta convergence in income inequality among the developed and developing countries.

Although there are many studies aiming to explain causes and the effects of the income inequality across the countries, there are only few studies (Gallup (2012), Lin and Huang (2012), Dhongde and Miao (2013), Chambers and Dhongde (2016) investigating the convergence in income inequality. But, none of these studies are aiming to examine the

convergence in income inequality between developed and developing countries. Thus, this study aims to fill this gap and contributes the income inequality literature by examining the convergence in income inequality between developed and developing countries.

The studies examining the convergence issues start with the neoclassical growth theory in the 1950s. But, the main contributors of the convergence theory are Barro and Sala-i- Martin (1992), Benabou (1996) and Ravallion (2002). While Barro and Sala-i- Martin (1992) provides evidences for the conditional convergence, Benabou (1996) and Ravallion (2002) concludes convergence in distribution for the countries having the same basics.

In the late 1990s, with the contribution of the studies of Barro and Sala-i-Martin (1991), Bernard and Durlauf (1995), Durlauf and Johnson (1995), Bernard and Durlauf (1996), the income inequality is mainly searched within the Neoclassical Growth Theories. All these studies heavily focused on the overall distribution. These studies also provided some evidences of the convergence in income distribution.

There are two broad categories of the convergence studies. These are sigma (unconditional) and beta (conditional) convergence. With an emphasis of 'Galton's fallacy' and depending on studies of Barro (1991), Barro and Sala-i-Martin (1991), Mankiw, Romer and Weil (1992), Quah (1993) considers these convergence categories. According to Quah (1993), the sigma (σ) and beta (β) convergences should be considered as different perspectives, since β convergence cannot be seen as an example of σ convergence. Instead, what it shows is that how quickly teams ranked at the bottom tend to pick up toward the middle or how quickly top teams tend to go back to moderation.

According to Barro and Sala-i-Martin (1991), β convergence must be the major concern, if we are trying to produce evidences for likelihood of how fast and to what extent the per capita income of a particular economy will catch up to the average per capita incomes across economies. However, if we would like to know how was the past per capita income distribution across nations or how it would be in the future, one should be interested in σ convergence. In this study, our focus is β convergence, because we know that it explains a process which describes how the countries with different initial inequality levels will have different scores regarding the inequality.

The rest of the paper is organized as following manner. The section 2 explains the data and methodology used in the study. The section 3 present the empirical results and the section 4 summarizes the results and concludes.

2. Data and Methodology

Unfortunately, as mentioned in Piketty and Saez (2001), Atkinson (2003), Solt (2008), Atkinson and Brandolini (2009); one common future of data used in empirical studies regarding income distribution and income inequality is the problematic nature of data. Researchers use different databases in different times. For example, while in the 1990s, Deinenger-Squire (1996) database has been widely used, in recent years, Unu-Wider World Income Inequality Database (WIID), The Standardized World Income Inequality Database (SWIID), The World Wealth and Income Database (WWID), University of Texas Inequality Project (EHII) and The Chart book of Economic Inequality have been used extensively. In this study, we used all these databases and Gini coefficients of all countries. Data is extracted from 2020 World Income Inequality Database (WIID).

In this study, we use three samples of data. First sample includes 98 countries for the period of 1995-2015. Second and third samples include 24[1] developing and 74[2] developed countries respectively over the same period. Before testing the validity of convergence hypothesis empirically, we examine the graphs based on the first and last observation on the Gini indexes of developed and developing countries, given in Figure 1 and 2. Visual examination of Figure 1 and 2 display tendencies of convergence which lead us to conclude that we should continue our empirical analysis with testing validity of beta convergence.

---

[1] Bangladesh, Bolivia, Cambodia, Cote d'Ivoire, Egypt, El Salvador, Ethiopia, Honduras, India, Indonesia, Kyrgyzstan, Madagascar, Malawi, Mauritania, Moldova, Mongolia, Morocco, Nicaragua, Pakistan, Philippines, Tajikistan, Tunisia, Uganda, Vietnam.

