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# EVALUATION OF THE FACTORS AFFECTING INCOME DISTRIBUTION IN OECD COUNTRIES WITH PANEL DATA ANALYSIS*

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## Abstract

The world economy received new impulses thanks to the acceleration of international trade and cooperation in the last decades and this process subsequently contributed to the growing research interest concerning the relative equality of the distribution of per capita income in various countries. Feeding into this, the issue of how rich-poor income inequality across the population shifts towards or away absolute zero has gained importance in relation to long term economic growth and equity. Thus, it is important to explore in-depth how or what the changes occurring in relation to the key aspects of income distribution would have on difference in income severity between the two groups in focus. The income inequality determinants in this paper are firstly investigated and then econometrically tested using 2001-2020 panel data for 25 OECD member countries. Due to cross-sectional dependence and cross-sectional heterogeneity present in the data, data is treated in the form of panel data. The series' stationarity is tested using the Pesaran's (2007) CIPS Panel Unit Root Test, which is classified amongst the second generation unit root tests. The relationship between the variables is also tested for a long run relationship in which case the Westerlund Panel Cointegration Test and the Estimation of Cointegration Coefficients Using the Panel AMG (Augmented Mean Group) method by Eberhardt and Bond are employed. The Dumitrescu Hurlin Panel Causality Test was used to assess the relationships, between the variables. The result of the study shows that a one percent increase in the consumer price index increases income inequality by 0.01%. Further, one unit increase in indirect tax, human development index political stability, and absence of violence/terrorism index decrease income inequality by 0.08%, 19.3%, and 0.04%, respectively. Hence, the result says that the concerned variables need to be considered while formulating policies for increasing income equality.

**Keywords:** *Income Inequality, Gini Index, Panel Data Analysis*

* This study is derived from a work of the same name conducted in the Department of Economics at Aydın Adnan Menderes University, Institute of Social Sciences.

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# OECD ÜLKELERİNDE GELİR DAĞILIMINI ETKİLEYEN FAKTÖRLERİN PANEL VERİ ANALİZİ İLE DEĞERLENDİRİLMESİ


## Öz

Son yıllarda küresel ticaretin ve uluslararası işbirliklerinin ivme kazanması, dünya ekonomisine yeni bir dinamik kazandırmış ve bu süreç, ülkeler arasındaki kişi başına düşen gelir düzeylerinin yakınsamasına yönelik ilginin artmasına zemin hazırlamıştır. Bu bağlamda, uzun vadede zengin ve yoksul kesimler arasındaki gelir dağılımının mutlak eşitlik seviyesine yakınsaması ya da ondan uzaklaşmasının incelenmesi, ekonomik kalkınma ve gelir adaleti açısından önemli bir araştırma konusu haline gelmiştir. Dolayısıyla, gelir dağılımını etkileyen temel faktörlerin, iki grup arasındaki gelir farklılıkları üzerindeki etkisinin kapsamlı bir biçimde analiz edilmesi gerekmektedir. Bu çalışmada, 25 OECD ülkesine ait 2001-2020 dönemine ilişkin veriler kullanılarak gelir adaletsizliğine etki eden faktörler öncelikle istatistiki, ardından ekonometrik yöntemlerle incelenmiştir. Verilerin yatay kesit bağımlılığı ve heterojen yapısı göz önüne alınarak panel veri analizi tercih edilmiştir. Serilerin durağanlığı, ikinci nesil birim kök testlerinden biri olan Pesaran (2007) CIPS Panel Birim Kök Testi ile değerlendirilmiştir. Panel eşbütünleşme ilişkisi ise Westerlund Panel Eşbütünleşme Testi ile incelenmiş, eşbütünleşme katsayılarının tahmini için Eberhardt ve Bond tarafından geliştirilen Panel AMG (Artırılmış Ortalama Grup) yöntemi kullanılmıştır. Değişkenler arasındaki nedensellik ilişkilerinin tespiti amacıyla Dumitrescu-Hurlin Panel Nedensellik Testi uygulanmıştır. Çalışma bulguları, tüketici fiyat endeksindeki artışın gelir eşitsizliğini %0,01 oranında artırdığını ortaya koymaktadır. Buna ek olarak, dolaylı vergiler, insani gelişim endeksi ve politik istikrar ile şiddet/terörizm yokluğu endeksindeki bir birimlik artışın sırasıyla %0,08, %19,3 ve %0,04 oranında gelir adaletsizliğini azalttığı tespit edilmiştir. Elde edilen bu sonuçlar, gelir dağılımını iyileştirme amacı güden politikaların oluşturulmasında, ilgili faktörlerin dikkate alınması gerektiğini göstermektedir.



**Anahtar Kelimeler:** *Gelir Eşitsizliği, Gini Endeksi, Panel Veri Analizi*

## 1. INTRODUCTION

On an individual level, income is a basis for economic security. On a national level, income acts as the foremost parameter of financial strength and development. Fair income and wealth distribution constitute a foundation for social peace and sustainable economic growth. Nonetheless, in the past, ranges of income distributions have been records of acting as motivators for social unrest and economic unrest. These differences create further distances between people and widen the economic gulfs looming between nations in the world. Recently, globalization has accelerated the observable accumulation of income differences in such a way that fighting them has become the top priority in both domestic and foreign policy measures.

