



A revisit to the relationship between globalization and income inequality: are levels of development really paramount?

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Abstract

The European Union is an important example of economic integration and regional cooperation. The expectation from the EU is to ensure a more equitable distribution of income among the members of the union. However, especially after 1980, inequality raises were seen within income groups and new members. It is aimed to determine the effects of the important determinants of globalization on the increasing inequality in the EU-28 countries by this study. The aim of this study is to determine the effects of important determinants of globalization on increasing income inequality in EU-28 countries. In the study, using data from 1995 to 2018, the relationship between globalization and income inequality was examined by panel quantile analysis method. The findings of the analysis helped us to see the effect of inequality variables within the various degrees of inequalities. It is aimed to contribute to the literature with the panel quantile approach, which we applied by examining the possible effects at different levels of development with different quantiles. In our study, we found that both trade openness and stock market capitalization reduce poverty at all levels of development. While R&D expenditure has a positive effect on medium and high levels of inequality, FDI at low and medium levels of inequality has a lowering effect on inequality. Finally, the effect of economic growth on income distribution increases inequality in all quantiles except the 90th. However, this effect of economic growth diminishes as the level of inequality increases and the GDP has an equalizing effect in the highest inequality countries.

Keywords Globalization · Income inequality · Economic growth · Technology advances · Quantile regression

JEL Classification F6 · E24 · O4 · O43 · N7 · C23

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1 Introduction

Globalization has had a greater impact on recent generations, particularly since 1980. This condition has an obvious influence on income inequality (Maskin 2014, 2015). Globalization can be explained as a multi-dimensional view that is articulated through a variety of mechanisms, such as financial and trade liberalization. Over the years, there has been great heterogeneity between countries and regions, as well as between cultures and skill classes in the globalization phase. One of the precedent theories for the “comparative advantage” of the international economy supports the increase of countries’ business specialization in competitive relative and international trade over their initial position. This heterogeneity, especially within and outside countries, causes adverse effects, such as increasing inequality. (Heshmati 2007). It is especially important to discuss the factors that create disparities for different levels of developed countries, their effects on citizens’ welfare, and the effects of countries’ skewed resource distribution.

The inequality impact of Globalization can be grouped into two samples; “less bad” and “worse” version. *In the first one*, inequality is the outcome of economic growth and can be tolerated within the country. *In the second one*, through globalization, low skilled workers’ wages decrease while high-skilled workers wages increase (Maskin 2014). Kuznets (1955) stated that income inequality increases until it reaches a certain income level, then inequality starts to decrease. While income rises with trade liberalization, this can cause inequality in gains and resource allocation when distributed between different parts of the community. For policymakers, it is necessary to know the causes of inequality in order to plan a successful agenda. This will allow increased wealth to be spread more efficiently in recent years, along with technological growth and globalization, than before inadequate allocation. Otherwise, growing inequality will lead to a response to economic liberalization and security pressures, which may also limit countries’ ability to take advantage of globalization (Jaumotte et al. 2013).

Globalization is not the only cause of income inequality issue, according to the studies reviewed in the literature. Globalization can bring both threats and advantages in an environment that has subsidized and promoted education and technological advancement through strong governance frameworks, and the potential for economic growth can also be realized. Moreover, globalization’s socio-economic importance cannot be discounted because it covers problems as well as macro-economic sustainability, such as wealth and economic output. The portion of the value-added allocated to labor hit a historically low level in 2006. In particular, this tendency is the product of technological development and globalization. This situation has a negative effect on social equity, economic success, and the stability of macroeconomics (Bernanke 2007; EU Commission 2007; Roach 2009; Atkinson 2013).