[2] Albania, Argentina, Armenia, Australia, Austria, Bahamas, Belarus, Belgium, Botswana, Brazil, Bulgaria, Canada, Chile, China,Colombia, Costa Rica, Croatia, Cyprus, Czechia, Denmark,Dominican Republic, Ecuador, Estonia, Finland, France, Georgia, Germany, Greece, Guatemala, Hungary, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Korea, Latvia, Lithuania, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, North Macedonia, Norway, Panama, Paraguay, Peru, Poland, Portugal, Romania, Russia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela.
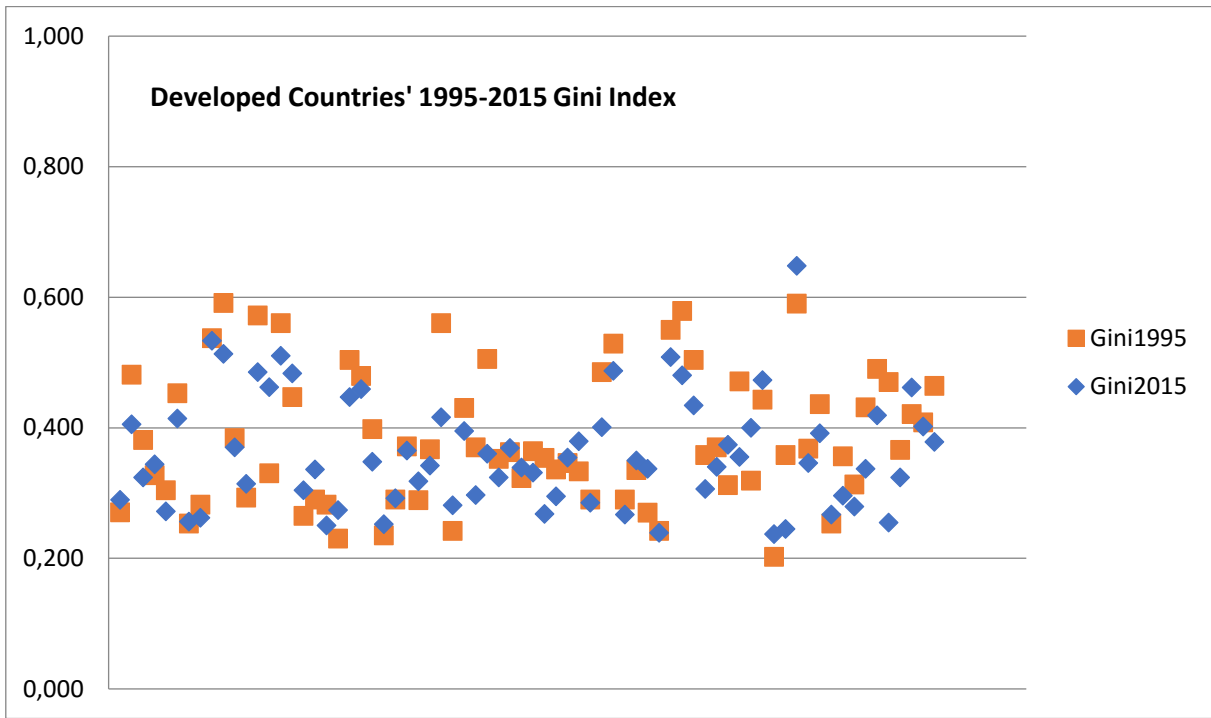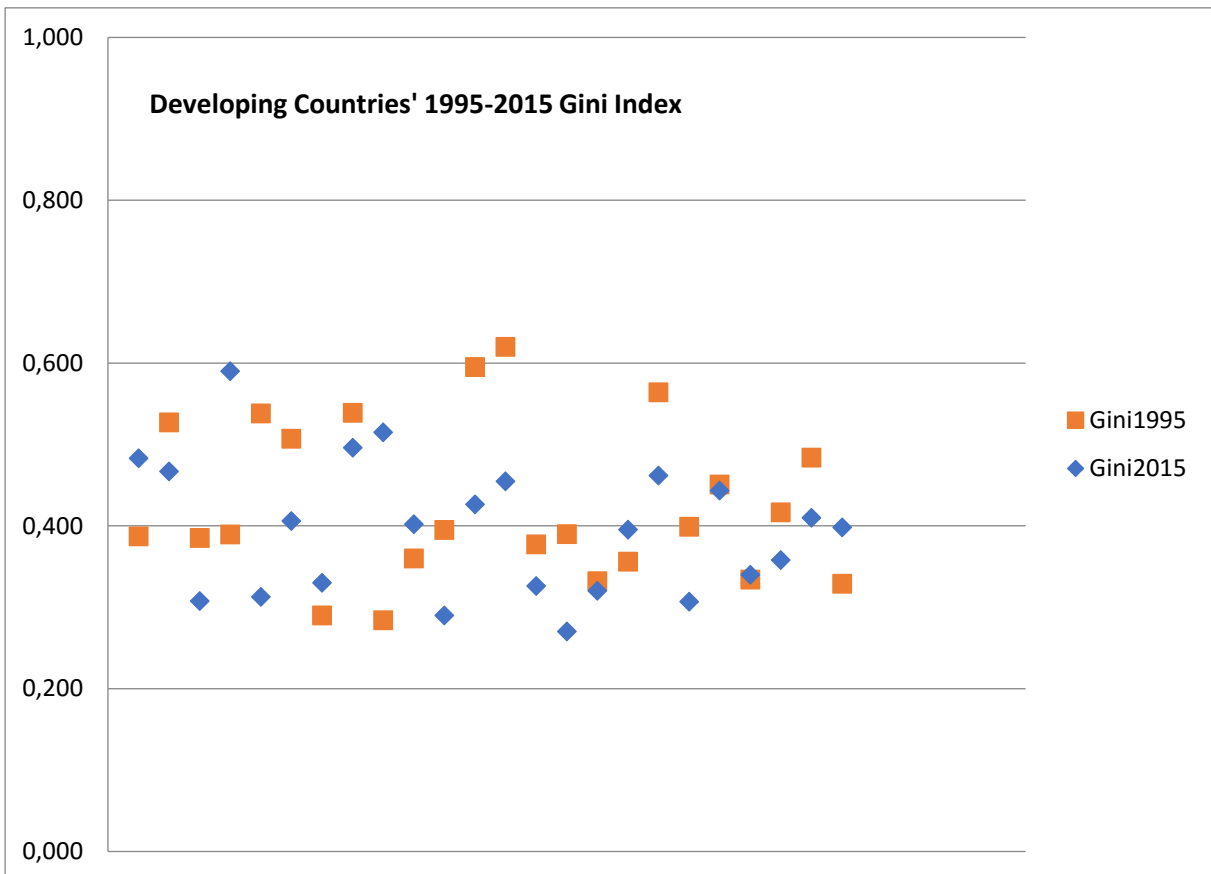
Figure 1. Gini Indexes of Developed Countries