Income inequality is a multifaceted phenomenon because it impacts economic development, social justice, equal opportunities, and political stability. This place, then, had great interest in examining the causes of income inequality and the factors contributing to widening the gap between the rich and the poor, being important for ensuring sustainable economic growth and social welfare. There is a lot mentioned in the literature about income inequality and the determinants of it. The paper, thus, aims to analyze the economic, social, and political factors of the social distribution of income within the OECD Countries.

The primary objective of this study is to econometrically examine the factors contributing to income inequality in OECD countries using panel data analysis. The data used in this study are sourced from reputable international organizations such as the OECD and the World Bank. The analysis focuses on the stationarity of the series, cointegration relationships, and causality between variables. By exploring the impacts of economic growth, human development, and political stability on income distribution, this study seeks to offer valuable policy recommendations for improving income equality. The findings are intended to guide policymakers in formulating effective strategies to promote social justice, economic stability, and inclusive growth.

## 2. DEFINITION OF INCOME DISTRIBUTION

Before discussing the concept of income distribution, such terms as "income" and "distribution" should first be defined. According to Seyidoglu (1995: 293), income is a flow concept, different from wealth, and is defined as the money, goods, or services generated in a given time by persons involved in economic activities. Conversely, distribution denotes the allocation of an output or nominal income along the factors of production (Uysal, 2007: 250).

According to Boratav (1976: 8-9), distribution can be understood as the mechanism that regulates the sharing of products or incomes within a society. The expression refers to social relations determining the individuals' or social groups' sharing of products or incomes as "distribution relations." Income distribution is through these relations, which is the manner in which individuals or groups receive their intrinsically based share of products or incomes.

The equality of income distribution is one of the associated features improving the living standards of the members of such a society; absolute equality, on the other hand, is not easily achieved in reality. This naturally brings to mind the concept of ideal income distribution. Accordingly, ideal income distribution may be defined as fair compensation for income distribution in a manner that raises the living standards of all members of these societies, using all possible means of blunt resources that can be used. Factors such as the individuals' productive capacity to utilize income according to their needs shape this distribution. Thus, rather than setting a minimum subsistence level for individuals, policymakers should aim to develop income distribution policies that strive for a more humane and sustainable level of welfare, targeting an ideal distribution that enhances overall societal well-being and mitigates income inequality.

## 3. TYPES OF INCOME DISTRIBUTION

Income distribution can be categorized into four primary types based on its sources: functional income distribution, personal income distribution, sectoral income distribution, and regional income distribution.

**Functional income distribution** forms the foundation of economic theories and refers to the allocation of national income among the different factors of production—labor, capital, entrepreneurship, and natural resources (Neumark, 1948: 354). In this type of distribution, labor earns wages, capital owners receive profits, entrepreneurs earn interest, and natural resources yield rent. Although functional income distribution represents the division of national income among production factors, it does not account for income disparities within social classes (Türk, 1985: 198).

**Sectoral income distribution** refers to the shares of national income received by different sectors, such as agriculture, industry, and services, over the long term. The distribution of income across these sectors indicates which sectors have benefited most from government policies and economic growth (Türk, 2003: 314). In less developed countries, agriculture typically receives the largest share of national income, whereas in developed countries, the industrial and service sectors dominate. It is important to note that individuals may earn income from multiple sectors, which may not be fully reflected in the sectoral income distribution (Ensari, 1997: 18). Sectoral income distribution is also divided between the public and private sectors, providing insights into the extent of government intervention in the economy and the type of economic system in place (Uysal, 2007: 251).

**Regional income distribution** reflects the distribution of national income across different geographic regions within a country. It highlights the disparities in economic development between regions, which arise from factors such as geography, social conditions, economic structures, and population dynamics (Karataş, 2019: 59). The specific characteristics of each region, including its productive capacity, contribute to these disparities. For example, while agricultural production may dominate in one region, industrial and service production may prevail in another. As a result, the income earned by a farmer differs from that of a high-level executive, leading to regional income disparities.

**Personal income distribution,** on the other hand, examines the share of national income received by individuals or households within a given period. In this type of distribution, the source of an individual's income, whether from wages or interest, is irrelevant, and it does not distinguish between different social classes. The personal income distribution refers to the distribution of the total income earned by an individual or household (Küçükkaya, 2017: 30).

## 4. PANEL DATA ANALYSIS OF FACTORS AFFECTING INCOME DISTRIBUTION IN OECD COUNTRIES

The interplay of a country's development stage, investment flows, technology change, and capabilities in confronting globalization (on technology) affect domestic income inequality. The variance in the degree of income distribution across countries is mostly attributable to tax policy and other macroeconomic variables in those respective countries. The uniqueness of each country's structural character explains the highly divergent effects of these interactions. Upon closer consideration, one finds that the economic variables exert a tangible impact on income distribution on par with or exceeding that of social and political determinants. These interactions are getting more complex and demand a comprehensive analysis that would encapsulate their structural diversity as well as their interrelationships with economic, social, and political variables on the features of income inequality.

