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IMPACT OF INCOME DISTRIBUTION INEQUALITY ON THE HUMAN DEVELOPMENT INDEX: PANEL DATA ANALYSIS FOR BRICS COUNTRIES[*]

Eylül KABAKÇI GÜNAY [**] & Ferhat TOPBAŞ[***]

Abstract

Understanding how income inequality affects the human development index (HDI) is crucial to understand where the multidimensional poverty problem originates from. The Gini coefficient expresses income inequality and allows the comparison of income distributions between countries. This study aims to use the HDI and the Gini coefficient, which shows the income distribution inequality, to analyse Brazil, Russia, India, China, and the Republic of South Africa (BRICS countries) and thus to understand how the income distribution inequality influences the human development index values. In this context, the Gini coefficient of the BRICS countries for the period 1990-2018 was analyzed with the panel data analysis method as the independent and the HDI data as the dependent variable. In addition, the economic growth variable was added as an explanatory variable to the model. In this analysis, the Augmented Mean Group Estimator (AMG) was used because the coefficient homogeneity could not be found after the cross-section dependence and cointegration test was performed and there was a correlation between the units. As a result, it was determined that there was no statistically significant relationship between the Gini coefficient and the HDI among BRICS countries. However, country-based showed that the changes in the Gini coefficient affected HDI in Brazil and Russia. While the direction of this effect was opposite in Brazil, it was linear in Russia.

Keywords*: Gini Coefficient, Human Development Index, BRICS, Augmented Average Group Estimator*

GELİR DAĞILIMI EŞİTSİZLİĞİNİN İNSANİ GELİŞİME ENDEKSİ ÜZERİNDEKİ ETKİSİ: BRICS ÜLKELERİ İÇİN PANEL VERİ ANALİZİ

Öz

Gelir eşitsizliğinin insani gelişme endeksini (İGE) nasıl etkilediğini açıklamak çok boyutlu yoksulluk sorununun nereden kaynaklandığını anlamak için çok önemlidir. Bu

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[**] Assist. Prof. İzmir Demokrasi University FEAS Department of Economics, eylul.kabakci@idu.edu.tr, https://orcid.org/0000-0001-5547-4316.

[***] Assoc.Prof., İzmir Demokrasi University FEAS Department of Economics, ferhat.topbas@idu.edu.tr, https://orcid.org/0000-0002-7576-4668.

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çalışma, Brezilya, Rusya, Hindistan, Çin ve Güney Afrika Cumhuriyeti (BRICS) için İGE ve gelir dağılımı eşitsizliğini gösteren Gini katsayısını birlikte analiz etmeyi ve böylece gelir dağılımı eşitsizliğinin İGE'yi nasıl etkilediğini anlamayı amaçlamaktadır. Bu kapsamda BRICS ülkelerinin 1990-2018 dönemi Gini katsayısı bağımsız değişken, İGE de bağımlı değişken olarak modele dahil edilmiş ve panel veri analizi yöntemi ile analiz edilmiştir. Ayrıca modele açıklayıcı değişken olarak ekonomik büyüme eklenmiştir. Bu analizde, yatay kesit bağımlılığı ve eşbütünleşme testi yapıldıktan sonra katsayı homojenliği bulunamadığı ve birimler arasında korelasyon olduğu için katsayı tahmini için Artırılmış Ortalama Grup Tahmincisi (AMG) kullanılmıştır. Sonuç olarak BRICS ülkeleri grubunda Gini katsayısı ile İGE arasında istatistiksel olarak anlamlı bir ilişkinin olmadığı tespit edilmiştir. Ancak ülke bazlı analizler incelendiğinde Gini katsayısındaki değişimlerin Brezilya ve Rusya'da İGE'yi etkilediği görülmektedir. Bu etki Brezilya'da ters yönlü iken; Rusya'da doğrusaldır.