Figure 2. Gini Indexes of Developing Countries

To examine whether or not beta convergence holds, we start with following equation:

$$G_{iT} - G_{i0} = \alpha + \beta G_{i0} + u_i \qquad (i = 1,..,N) \qquad (1)$$

where G_{iT} mentions ith country's Gini coefficient during time period $t = 1,..,N$; α and β are the coefficients of model and u is an error term. If the sign of the convergence coefficient (β) is negative, it is understood that there is inequality convergence. On the other hand, if it has a positive sign, it shows the divergence. According to (Ravallion, 2002:6), the 'steady-state inequality' converges to an expected value of $-\alpha/\beta$ provided by non-zero values of β.

Before Equation 1 is estimated, some more estimation points must be reported. At first, as there may be measurement error in the inequality data, the direction of the convergence test should be considered to have misleading results. Friedman (1992) denominates this issue as a regression error. Secondly, according to Barro and Sala-i-Martin (1992), it shouldn't be handled that the main reversion hypothesis and convergence as same issue. Besides that, negative beta coefficient does not certainly denote that there is a inclination of reducing per capita income among countries. We can prevail over these faults, following Ravillion (2002), we use Gini coefficient as G_{it}^* [3]. This Gini coefficient points out time specific value so that we can calculate appropriately the change of the real degree of inequality. Secondly, by using Equation 2, the change in inequality is tested.

$$\Delta_\tau G_{it} = (1 - \Phi^\tau)(G_{it}^* G_{it-\tau}) - T_i B_{it} + v_{it} \qquad (2)$$

As indicated by Ravallion (2002), ascertained change in inequality can be divided into three parts. The first part is on the right side of Equation 2, which is the deviation between the computed Gini index based on the current survey and its corresponding steady-state value. The second part results from the uneven spacing and because of a trend and when $\tau_{it} = 1$ for all i and t this term withdraws. The third part includes a term arises from the error term.

Following the study of Caselli et al (1996), Bao and Dhongde (2009) uses below dynamic panel data regression in Equation 3 to test the existence of convergence in income distribution.

$$ln(G_{it}) - ln(G_{i,t-\tau}) = \beta ln(G_{i,t-\tau}) + \eta_i + \xi_t + \varepsilon_{it} \qquad (3)$$

Where G_{it} represents Gini coefficient of ith country at time t, η_i represents the country-specific effects, ξ_t is time-specific constant and ε_{it} is serially uncorrelated zero mean error term both in terms of units and over time.

Model presented Equation 4 is widely used in most of the convergence studies and tretaed as fixed effects panel model. When all the variables are taken deviations from period means, the time-specific constant (ξ_t) is dropped out from Equation 3.

---

[3] Inverted Gini coefficients take values that change in time.

$$g_{it} = \beta^* g_{i,t-\tau} + \eta_i + \mathcal{E}_{it} \tag{4}$$

Where $g_{it} = \widetilde{ln}(G_{it})$ and $\beta^* = 1 + \beta$.

Following the suggestion of Caselli et al (1996), it can be derived the difference form of Equation 4 to eliminate the individual-effect term (η_i) and get Equation 5.

$$g_{it} - g_{i,t-\tau} = \beta^*(g_{i,t-\tau} - g_{i,t-2\tau}) + \mathcal{E}_{it} + \mathcal{E}_{i,t-\tau} \tag{5}$$

Chambers and Dhongde (2016) test the existence of convergence by using both cross-section and panel data models. First, they use Equation 6 to test the existence of convergence by estimating the model by OLS.

$$\frac{1}{\tau}\ln(\frac{Gini_{iT}}{Gini_{iT-\tau}}) = \alpha + \beta \ ln(Gini_{iT-\tau}) + u_i \tag{6}$$

Where $Gini_{iT}$ represents the Gini index of country i $i = (1,2,...,N)$ at time T, τ is time horizon, α is intercept, β is the convergence coefficient and u_i is a mean zero error term. As it can be seen from the Equation 6, once the last year's Gini value is proportioned to first year Gini value, the statement on the left of the equation $(\ln(\frac{Gini_{iT}}{Gini_{iT-\tau}}))$ is obtained. The left side of the equation represents ten periods in total, which have different first and ending years leading us to obtain various results for the different time periods.

To test the validity of convergence, we prefer to use Equation 6, because of τ which allows for different time horizons and changes with each estimation. Also, this model allows us define the change in a country's inequality level as a function of initial inequality level.

3. Empirical Results

To test whether or not beta convergence in income inequality holds for both developed and developing countries, we estimate Equation 6 by the panel Ordinary Least Squares (OLS) where we use balanced panel that consists of 24 developing and 74 developed countries for the period 1995-2015 and Table 1 presents the results.