### 4.1. Selected Literature Review

**Table 1.** Literature Review Table

| Authors | Variables Used | Conclusions |
|---|---|---|
| **Kuznets (1955)** | National income data from the US, UK, Germany. | Income inequality tends to decrease in advanced countries when secondary redistribution mechanisms (taxes, state contributions) are accounted for. |
| **Stiglitz (1969)** | Labor skills, consumption patterns, inheritance policies. | Developed Champernowne and Mandelbrot theories to explain income inequality. Found capital-labor ratios affect inequality under specific conditions. |
| **Achdut and Kristal (1993)** | International poverty perspectives and income inequality. | Significant disparities in poverty across countries, with some evidence of rising inequality in certain regions. |
| **Förster (1994)** | Measurement of poverty and low incomes in a comparative international framework. | Found that income poverty levels varied significantly across countries, depending on welfare state interventions |
| **Atkinson et al. (1995)** | Cross-country income distribution in OECD countries. | Documented variations in income inequality across OECD countries |
| **Aaberge et al. (1996)** | Income inequality and mobility in Scandinavian countries compared to the U.S. | Scandinavian countries had lower inequality and higher mobility than the U.S. |
| **Benabou (1996)** | The relationship between income inequality and economic growth. | Found that higher inequality may impede growth, particularly in imperfect capital markets |
| **Gregg and Wadsworth (1996)** | Polarization of employment and its effects on income inequality in OECD countries. | Increasing employment polarization contributed to rising inequality |
| **Gustafsson and Johansen (1997)** | Inflation, GDP, unionization rates. | Found that inflation and GDP reduce inequality, while unionization increases it. No significant link between unemployment and inequality. |
| **Gottschalk and Smeeding (1997)** | Cross-national comparisons of income inequality trends across industrialized countries. | Inequality trends varied, with the U.S. experiencing larger inequality increases than European nations |
| **Becker (1998)** | Income distribution trends in Germany, focusing on the 1990s. | Rising inequality in Germany, particularly in the 1990s |
| **Förster and Pearson (2000)** | Income distribution and poverty trends in the OECD. | Documented rising inequality in many OECD countries since the 1980s |
| **Melchior et al. (2000)** | Life standard indicators, GDP per capita. | Found stronger equality trends than expected. Global inequality decreased during 1960-1998, particularly in life standards. |

| | | |
|---|---|---|
| **Piketty (2003)** | Capital income, taxation, shocks (France 1901-1998). | Income inequality reductions in the early 20th century were largely due to capital shocks like wars, not structural economic changes. |
| **Martinez et al. (2012)** | Taxation, public spending, Gini coefficient. | Progressive taxes had a small effect on reducing inequality. Corporate taxes and customs duties had larger positive effects on reducing inequality. |
| **Eroglu et al. (2017)** | Social welfare expenditures, income distribution, Gini coefficient. | Social welfare expenditures are effective in the egalization of income distribution. |
| **Demir (2020)** | Gini coefficient and luxury goods import expenditures. | There is significant causality from luxury goods importation to income inequality, and the country-specific results also find this relationship to hold for 9 out of 13 countries. |
| **Song et al. (2021)** | Remittances, Foreign Direct Investment (FDI) inflows, income distribution. | While remittances tend to decrease income inequality, FDI inflows may cause an increase in inequality within the developing economy. |
| **Bilik (2022)** | The household debt level and income distribution. | Income distribution inequality tends to increase household debt levels. |
| **Efeoğlu (2023)** | Indirect and direct taxes, income inequality measured by Gini coefficient. | Direct taxes reduce income inequality, but indirect taxes increase income inequality. |
| **Włodarczyk (2024)** | Information flow, income distribution metrics. | The better access to information can therefore decrease income inequality due to the creation of more equal economic opportunities. |
| **Bozkurt and Altıner (2024)** | Social spending, income inequality. | Social spending is negatively associated with higher income inequality and is more responsive the greater the level of inequality. |

This paper investigates the determinants of economic, social, and political factors of income distribution in OECD countries. Indeed, the research findings of the present study are in line with the literature on many aspects. The common features of the literature generally suggest that inflation widens income inequality, the effects of indirect taxes are ambiguous and vary across countries, while social spending is usually inequality reducing. The present findings confirm the previous studies that inflation widens income inequality and that the effects of indirect taxes on income distribution are clearer in developed economies. However, it is unique in highlighting how social and political variables influence income inequality, such as human development and political stability. The present research has underlined, above all, the crucial role of political stability in reducing inequality; this variable points, in fact, to a wide approach by policymakers in balancing political and social considerations.

## 4.2. Model, Data Set, And Methodology

Panel data analysis will be adopted in this study to investigate the impact of different economic, social, and political variables on income inequality. The fundamental purpose of this research is to provide a thorough analysis of what drives income distribution and to dynamize the relative effects of the determining factors on income inequality. The analysis adopts a multidimensional approach through the application of panel data methodology.

Due to the issue of missing data, certain OECD countries, including Australia, Hungary, Switzerland, Iceland, Japan, South Korea, Latvia, Lithuania, the Netherlands, New Zealand, Poland, Slovakia, and Slovenia, have been excluded from the analysis. Consequently, the panel data analysis was conducted using data from the remaining 25 countries over the period 2001-2020. To ensure the robustness and reliability of the results, stationarity tests were applied, and only those variables that became stationary at second differences were included in the model. The model is estimated as follows:

$$ddGINI = \alpha_0 i + \alpha_1 i\ ddCPI_{it} + \alpha_2 i\ INDT_{it} + \alpha_3 i\ ddHDI_{it} + \alpha_4 i\ ddPSI_{it} + \varepsilon_i \qquad (1)$$

**Table 2.** Data Set

| Variable | Symbol | Data Type | Representation |
|---|---|---|---|
| Income Inequality | DdGINI | Ratio | Gini Index |
| Inflation | DdCPI | Ratio | Consumer Price Index (CPI) |
| Tax | DdINDT | Ratio | Indirect Tax |
| Human Development | DdHDI | Ratio | Human Development Index (HDI) |
| Political Stability | DdPSI | Ratio | Political Stability and Absence of Violence/Terrorism Index |

Information regarding the variables is provided in the table above. The data were sourced from the official websites of OECD Statistics and the World Values Survey. The analysis was conducted using the econometric software EViews 13 and Stata 14.