***Anahtar Kelimeler:** Gini Katsayısı, İnsani Gelişme Endeksi, BRICS, Genişletilmiş Ortalama Grup Tahmincisi*

Introduction

The human development index (HDI) is an index that evaluates countries in terms of education, health, and living standards. In this respect, it is one of the research topics of development economics. HDI, which was developed by the United Nations Development Program (UNDP), has been used since 1990. The HDI values along between 0 and 1. The closer a country's HDI is to 1, the more advanced that country is in human development. Based on the definition of a good and long life, access to information and a high standard of living, the index comprises income, education, and health indicators, associates socioeconomic indicators with economic growth, and allows international comparisons to be made by monitoring the situations of developed countries and less developed countries together. However, debate continues over whether HDI can accurately measure human development.

According to the current method, HDI consists of three components. The *health* is life expectancy at birth; *the education* is measured by the mean of years of schooling for 25 years old above and expected years of schooling for children of school entering age. *The standard of living* is measured by gross national income per capita (UNDP, 2007/2008, p.356). Ranking high in the HDI is one of the primary goals of developing countries because the index is one of the development indicators.

However, maintaining the human development of countries by taking into account only these 3 components is far from providing a deep enough perspective. As we know, there are some external indicators that effects the HDI. For example, in the context of development, how that income is distributed among individuals is more essential than the income created in a country. Therefore, how HDI has changed in developing countries where income inequality is occurrent should also be examined. In this context, this study aims to reveal the relationship of HDI with the Gini coefficient and GDP growth rate and to determine the direction of the relationship for the BRICS countries. In this way, a new perspective will be developed by evaluating the human development index and income inequality together. By understanding the Gini coefficient and whether economic growth has an impact on the human development index, policy proposals can be developed for sample countries in order to rank higher in this index.

The data were analyzed for the period between 1990-2018 for the BRICS countries by using the AMG estimator. Gini coefficient is an indicator that represents income inequality. Gini index measures the extent to which the distribution of income (or, sometimes, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. Economic growth rate represents annual percentage growth rate of GDP at market prices based on constant local currency.

Besides, the major reason to select the BRICS (Brazil, Russia, India, China, and South Africa) as a sample of the study; the countries' economies are developing. As is known, economic growth is essential for development, but it is not sufficient alone. In this context, understanding how the HDI values of BRICS countries, which are countries with high economic growth rates but not fully developed yet, are affected by income inequality will contribute significantly to the literature. Relatively to the results, these countries can aim to be fairer (lower gini index) in the income distribution according to the direction of the relationship between the income distribution and the human development index.

1. LITERATURE REVIEW

When we checked out the former studies related to the scope, we came across some distinguished studies. Some studies are related with directly Gini coefficient and HDI's relationship. However, the others are related to the HDI and economic growth. Our econometric model contains both variables; and thus, we took into consideration the studies that comprise both Gini coefficients and economic growth's effects on HDI together or separately. Some of them are as follows.

Mo (2003) showed that income inequality had a considerable negative impact on GDP growth rates. The transfer channel was the most important of the routes identified by contemporary literature, whereas the human capital channel was the least essential. The direct influence of income disparity on the rate of productivity growth, on the other hand, accounted for more than 55% of the total.

Mikk (2008) examined how HDI values in Baltic countries affected the Gini index values. It was concluded that low-income inequality was associated with higher human development.

Alvan (2009) investigated the relationship between income inequality and human development in 90 countries. It was found that two factors were negatively correlated and there was causality in both directions. When human development increased (High Human Development), income distribution tended to be fairer, also when income distribution was more equal, human development tended to become higher.

Hysa (2014) examined the relationship between inequality level and human development for a group of 151 countries. The study reported a statistically significant negative relationship between Gini index and human development.

Theil (2016) applied panel analysis to estimate the effect of net income inequality on the HDI and its components in a panel of 117 countries for 1970 to 2010. In conclusion, a negative long-run effect of inequality on human development was found. Briefly, Theil claimed that income inequality led to a decreasing effect on HDI.