Table 1. The Results of Panel OLS Estimations for Whole Sample

	5 twelvemonths	10 twelvemonths	15 twelvemonths	20 twelvemonths
Gini index 2010				
Constant term	-0.023914			
	(0.0319)**			
First Gini	-0.021988			
	(0.0463)**			
R^2 stat	0.041586			
Number of obs	490			

Gini index 2005				
Constant term	-0.040303	-0.021051		
	(0,0000)***	(0,0001)***		
First Gini	-0.038111	-0.018801		
	(0.0001)***	(0.0005)***		
R^2 stat	0.155160	0.122186		
Number of obs	490	490		
Gini index 2000				
Constant term	-0.049059	-0.033762	-0.025674	
	(0,0000)***	(0,0000)***	(0,0000)***	
First Gini	-0.052449	-0.033890	-0.025052	
	(0,0000)***	(0,0000)***	(0,0000)***	
R^2 stat	0.208961	0.315465	0.290317	
Number of obs	490	490	490	
Gini index 1995				
Constant term	-0.080259	-0.049127	-0.037830	-0.031103
	(0,0000)***	(0,0002)***	(0,0000)***	(0,0000)***
First Gini	-0.083721	-0.052048	-0.038653	-0.031170
	(0,0000)***	(0,0000)***	(0,2383)***	(0,0000)***
R^2 stat	0.184236	0.289038	0.363800	0.364790
Number of obs	490	490	490	490

Note: *, **, *** denotes 10%, 5% and 1% significance levels respectively.

According to results in Table 1, for each initial period, the estimated value of convergence parameter β has a negative sign and statistically significant at all periods. β parameter is statistically significant at 1% significance level at eight time periods, while at two periods β is statistically significant at 5% significance level. The negative β parameter indicates the existence of the convergence among all countries at all time periods. Moreover, given the first year, over the time, the absolute value of β parameter decreases, which means that the speed of convergence is higher in short-term than in the long-term.

We also estimate the Equation 6 by using two different samples of developed and developing countries. Table 2 presents the results.

Table 2. The Results of Panel OLS Estimations for Developed Countries

	5 twelvemonths	10 twelvemonths	15 twelvemonths	20 twelvemonths
Gini index 2010				
Constant term	-0.029799			
	(0.0238)**			
First Gini	-0.026895			
	(0.0362)**			
R^2 stat	0.061145			
Number of obs	370			
Gini index 2005				
Constant term	-0.033190	-0.019622		
	(0.0007)***	(0.0005)***		
First Gini	-0.031570	-0.017330		
	(0.0010)***	(0.0017)***		
R^2 stat	0.144180	0.132487		
Number of obs	370	370		
Gini index 2000				
Constant term	-0.036211	-0.028523	-0.021644	
	(0.0035)***	(0.0000)***	(0.0000)***	
First Gini	-0.039106	-0.028933	-0.020915	
	(0.0012)***	(0.0000)***	(0.0000)***	
R^2 stat	0.140104	0.250270	0.243905	
Number of obs	370	370	370	
Gini index 1995				
Constant term	-0.093818	-0.047031	-0.036383	-0.029753
	(0.0001)***	(0.0000)***	(0.0000)***	(0.0000)***
First Gini	-0.096665	-0.049865	-0.037464	-0.029765
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
R^2 stat	0.215303	0.252827	0.325835	0.334784
Number of obs	370	370	370	370

Note: *, **, *** denotes 10%, 5% and 1% significance levels respectively.

According to the results in Table 2, estimated β parameter is statistically significant and has a negative value in all time periods. In comparison with β parameters that calculated for

whole sample, in this table, convergence values are smaller. In other words, convergence hypothesis is proved, but convergence parameter for developed countries gets smaller values.