### 4.3. Testing for Cross-Sectional Dependence and Homogeneity

One of the preliminary steps in the analysis involves examining the presence of cross-sectional dependence. This is particularly crucial when the number of cross-sectional units (N) is large while the time dimension (T) is relatively small. In such cases, cross-sectional dependence tests should be conducted, preferably those that do not rely on specific spatial weight matrices and are known to perform well under small sample conditions. Breusch and Pagan's LM test, although widely used, exhibits certain limitations when N is large. To address this, an alternative approach based on pairwise correlation coefficients is often employed, offering a simpler and more efficient test compared to the quadratic form of the LM test.

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{P}_{ij}\right) \qquad (2)$$

Unlike the LM test, the CDlm test statistic approaches zero under the assumption that $y_{it}$ and $x_{it}$ are time-invariant in an unconditional sense and that innovations are symmetrically distributed. This holds even in the presence of heterogeneous dynamic models that accommodate multiple structural breaks in slope coefficients and error variances. The CDlm test is robust across a wide range of panel data models, making it applicable under fixed values of both T and N. The hypotheses for the test are as follows:

**$H_0$:** Cov(uit,ujt) = 0 for all t and i!=j indicating no cross-sectional dependence.

**$H_1$:** Cov(uit,ujt) ≠0 for all t and i! ≠j ndicating the presence of cross-sectional dependence.

At the 5% significance level, if the p-value obtained from the analysis exceeds 0.05, the null hypothesis ($H_0$) is accepted, indicating no evidence of cross-sectional dependence. Conversely, if the p-value is below 0.05, the alternative hypothesis ($H_1$) is accepted, suggesting the presence of cross-sectional dependence (Pesaran, 2004: 5-8). In this study, cross-sectional dependence was tested using Stata 14 codes to analyze the data. The results of the tests, which assess cross-sectional dependence for the panel data, are presented below.

**Table 3.** Cross-Sectional Dependence Test Results

| Test | Statistic | P-Value |
|---|---|---|
| LM | 459 | 0,0000 |
| LM adj* | 6,454 | 0,0000 |
| LM CD* | 0,0515 | 0,5652 |

*Two sided test

Based on the results of the LM and LM adj* tests, since the p-value is less than 0.05, the alternative hypothesis ($H_1$) is accepted, indicating the presence of cross-sectional dependence in the series. However, according to the LM CD* test, the p-value is greater than 0.05, leading to the acceptance of the null hypothesis ($H_0$), meaning there is no cross-sectional dependence in the series. Given that N>T in this study, the LM adj* test, which represents the Pesaran Scaled LM test, is taken as the basis. Consequently, we accept the presence of cross-sectional dependence in the series.

Following the identification of cross-sectional dependence, the next issue to be examined in the series is the question of homogeneity versus heterogeneity. The homogeneity test was developed by Pesaran and Yamagata in 2008. Consider a panel data model with fixed effects and heterogeneous slopes.

$$y_{it} = \alpha_i + \beta_i' x_{it} + \varepsilon_{it},\ i = 1, \dots, N,\ t = 1, \dots\dots, T \qquad (3)$$

In the case where αi is bounded by a compact set, xit represents a kx1 vector of exogenous regressors, and under the condition || β || < K, ßi is a kx1 vector with unknown slope coefficients. The distribution of time series observations for the i outputs

$$y_i = \alpha_i T_T + X_i \beta_i + \varepsilon_i,\ i = 1,2, \dots, N, \qquad (4)$$

Here, yi = $(y_{i1},\dots,y_{iT})'$ represents one of the Tx1 vectors, Xi = $(x_{i1},\dots,x_{it})$, and εi = $(\varepsilon_{i1},\dots,\varepsilon_{iT})'$. Therefore, the null and alternative hypotheses are as follows (Pesaran and Yamagata, 2007: 2).

**$H_0$:** βi = β for all i, meaning that the slope coefficients are homogeneous.

**$H_1$:** βi ≠ βj for i≠j, meaning that the slope coefficients are heterogeneous.

The results of the homogeneity test for the data are presented below.

**Table 4.** Homogeneity-Heterogeneity Test Results

| | **Delta** | **P-Value** |
|---|---|---|
| | 14,487 | 0,000 |
| adj. | 17,315 | 0,000 |

According to the test results, since the p-value is less than 0.05, the series are considered heterogeneous, meaning that the alternative hypothesis ($H_1$) is accepted. After the homogeneity-heterogeneity test, it is necessary to reanalyze cross-sectional dependence. Therefore, the results of the cross-sectional dependence test conducted on the heterogeneous data are presented below.

**Table 5.** Cross-Sectional Dependence After Homogeneity-Heterogeneity Test

| | **Delta** | **P-Value** |
|---|---|---|
| | 14,487 | 0,000 |
| adj. | 17,315 | 0,000 |
| | **Delta (Hac)** | **P-Value** |
| | -2,996 | 0,003 |
| adj. | -3,581 | 0,000 |
| Cross Sectional dependence in base variables detected: | | CPI INDT HDI PSI |

According to the test results in the table, cross-sectional dependence was analyzed after the homogeneity-heterogeneity test. The Delta and adjusted Delta values (adj. Delta) are 14.487 and 17.315, respectively, with p-values of 0.000, indicating the presence of cross-sectional dependence in the series. Similarly, the HAC method results show a Delta value of -2.996 and an adjusted adj. Delta of -3.581, with corresponding p-values of 0.003 and 0.000. These results confirm the existence of cross-sectional dependence in the series. In conclusion, cross-sectional dependence was detected in the base variables such as CPI (Consumer Price Index), INDT (Industrial Index), HDI (Human Development Index), and PSI. This suggests that these series are interdependent and move together.