Parikh et al. (2018) investigated whether Gini coefficient affected HDI or not in 78 countries. They found that the Gini index predominantly had a strong positive relationship with the HDI, but more so in developed countries than in developing nations.

Ceesay et al. (2019) investigated the effect of income inequality on economic growth in the selected Western African countries for the period of 1969-2016 using panel data analysis. The result showed that poverty had a positive and statistically significant effect; openness had a negative, and also a significant effect on economic growth. Inequality and human capital had a negative effect on economic growth and were slightly statistically significant. Therefore, the result of the study was that government should focus on human capital more precisely.

Sarkodie and Adams (2020) investigated the relation between electricity access, human development index, governance, and income inequality in sub-Saharan Africa. They used data between 1990 to 2017 in sub-Saharan Africa using a non-parametric regression technique with Driscoll–Kraay standard errors. The study revealed that income inequality was found to reduce human development, claims that evidence from the study showed that income inequality reduces human development.

It is seen that, in most studies, income inequality reduces human development. When we evaluate economic growth, the variable has a positive effect on human development.

2. EMPIRICAL ANALYSIS

In this study, we used the augmented mean group estimator by Eberhardt and Teal (2010) to investigate the relationship of the HDI with the income distribution inequality and economic growth in BRICS countries which are represented by Gini coefficient and GDP growth rate, respectively. The data belonged to the period between 1990-2018.

The econometric model we use was as follows,

- $HDI = \alpha_1 + \beta_1 (GINI)_t + \beta_2 (GROWTH\%)_t + \varepsilon_{it}$

- **HDI:** Human Development Index contains The ***health dimension, the education dimension,*** and ***the standard of living dimension***. In the study HDI range is 0-1.

- **GINI:** Gini index the distribution of income among individuals or households within an economy that deviates from a perfectly equal distribution. The Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

- **GROWTH %:** Annual percentage growth rate of GDP based on constant 2010 U.S. dollars.

2.1. Coefficient Heterogeneity

Before the panel data analysis, whether the slope coefficients have homogeneity or heterogeneity for each unit is revealed by the delta test developed by Pesaran and Yamagata (2008). Pesaran and Yamagata (2008), based on Swamy's (1970) study, proposed asymptotically normal distribution standardized distribution statistics for panel data models where unit size N and time dimension T are large. Determining the slope coefficient heterogeneity is important for choosing the most appropriate test.

Table 1. Heterogeneity Test Results

Test	Test Statistics	Prob.
$\tilde{\Delta}$	5.060	0,000
$\tilde{\Delta}$adj	5.449	0,000

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According to the results of the present study, p-value was smaller than 0,05. Therefore, we had to reject null-hypothesis. As a result, slope coefficients were heterogeneous. It should be used as a test for considering the heterogeneity. Thus, we preferred a test that considers slope heterogeneity.

2.2. Cross Section Dependence Test

The test of cross-sectional dependency (CD) is a requirement for estimating panel data models. Cross-section dependency is important in determining whether all series will be affected equally by a shock to the section units of the analysis. To determine whether Cross Section Dependence is among the series, Breusch-Pagan (1980) LM or Pesaran (2004) CD test can be used. Breusch-Pagan (1980) LM test can be used where if (T> N). Pesaran (2004) CD test can be used if both the time dimension is greater than the cross-sectional dimension and the cross-section dimension is larger than the time dimension (T> N, N> T). If the time dimension of the panel is smaller than the section size of the panel (T <N), Bias-corrected scaled LM (Baltagi, et al., 2012) test statistics can be used. For our study, the time dimension was equal to 29, and cross-section dimension was equal to 5. In short, T= 29, and N:5. Thus, we applied Pesaran CD test. The cross-sectional dependence null hypothesis was as follows:

H_0 = No cross-section dependency. (There is no correlation between units)