Table 3. The Results of Panel OLS Estimations for Developing Countries

	5 twelvemonths	10 twelvemonths	15 twelvemonths	20 twelvemonths
Gini index 2010				
Constant term	-0.001565			
	(0.9429)			
First Gini	-0.001506			
	(0.9471)			
R^2 stat	0.000205			
Number of obs	120			
Gini index 2005				
Constant term	-0.069897	-0.028209		
	(0.0156)**	(0.0751)*		
First Gini	-0.068560	-0.026766		
	(0.0264)**	(0.1148)		
R^2 stat	0.204842	0.109174		
Number of obs	120	120		
Gini index 2000				
Constant term	-0.090048	-0.048562	-0.038342	
	(0.0005)***	(0.0001)***	(0.0005)***	
First Gini	-0.099333	-0.049290	-0.039393	
	(0.0003)***	(0.0001)***	(0.0003)***	
R^2 stat	0.449660	0.507306	0.434184	
Number of obs	120	120	120	
Gini index 1995				
Constant term	-0.035194	-0.057756	-0.040881	-0.036656
	(0.2759)	(0.0009)***	(0.0002)***	(0.0006)***
First Gini	-0.033071	-0.062419	-0.041374	-0.036656
	(0.3540)	(0.0012)***	(0.0006)***	(0.0003)***
R^2 stat	0.039157	0.386627	0.420672	0.419702
Number of obs	120	120	120	120

Note: *, **, *** denotes 10%, 5% and 1% significance levels respectively.

In the Table 3, OLS estimations for 24 developing countries are represented. Except one period, estimated convergence parameter is statistically significant and negative in nine time periods. β parameters for this subgroup have values between -0.09 and -0.02. It is quite remarkable that compared to the sample of developed countries, the convergence parameter values are absolutely higher. In other words, convergence in developing countries takes place more rapidly with respect to developed countries.

The other point requiring attention is that for the periods the R^2 values calculated in OLS estimations are high, the convergence parameters have high values, as well. Since a rise in the parameter together with a rise in R^2 values indicates a sounder and more powerful explanation for the model, it verifies our argument about the convergence hypothesis.

4. Conclusion

In this study, we try to test whether or not the convergence hypothesis holds among developed and developing countries by utilizing beta convergence. To examine this hypothesis, we estimate three different panel data models. First model includes all 98 countries. The second model estimates developed countries and the third model estimates developing countries. The empirical outcomes of study do provide strong evidence in favor of on beta convergence. Thus, it is fair to conclude that during the examination period, there is a tendency of reducing gini indexes in countries which have high inequality scores at the beginning of the period and rising gini indexes in countries which have low inequality scores at the beginning of the period of the analysis.

 The empirical results of the study are also in accordance with convergence literature and nations' income inequality histories. This analysis points out that developed countries such as United States of America and United Kingdom have greater increase in inequality scores. On the other hand, the developing countries, especially Moldova and Egypt, have greater decreases in inequality, which indicates improvement in income distribution.

Reflecting on overall the study, the main point that we should underline is that the convergence in income inequality is valid for the period 1995-2015 and the sample of the analysis, for depending on the length of the period under study, changes might be seen in the income inequality trends of the countries. Similarly, recently prominent Branko Milanovic points to the fact that the income inequality trends of the countries should be interpreted as Kuznets waves rather than Kuznets curve. For this reason, income inequality trends of countries are utilized with changing time periods and macroeconomic policies. In addition to all these, it can be said that in developed countries, income inequality tends to increase in time and the development of inequality in Europe comes up much more alarming. The downward

trend of inequality in developing countries is expected to continue. It is possible to derive important implications from the results of the study which contributes the convergence/divergence debate. One prominent deduction of this study for those with a concern for global inequality is the significant role which continued convergence with global incomes must be occupied. Intrinsically, it would be captivating for future research to further examine the determinants of the convergence process found in this paper.

REFERENCES

Atkinson, A. B. (2003), ''Income Inequality in OECD Countries: Data and Explanations'', 49(4), *CESifo Economic Studies*, 479-513.

Atkinson, A. B. & Brandolini, A. (2009), ''On data: A Case Study of the Evolution of Income Inequality Across Time and Across Countries'', *Cambridge Journal of Economics*, 33, 381-404.

Bao, Y. & Dhongde, S. (2009), ''Testing Convergence in Income Distribution'', *Oxford Bulletin Of Economics and Statistics*, 71(2), 295-302.