**4.4. Unit Root Tests**

According to the method developed by Pesaran in 2007, a simple approach is proposed to eliminate the correlation between units. In this method, the lagged cross-sectional averages of the ADF regression, along with its augmented version, are used together. By differencing this regression, the correlation between units is removed. The simple regression model, referred to as the "Cross-Sectionally Augmented Dickey-Fuller (CADF)" test, is shown as follows.

$$\Delta Y_{it} = \alpha_i + \rho_i^* Y_{it-1} + d_0 \Delta \bar{Y}_{t-1} + d_1 \Delta \bar{Y}_t + \varepsilon_{it} \qquad (5)$$

According to the equation, $\bar{Y}t$ represents the average of all observations (N) over time (t). The correlation between units is calculated through the factor structure, by taking the lagged cross-sectional averages and their differenced forms. If there is autocorrelation in the factor or error term, the model can be extended by adding the lagged differences of Yit and $\bar{Y}t$ to the univariate regression model.

$$\Delta Y_{it} = \alpha_i + \rho_i^* Y_{it-1} + d_0 \Delta \overline{Y}_{t-1} + \sum_{j=1}^{p} d_{j+1} \Delta \overline{Y}_{t-j} + \sum_{k=1}^{p} C_k \Delta Y_{it-k} + \varepsilon_{it} \qquad (6)$$

The degree of augmentation is selected either by an information criterion or through sequential analysis. After estimating the CADF regression model, the CIPS statistic is calculated using the average of the t-statistics of the lagged variables, referred to as CADFi.

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} CADF_i \qquad (7)$$

The CIPS statistic does not have a standard unified asymptotic limit. Critical values have been calculated for different T and N values (Tatoğlu, 2013: 223-224). According to the test statistic, if the CIPS values are smaller than the critical values, the null hypothesis is valid, meaning that the series is found to be non-stationary. If the CIPS values are greater than the critical values, the alternative hypothesis is valid, and the series is considered stationary. The hypotheses of the test are as follows.

**$H_0$:** CIPS < CADF If the values are smaller than the critical values, the series is non-stationary.

**$H_1$:** CIPS > CADF If the values are greater than the critical values, the series is stationary.

Based on the number of observations (N=25) and time (T=20), when examining the CADF critical values table, the values are in the range of - 2.40 and - 2.32 for 1%, - 2.21 and - 2.15 for 5%, and - 2.10 and - 2.07 for 10%. Accordingly, the unit root test results calculated using the Eviews13 program are as follows.

**Table 6.** CIPS Unit Root Test

| Variables | Level Values | | Variables | Second Difference Values | |
|---|---|---|---|---|---|
| | T-Statistic | P-Value | | Statistic | P-Value |
| GINI | -2,52 | <0,01 | DDGINI | -3,16 | <0,01 |
| CPI | -1,55 | >=0,10 | DDCPI | -2,42 | <0,01 |
| INDTAX | -0,93 | >=0,10 | DDINDTAX | -2,25 | <0,01 |
| HDI | -3,66 | <0,01 | DDHDI | -3,16 | <0,01 |
| PSI | -2,31 | =0,10 | DDPSI | -2,83 | <0,01 |

It is observed that GINI and HDI are stationary at the 1%, 5%, and 10% significance levels with constant and trend, while PSI is stationary at the 10% significance level. In contrast, the CPI and INDTAX series are not stationary at the level value. However, after taking the second difference of all variables, GINI, CPI, HDI, and PSI become stationary at the 1% significance level. Similarly, INDTAX also becomes stationary at the 1% significance level after the second difference is taken. For all variables with second differences, because the T-statistic values are greater in absolute magnitude than the CADF critical values at the 5% and 10% significance levels, no unit root is detected. Since all variables are found to be stationary at the same level after taking the second difference, the alternative hypothesis ($H_1$) is accepted.

### 4.5. Cointegration Test

In analyses involving non-stationary series, there is a risk of encountering spurious regression. Therefore, to make the series stationary, first and second differences are taken. However, while eliminating the effects of shocks, the characteristic features of the series may also be lost, making it more difficult to reveal long-term effects between the series.

In 2007, Westerlund developed four panel cointegration tests based on an error correction model for panel data. These tests determine the existence of cointegration by examining whether there is error correction in each unit. The regression equation has been developed as follows.

$$\Delta Y_{it} = \delta_i' d_t + \Delta X_{it} + \gamma_i Y_{it-1} + \varphi_i X_{it-1} + e_{it} \qquad (8)$$

In the equation, **dt** represents the vector of deterministic components containing constant and trend, **λi** denotes the long-term parameter, and **ϒi** and **ϕi** represent the short-term parameters. Accordingly, three scenarios arise.