The long-standing EU, accelerating globalization and playing a vital role in global trade, is a prime example of international integration and regional cooperation. These countries of the Union have transferred their domestic, country-specific powers to the EU to govern the economy. Thus, in a changing global world, the European Union has expanded its powers to control the economy, while the Member States have limited their powers. This policy has been part of globalization’s phase of creation. In short, it is more appropriate to define the process as the co-evolution of globalization rather than the effect of globalization on the EU for stronger unity and its members who adapt by transferring their powers to the union (Walby 2009). Otherwise, the redistribution policies in the European Union are mostly under the authority of national governments. However, *the EU*’ regional policy can

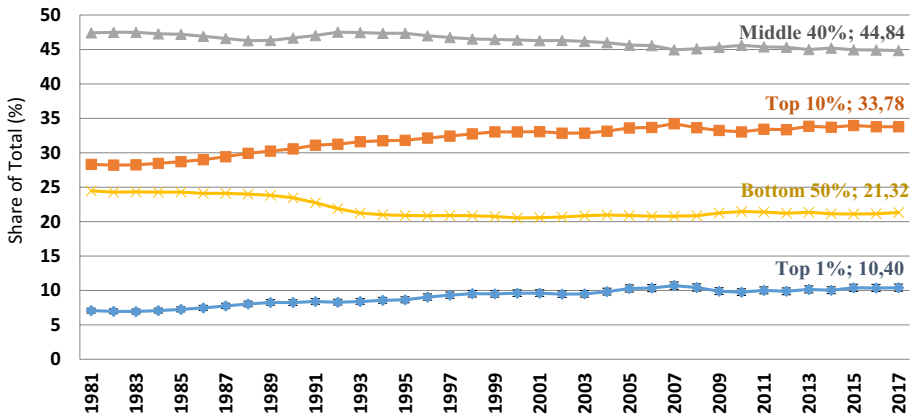


Fig. 1 European Union Income Inequality (1981–2017). *Source* World Inequality Database <https://wid.world>

be taken into consideration as a unity-wide policy that aims to reduce inequality between regions and makes it important to assess its potential contribution to inequalities. In addition, social cohesion concerns, including inequality within the European Union, are gaining momentum (Fredriksen 2012).

The income shares of the wealthy 1% of the globe is over 20 percent, according to the 2018 World Inequality Survey, and even under ambitious projections, it is believed that this rate may reach 24 percent in 2050. Also, it is stated that the share of the poorest 50% of the world can decrease from 10 to 9% (Alvaredo et al. 2018). Figure 1 shows the share of the European Union received from pre-tax national income according to income groups in the globalization process.

According to the Fig. 1, the highest 1% and 10% have continuously increased their shares from the income during this process, while the shares of the lowest 50% and the middle 40% on the other hand have constantly decreased. Inequality between income groups has gradually increased since high income group increased their share of national income. The income shares of the lowest 50% (24.47%) and the highest 10% (28.30) in the year the chart started were close, but the difference has widened gradually in the past 40 years (the difference is approximately 50%). While the increase in income inequality seems to have stopped after 2007, this can be explained by the negative effects of economic crises on globalization. Since crises have a decreasing impact on inequality in many countries by stagnating development. However, the fact that new countries joined the union in 2007, and in particular the strategy of extension to Eastern Europe, increased the disparities. The world's imbalance in the allocation of wealth continues to rise over time. It aims to provide new evidence in this study by analysing, in line with EU globalization, the factors that have an effect on inequality and income distribution.

The current global political environment has played a major role in the growth of FDI over the past 40 years. The growth of FDI has increased investment in technology and R&D spending. This process increased the demand for skilled workers with a high level of education and thus increased the labor wage gap. In addition, financial liberalization, an important element of globalization, provided an increase in expanded capital mobility (ILO 2004). The Information and Communication Technologies transition has strongly helped this rise. In this study the EU countries (28) has been selected, cause of the union that

experiences regional integration and builds an international economy and administration. These improvements have brought prosperity and economic growth in the region. However, the union has gradually increased inequality, as can be seen in Fig. 1, even though the degree of income inequality is lower than the world average.¹

It is important for economists to analyze the factors influencing the EU's issue of income inequality, as well as to assess their economic and income distribution implications. In this analysis, globalization, technology, education, trade, jobs, growth, and financial development factors that directly affect the data on welfare and economic development are used. The traditional OLS method cannot analyze the heterogeneous effects applied by globalization variables on different inequalities quantiles by presenting the full picture of the conditional distribution. The quantile regression has attracted the attention of many researchers and has been widely used in economic studies in recent years (Girma and Görg 2002, 2013; Dufrenot et al. 2010; Wang 2011; Chen and Lei 2018; Ren et al. 2019; Yan et al. 2020; Adebayo and Acheampong 2021; Alharthi et al. 2021). Using this quantile analysis, we have seen how the effects of variables change at various levels of income inequality. The advantage of panel quantile is that the distributional heterogeneity may be contained to see a comprehensive explanation of the linkage between globalization and income inequality at different quantile levels. Another contribution of this paper is to eliminate the omitted-variable bias confronted by earlier studies, several related control variables are taken into account in the models. The remainder of the paper has been scheduled accordingly. Section 2 reviews the literature for studies on relationships between globalization and inequality. Section 3 discusses the details, methods and analytical results and, the conclusion section includes analysis results evaluation and policy recommendations.