H_1 = There is cross section dependency. (There is a correlation between units)

Table 2. Cross Section Dependence Test Results

Variables /TESTS	HDI p-value	GINI p-value	GROWTH p-value
Breusch Pagan LM	0,000	0,0032	0,000
Pesaran CD	0,000	0,1952	0,000
Bias Corrected Scale	0,000	0,0003	0,000

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Probability values are expected for Pesaran CD for Gini to be below 0.05. According to test results, the null hypothesis was rejected and an alternative hypothesis was accepted. In short, there was a cross-sectional dependency and correlation between units. Therefore, we had to use a 2nd generation unit root test that considers cross-section dependence. In this study, Pesaran (2003) was preferred as the unit root test. Investigating the cross-sectional dependency between the series in the fixed effects panel data model is a crucial step in achieving accurate results. It is very important to take this into account in the unit root and cointegration tests to make the analysis results more consistent.

2.3. Unit Root Test

Unit root tests developed for the absence of correlation between units in the literature are called first-generation tests and tests used in the presence of a correlation between units are called second-generation unit root tests. Since there was a correlation between units in the study, a second-generation unit root test was used. In this study, Pesaran (2003) was preferred as the unit root test. Pesaran (2003) introduced a simple and new process to test unit roots in dynamic panels that serially depend on correlated errors and have cross-section dependence. For this, he expanded the standard DF (or ADF) regressions with the first differences of individual series and cross-sectional averages of lag levels. When applying the Pesaran CADF-CIPS statistics to find the lag lengths for the variables, Schwarz Info Criteria (SIC) was taken into consideration.

H_o: Unit root (Non-Stationary)

H_1= No Unit Root (Stationary)

Table 3. Unit Root Test Results

Variables	HDI	GINI	GROWTH
Schwarz Info Criteria	-7.962513 (4th Lag)	3.365707 (2nd Lag)	4.998227 (3rd Lag)
Unit Root Test Results Pesaran CD (2nd Gen)	-2,757 (0,142)	-2,744 (0,035)**	-3,004 (0,047)**

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2.4. Panel Cointegration Test

It is ensured that the variables used in the model are stationary in the same order. It was checked whether the error terms of the regression established with these variables were stationary in the level values. If the error terms are stable in level values, there is cointegration between variables. To define the cointegration exists or not, we used the Westerlund cointegration test. As a result of the test, the null hypothesis was rejected. Therefore, there was cointegration between variables. The panel cointegration test was done through Westerlund (2008) test. The main feature that distinguishes this test from other cointegration tests is that all other tests are based on the prerequisite that all variables in the model should not be stationary while determining the cointegrated relationship between variables, while Westerlund (2008) works with the prerequisite that at least one variable in the model is not stationary.

- **Ho:** No Cointegration
- **H_1:** Cointegration

As we can see clearly in Table 4, p value was smaller than the 0.05. Therefore, we should reject the null hypothesis. The result was H_0 reject, the claim was cointegration for variables.

Table 4. Westerlund Cointegration Test Result

Cointegration Test	Statistics	p-value
Westerlund Cointegration Test	5.3113	0,0000

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2.5. Panel Causality Test

The method developed by Dumitrescu and Hurlin (2012) was used to test the existence of a causality relationship between the series. The advantages of this method are that it can consider both the cross-sectional dependency and heterogeneity between the countries, it can be used when the time (T) dimension is smaller than the cross-section size (N), and it can also produce effective results in unbalanced panel data sets (Dumitrescu & Hurlin, 2012). Another feature of the Dumitrescu and Hurlin tests is that can analyze both in the presence and absence of a cointegrated relationship. For this reason, Dumitrescu-Hurlin panel causality test was used for causality analysis in this data set where there is no cointegrated relationship.