I. $d_t = \{\emptyset\}$
II. $d_t = 1$
III. $d_t = (1, t)$

The autoregressive parameter **ρ** is estimated either for each unit or for the entire panel. When examining the first type of statistics, which are panel variance ratio statistics, the autoregressive parameter is assumed to be constant across all units (**ρi = ρ**). In contrast, in the second type of statistics, which represent group mean variance ratio statistics, **ρ** varies for each unit. The **Pa** and **Pt** statistics reflect the results for the panel statistics. The panel statistics and the hypotheses of the test are as follows.

$$P_a \quad : P_a = \left(\sum_{i=1}^{N} L_{i11}\right)^{-1} \sum_{i=1}^{N} L_{i12} \qquad (9)$$

$$P_t \quad : P_t = \hat{\sigma}^{-1}\left(\sum_{i=1}^{N} L_{i11}\right)^{-1/2} \sum_{i=1}^{N} L_{i12} \qquad (10)$$

**$H_0$:** $\rho_i = 0$ If (for all i), there is no cointegration relationship.

**$H_1$:** $\rho_i < 0$ If (for all i), there is a cointegration relationship.

The Ga and Gt group mean statistics are calculated by taking the weighted average of the ρi and the t-ratios of ρi obtained for each unit. The hypotheses of the test and the group statistics are as follows (Tatoğlu, 2013: 239-241).

$$G_a \quad : G_a = \sum_{i=1}^{N} L_{i11}^{2} L_{i12} \qquad (11)$$

$$G_t \quad : G_t = \sum_{i=1}^{N} \hat{\sigma}_i^{1} L_{i11}^{-1/2} L_{i12} \qquad (12)$$

**H$_0$:** $\rho_i = 0$ If (for all i), there is no cointegration relationship.

**H$_1$:** $\rho_i < 0$ If (for all i), there is a cointegration relationship.

**Table 7.** Westerlund Cointegration Test

| Results for H$_0$: no cointegration | | | |
|---|---|---|---|
| With 25 series and 4 covariates | | | |
| **Statistic** | **Value** | **Z-Value** | **P-Value** |
| Gt | -3,934 | -9,504 | 0,000 |
| Ga | -8,142 | 1,221 | 0,889 |
| Pt | -14,632 | -5,168 | 0,000 |
| Pa | -5,810 | 0,208 | 0,582 |

In the Westerlund cointegration test, where the lag length is set to 1, the Gt, Ga, Pt, and Pa test statistics, as well as the Z statistics and p-values, were analyzed. When evaluating the analysis as a whole, the Pt and Pa test statistics, which represent the panel results, should be considered. According to the results, since the p-value at the 1%, 5%, and 10% significance levels is “zero,” the alternative hypothesis (H$_1$) is accepted based on the Pt statistic. Therefore, there is a cointegration relationship between the dependent variable, the Gini coefficient, and the independent variables: the consumer price index (CPI), indirect taxes, the human development index (HDI), and the political stability/absence of terrorism index. However, according to the Pa statistic, no cointegration relationship exists between the variables.

After detecting the presence of a cointegration relationship between the variables, it is necessary to calculate the long-term cointegration coefficients. Therefore, the data, which exhibit cross-sectional dependence and heterogeneity, have been estimated using the Augmented Mean Group (AMG) estimator developed by Eberhardt and Bond in 2009. The AMG estimation is derived as follows:

*i = 1, …, N and t = 1, …, let T be,*

$$y_{it} = \beta_i' x_{it} + u_{it}\ ; \quad u_{it} = \alpha_i + \lambda_i' f_t + \varepsilon_{it} \qquad (13)$$

$$x_{mit} = \pi_{mi} + \delta_{mi}' g_{mt} + \rho_{1mi} f_{1mt} + \cdots + \rho_{nmi} f_{nmt} + v_{mit} \qquad (14)$$

here $m = 1, \ldots, k$ ve $f_{.mt} \subset f_t$,

$$f_t = \vartheta' f_{t-1} + \epsilon_t \ \ ve\ g_t = N' g_{t-1} + \omega_t \qquad (15)$$

The vector of observable common variables is **xi**, the fixed effects specific to the group are ***α*i**, and a set of common factors **ft** along with the country-specific factor loading **λi** are used to express the model (Eberhardt and Bond, 2009: 1-2). The results obtained using the Panel AMG estimator are presented below.

**Table 8.** Panel AMG Cointegration Coefficient Analysis

| **Dependent Variable** | **Independent Variable** | | | |
|---|---|---|---|---|
| | **ddCPI** | **ddINDT** | **ddHDI** | **ddPSI** |
| ddGINI | 0,0149 | -0,0809 | -19,3640 | -0,0403 |

According to the analysis results, the increase in consumer inflation rates contributes to a 0.01 increase in the Gini coefficient, indicating a rise in income inequality. A one-unit increase in indirect taxes, on the other hand, reduces the Gini coefficient by 0.08. While the impact of indirect taxes on income inequality tends to have an positive effect in developed countries, it has a deteriorating effect in developing economies (Nantob, 2015). An improvement in the Political Stability and Absence of Violence/Terrorism Index decreases income inequality by 0.04. The findings of the study regarding the cointegration between the Gini coefficient and other variables align with those from previous research conducted by Sharafat (2014b), Nantob (2015), Ebimobowei and Israel (2021), Thiel (2016b), and Khan et al. (2022a).

Sharafat’s research, using Pakistan's data from 1972-2007, reveals that inflation has a stimulative effect on growth, but at high levels, it adversely impacts growth, leading to an increase in poverty. Nantob’s (2015) study, which covers the period from 2000 to 2012 for 46 countries, investigates the relationship between income inequality and variables such as inflation, growth, unemployment, openness, and governance using dynamic panel data analysis. It reflects a positive and significant relationship between the Gini coefficient and inflation, indicating higher inflation with more income inequality.