Barro, R. J. & Sala-i-Martin, X. (1991), ''Convergence across States and Regions'', *Brookings Papers on Economic Activity*, 1, 107-182.

Barro, R. J. & Sala-i-Martin, X. (1992), ''Convergence'', *Journal of Political Economy*, 100(2), 223-251.

Barro, R. J. & Sala-i-Martin, X. (1992), ''Convergence'', *The Journal of Political Economy*, 100(2), 223-251.

Benabou, R. (1996), ''Inequality and Growth'', *NBER Macroeconomics Annual*, 11, 11-92.

Bernard, A. B. & Durlauf, S. N. (1995), ''Convergence in International Output'', *Journal of Applied Econometrics,* 10(2), 97-108.

Bernard, A. B. & Durlauf, S. N. (1996), ''Interpreting tests of the convergence hypothesis'', *Journal of Econometrics*, 71, 161-173.

Caselli, F., Esquivel, G. & Lefort, F. (1996), ''Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics'', *Journal of Economic Growth*, 1, 363-389.

Chambers, D. & Dhongde, S. (2016), ''Convergence in income distributions: Evidence from a panel of countries'', *Economic Modelling*, 59, 262-270.

Deinenger, K. & Squire, L. (1996), ''A New Data Set Measuring Income Inequality'', *The World Bank Economic Review*, 10(3), 565-591.

Dhongde, S. & Miao, X. (2013), ''Cross-Country Convergence in Income Inequality'', *Society for the Study Of Economic Inequality Working Paper Series*, 290.

Durlauf, S. N. & Johnson, P. A. (1995), ''Multiple Regimes and Cross-Country Growth Behavior, *Journal of Applied Econometrics,* 10(4), 365-384.

Friedman, M. (1992), ''Do old fallacies ever die?'', *Journal of Economic Literature*, 30(4), 2129-2132.

Gallup, J. L. (2012), ''The Global Convergence of Income Distribution'', *https://www.pdx.edu/econ/sites/www.pdx.edu.econ/files/inequality_convergence_complete_0.pdf*.

Hotelling, H. (1933), ''Review of 'The triumph of mediocrityin business' by Horace Secrist'', *J Am Stat Assoc*, 28, 463-465.

Lin, P. C. & Huang, H. C. (2012), ''Convergence in Income Inequality? Evidence From Panel Unit Root Tests With Structural Breaks'', *Empirical Economics*, 43, 153-174.

Mankiw, N. G. et al (1992), ''A Contribution to the Empirics of Economic Growth'', *The Quarterly Journal of Economics*, 407-437.

Quah, D. (1993), ''Galton's Fallacy and Tests of the Convergence Hypothesis'', *The Scandinavian Journal of Economics*, 95(4), 427-443.

Piketty, T. & Saez, E. (2001), ''Income Inequality in The United States 1913-19998'', *NBER Macroeconomics Annual,* 8467.

Ravallion, M. (2002), ''Inequality Convergence'', *WB Policy Research Working Paper Series*, 2645.

Solow, R. M. (1956), ''A contribution to the Theory of Economic Growth'', *The Quarterly Journal of Economics*, 70(1), 65-94.

Solt, F. (2008), ''Standardizing the World Income Database'', *LIS Working Paper Series*, 496.

ATG, <https://www.gc.cuny.edu/Page-Elements/Academics-Research-Centers-Initiatives/Centers-and-Institutes/Stone-Center-on-Socio-Economic-Inequality/Core-Faculty,-Team,-and-Affiliated-LIS-Scholars/Branko-Milanovic/Datasets>

EHII, University of Texas Inequality Project, <http://www.utip.lbj.utexas.edu>

SWIID, The Standardized World Income Inequality Database, <http://fsolt.org/swiid/>

UNU-WIDER, Unu-Wider World Income Inequality Database, <http://www.wider.unu.edu>

WWID, The World Wealth and Income Database <http://www.parisschoolofeconomics.eu/en/research/the-world-wealth-income-database/>