Table 5. Dumitrescu-Hurlin Causality Test Results

Number of Causalities	Dumitrescu-Hurlin Causality Null Hypothesises	Statistics (Z-BAR)	p-value
1	Ho: GINI does not Granger Cause HDI	10.7756	0.0000
2	H_0: Growth does not Granger cause HDI	5.5382	0.0000

3	H_0: HDI does not Granger cause GROWTH	3.1056	0.0019
4	H_0: HDI does not Granger-cause GINI	1.6910	0,0908

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When we evaluate table 5, both Gini and Growth Rate can cause HDI. It means income inequality and economic growth rate can affect and cause Human Development Index. Another inference is that we can claim HDI can cause growth, but HDI cannot cause income inequality.

2.6. Augmented Mean Group Estimator

As mentioned before, there was an inter-unit correlation (Cross Section Dependence); and thus, heterogeneity in the cross-sections was used in the analysis. Here, the data needed to be tested with an estimator according to these properties. Hence, the estimator to be applied in our study was the Augmented Mean Group estimator. The Augmented Mean Group estimator (AMG) was developed by Eberhardt and Teal (2010) which takes into consideration both cross-section dependence and heterogeneity.

Table 6. Augmented Mean Group Estimator Results

Countries	**Growth**	**Gini Coefficient**
Brazil	0.000395 (0.123)	.0005804 (0.023)
Russia	.0000599 (0.000)	-.0003305 (0.001)
India	.0001907 (0.001)	.0000875 (0.884)
China	.000142 (0.000)	.0002098 (0.348)
South Africa	.0003457 (0.541)	.0004724 (0.409)

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Table 6 shows the coefficient estimation results of the BRICS countries estimated by the AMG Estimator. According to the results, the growth had a statistically significant relationship with the HDI for Russia, India, and China. Because these countries' p-values were smaller than 0,05. The direction of the relationship revealed a positive sign for all the coefficients, which indicated that there was a linear relationship for these countries, that is when growth increased, HDI increased too.

On the other hand, Gini coefficient had a statistically significant relationship with HDI for Brazil and Russia. This means that there was a linear relationship for Brazil and inverse relationship for Russia. Therefore, if Gini coefficient rises; HDI rises as well; but if the Gini coefficient rises; HDI decreases, respectively.

Conclusions

As we stated before, the growth had a statistically significant and linear relationship with the HDI for Russia, India, and China. The linear relationship between the growth rate and the HDI for Russia, India and China indicates that the growth rate in these countries has a healing effect on human development. The obtained result through GDP growth rate is expected and rational because unless there is an increase in population that exceeds the growth rate, an increase in economic growth will increase per capita income. Increasing per capita income will also increase life expectancy and education level at birth.

On the other hand, when the Gini coefficient increased, which means inequality rises, Brazil's and Russia's Human Development Index values were affected positively and negatively, respectively. For Brazil, there was a linear relationship between the Gini coefficient and HDI, while there was an inverse relationship for Russia. In this context, the increase in income inequality in Brazil increased HDI. It can be said that because of the increasing income inequality, the people with higher income in the population immediately improved in HDI component's areas such as getting education, health, and standards of living. Our finding for Brazil is consistent with the study of Parikh et al. (2018). When the Gini coefficient increased in Russia, the HDI decreased. The result claims that income inequality created a disruptive effect on HDI. This finding is compatible with previous literature such as Alvan (2009), Hysa (2014), Theil (2016), and Sarkodie and Adams (2020). This situation suggests that there is a fairer income distribution in Russia than in Brazil because in a society that already has a fairer income, the living conditions of the society will deteriorate as equality deteriorates. Another conclusion that we can draw in Russia is, contrary to Brazil, that components of the HDI were more directly related to the income distribution and these components had more sensitivity to the income distribution.

In future studies, it will be useful to examine the HDI and income distribution inequality with other country groups. We believe that doing this test, especially in country groups with similar development levels, will be useful to understand the nature of the relationship between human development and income distribution inequality. We also believe that it could be useful to calculate o new HDI that considers the Gini coefficient as a component.

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