Thiel's panel study, over the period 1970-2010 for 117 countries, examines the impact of income inequality on HDI and its components. Results indicate that income inequality has a negative long-run effect on HDI, decreasing HDI levels over time. In a similar vein, the analysis of Khan et al. (2022a) applied the two-stage GMM and panel quantile regression techniques to evaluate the impact of political stability, growth, financial development, and carbon emissions on income inequality among developed, developing, and BRI countries within the period spanning 2002-2019. The findings showed that in developing countries, carbon emission, financial development, and political stability increase income inequality, while economic growth suppresses it. In high-income countries, political stability and carbon emissions decrease income inequality, whereas financial development increases it. In the BRI countries, income inequality is reduced by political stability, economic growth, and even carbon emissions.

### 4.6. Causality Test

The Granger causality test used in this paper is Dumitrescu-Hurlin, adequate to establish the existence of a causal relationship among the variables. Dumitrescu and Hurlin developed this test in 2012, and the main advantage that it presents is that it applies to data sets that have been previously processed for cross-sectional dependence and heterogeneity. The method is also appropriate when the cross-sectional dimension is larger than the time one. The following causality test defined for the values of X and Y established at every i=1,.,N and t=1,.,T is formulated as (Dumitrescu and Hurlin, 2012: 1451-1454):

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \qquad (16)$$

In the equation, K∈N∗K \in N^*K∈N∗ and βi=(βi(1),…,βi(K))′\beta_i = (\beta_i(1),…, \beta_i(K))′βi=(βi(1),…,βi(K))′ are defined. Suppose that αi\\\alpha_iαi, that contains individual effects, does not change across time. Under these conditions of (yi,−K,…,yi,0)(y_{i, -K},…, y_{i,0})(yi,−K,…,yi,0) and (xi,−K,…,xi,0)(x_{i, -K},…, x_{i,0})(xi,−K,…,xi,0), both coefficients for yi,ty_{i,t}yi,t and xi,tx_{i,t}xi,t are given.

$\boldsymbol{H_0}: \beta_i \ = \ 0 \qquad \forall_i = 1, \dots, N$

$\boldsymbol{H_1}: \beta_i \ = \ 0 \qquad \forall_i = 1, \dots, N \qquad 0 \leq \frac{N_1}{N} < 1 \qquad \beta_i \neq 0 \qquad \forall_i = N_1 + 1, \dots, N$

**Null hypothesis ($H_0$)** For all units, the variable yyy does not Granger cause the variable xxx; that is, there is no causal linkage from yyy to xxx across any cross-section. According to the **alternative hypothesis ($H_1$)**, there is a causal relationship from the yyy variable to the xxx variable for all units (i.e., there is Granger causality from yyy to xxx for every cross-section).

The test statistic associated with the null hypothesis, which reflects the average statistic, is denoted as WN, THncW_{N,T}^{Hnc}WN,THnc. This statistic is defined as follows:

$$W_{N,T}^{Hnc} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \,, \qquad (17)$$

Here, the statistic Wi, TW_{i,T}Wi, T represents the individual Wald statistic for the cross-sectional unit iii, corresponding to the individual test for the null hypothesis H0:βi=0H_0: \beta_i = 0H0:βi=0. In the case where both TTT (time dimension) and NNN (cross-sectional dimension) approach infinity, the average statistic based on the asymptotic distribution is denoted as ZN,THncZ_{N,T}^{Hnc}ZN,THnc. When TTT is constant (with N>TN > TN>T), the average statistic based on the semi-asymptotic distribution is also represented by $Z_{N,T}^{Hnc}$.

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{Hnc} - K\right) \xrightarrow[T,N\to\infty]{d} N(0,1) \qquad (18)$$

$$Z_{N,T}^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E(W_{i,T})\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(W_{i,T})}} \xrightarrow[N\to\infty]{d} N(0,1) \qquad (19)$$

The causality test developed by Dumitrescu and Hurlin is effective even for panel data with a small number of units, providing robust results. The results of the causality analysis conducted using this method are presented in the following table.

**Table 9.** Dumitrescu-Hurlin Panel Causality Test Results

| Causality Direction | Wbar Statistic | Zbar Statistic | p-value |
|---|---|---|---|
| GINI ➔ CPI | 3,7289 | 9,6483 | 0,0000 |
| CPI ➔ GINI | 1,1200 | 0,4243 | 0,6713 |
| GINI ➔ INDTAX | 2,2259 | 4,3341 | 0,0000 |
| INDTAX ➔ GINI | 1,7554 | 2,6708 | 0,0076 |
| GINI ➔ HDI | 3,0855 | 7,3732 | 0,0000 |
| HDI ➔ GINI | 1,3234 | 1,1434 | 0,2529 |
| GINI ➔ PSI | 2,4812 | 5,2367 | 0,0000 |
| PSI ➔ GINI | 2,6836 | 5,9525 | 0,0000 |

A unidirectional causality has been identified from the Gini coefficient to the consumer price index, indirect taxes, and the Human Development Index (HDI). Furthermore, there is evidence of bidirectional causality between the Gini coefficient and the Political Stability and Absence of Violence/Terrorism Index. On the other hand, no causality from the other variables to the Gini coefficient was found. These results complement the findings from previous research that include Sharafat (2014a) and Günay and Topbaş (2021).

In the pairwise Granger causality test, Sharafat found that Gini and inflation are bidirectionally causal, and similarly, between the Gini coefficient and foreign direct investments. Likewise, in their study Günay and Topbaş (2021), by applying Dumitrescu-Hurlin Granger causality to BRICS countries data for 1990-2018, they found unidirectional causality from HDI to the Gini index and economic growth.

It further adds to the literature of interactions between inequality and macroeconomic variables and institutional stability with complex and context-dependent relationships reconfirmed.

## 5. CONCLUSION

Income inequality has to be understood basically from the economic and social point of view. Unequal distribution of income is not only a threat to the sustainability of economic growth but also acts as a fertile breeding ground for social unrest and political instability. Identification of the factors leading to income inequality becomes all the more imperative in this context for the formulation and implementation of healthy economic and social policies. Apart from being strictly an economic issue, income inequality touches on vital factors affecting social peace, welfare, and developmental goals. This paper, therefore, tries to analyze the causative elements of income inequality with a view to assisting policymakers in developing appropriate solutions.

In the paper, data from 25 OECD countries ranging from 2001 to 2020 are considered in order to study determinants of income inequality with the help of some econometric approaches. Cross-sectional dependence and heterogeneity were detected in this panel, and hence, for the unit root test on the series, second-generation tests have been used such as the test by Pesaran (2007) called CIPS Panel Unit Root Test. It detects the panel cointegration relations by using the Westerlund Panel Cointegration Test, where afterward the estimation of cointegration coefficients was done with the help of the Panel AMG analysis. A Dumitrescu-Hurlin Panel Causality Test was conducted to analyze the causal relationship among the variables. The results suggest that inflation, indirect taxes, the human development index, and political stability are some of the important factors that influence income inequality. Also deduced from these is the fact that increasing the consumer price index increases income inequality and indirect taxes, human development index, and political stability decrease income inequality.

From a policy perspective, the results show that inflation has a highly undesirable impact on income distribution. In the given scenario, low-income households should be protected from inflationary pressures via targeted social transfers and assistance programs. All these measures can bring short-term relief only. Over the long run, effective fiscal and monetary policies are called for to control inflation. In highly inflationary economies, a stronger sense of social policies and price stability go hand in glove with the intention behind the accomplishment of a more just distribution of income. The adverse effect of inflation on the low-income bracket groups calls for the introduction of policies that diminish these very effects and engender greater equality of income.

The results from the econometric analysis indicate that a high consumer price index increases income inequality, while indirect taxes, human development index, and political stability decrease income inequality. These are based on a wide range of studies in the literature. For instance, Sharafat (2014a) and Nantob (2015) have argued that inflation can lead to a rise in income inequality. Following Thiel (2016a), Khan et al. (2022b), social and political factors such as human development and political stability positively affect income distribution. Moreover, Demir (2020) found unidirectional causality from income inequality to imports of luxury goods, while Bilik highlights high and rapidly rising household debt as a cause of increased inequality. Bozkurt and Altıner (2024) also indicate that social spending can reduce general disparities, especially in the case of highly unequal regions. The findings underline manifold effects on income distribution and emphasize an integrated economic and social policy approach.

Moreover, the analysis brings out that indirect taxes can have a progressive effect on income inequality reduction, especially in the context of developed countries, which may be less pronounced in developing and less-developed countries. In these cases, it is important to bear in mind the design of indirect tax rates to fit into the social justice imperatives. Therefore, if indirect taxes bear down disproportionately more on consumption, they will result in increased income inequality, especially at lower-income levels. Hence, all tax reforms in developing countries should be integrated with social protection mechanisms that ensure equity.

The policymakers, therefore, need to have relative interest in reforming factors of human development index and political stability, which both positively influence the income distribution. The developed countries are to keep their policies to develop human capital but with relative interest in seeing the developing nations adequately supported with technical and financial resources to develop their social welfare apparatus. Such investment in education, health, and social security will, besides contributing towards human development, help to reduce income inequality in the long term. Developed countries can definitely make an important contribution to the process of development through financial assistance, transfer of knowledge, especially in education and health sectors.

In the final analysis, political stability positively impacts income distribution, emphasizing the desirability of a stable political climate in countries experiencing a high degree of polarization and instability. Political stability engenders domestic and foreign investment that catalyzes employment opportunities and, by implication, improves income distribution. A stable political climate is thus a sine qua non in the pursuit of economic and social development in countries. Political stability of a country increases domestic and foreign investments in developing countries, enables higher economic growth along with better equality of income. International organizations should support such programs as promoting political stability helps to minimize the effects of political disorder on income equality. Global efforts to reduce income inequality should be pursued more actively through sustainable development goals led by the United Nations and other international organizations. Combatting income inequality in less-developed countries requires not only financial aid and goods but also the development of social structures and educational infrastructure. The role of developed countries should go beyond providing financial resources; they should also ensure that these resources are used efficiently and effectively. In the long term, achieving economic development in less-developed and developing countries will only be possible through the implementation of structural reforms in education, healthcare, and social welfare.

From this, the following could be some future directions of research: studying the effect of exogenous environmental factors, such as carbon emissions and sustainable energy policies on income inequality in OECD countries; comparative country studies with regard to the mechanisms for social policy. This might clarify the effectiveness of their interaction in terms of affecting income inequality. Other future studies may also focus on digitalization and technological changes in terms of labor market and income distribution in order to illustrate how modern economies function. Expanding the scope of this study to include developing countries may expand the possibility to formulate global policy recommendations in order to address income inequality.

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