2 The globalization and income inequality nexus

Depending on a country's development trajectory, globalization can result in an increase or decrease in inequality. While globalization increases total income, it can be said that it increases income inequality within the country and between countries when the distribution is not equivalent. In this context, theoretical studies search for (Kuznets (1955), Kanbur (2000), O'Rourke (2001), Cornia (2004), Mills (2009), Milanovic (2002), Piketty and Saez (2003), Wade (2004), Heshmati (2007), Atkinson (2015), Kanbur (2015), Milanovic (2016), Bourguignon (2017)) the key questions whether the two factors, inequality, and globalization, are related. Do they even try to figure out how much the growth in inequality reflects globalization? And if a relationship exists, is it possible to do something about it, and what needs to be done?

Globalization and income inequality issues have been popular in the economic literature for many years. Globalization should be considered as a concept closely related to both the social and economic development of countries. Many studies show that globalization positively affects economic growth by increasing economic investments and employment and leads to developments that reduce income inequality (Haseeb et al. 2020). Globalization is generally measured by variables such as trade, financial development, and FDI. In the literature, the analysis of the effect of globalization on inequality has been extensively studied using different methodologies for various time periods and countries.

¹ According to 2016 World inequality data: {Top 1% = share % 20.4}, {Top 10% = share % 52.1}, {Bottom 50% = share % 9.7}, {Middle 40% = share % 38.2}.

According to country groups, European countries (Lee 2006; Beckfield 2006; Fredrikson 2012; Asteriou et al. 2014), OECD countries (Alderson and Nielsen 2002; Dreher and Gaston 2008), G7 countries (Balan et al. 2015; Çelik 2021), MENA Region (Benar 2007) and various examples of developed and developing countries (Adams 2008; Bergh and Nilsson 2010; Zhou et al. 2011; Jaumotte et al. 2013; Ezcurra and Rodríguez-Pose 2013), and single country examples, China (Wei and Wu 2001; Wan et al. 2007), South Korea (Mah 2003), Mexico (Borraz and Lopez-Cordova 2007), and Turkey (Ucal et al. 2016; Destek et al. 2020) with the help of various analyzes for different sample groups, the relation between globalization and income inequality has been examined. Empirical studies have obtained important findings and made useful policy suggestions for identifying sources of income inequality, and they also suggest ways to eliminate inequality problems. The link between globalization and inequality was investigated using multiple tests for different study classes. Although the results of these studies have influenced the different stages of economic growth of countries, it has been concluded that increasing globalization, typically in line with the hypothesis, has an opposite impact on income inequality. The following is a literature review that discusses the globalization and income inequality nexus through numerous econometric studies.

Lee (2006) examined the effect of globalization on income inequality in the EU between 1951 and 1992. According to a panel data analysis of 14 European countries, foreign direct investment has broadened tax inequalities. The study's results have also highlighted the acceptance of Kuznets' theory. Wan et al. (2007) also examined the relationship between globalization and regional income disparities in China during the 1987–2001 period by using GMM estimation and the findings show that globalization is increasing regional inequality. For 39 OECD and Balkan countries, Roy-Mukherjee and Udeogu (2021) found a positive correlation between globalization and income inequality by using the FGLS method over the period 1991–2017.

Adams (2008) carried out a panel study to identify the effect of globalization on income inequality, using evidence from 62 developing countries from 1985 to 2001. The paper has included the protection of intellectual property rights as a globalization component, and the results include the strong positive connection between intellectual property rights, access to markets, and revenues inequalities, and a negative correlation among FDI, business infrastructure, and income inequality. Dreher and Gaston (2008) performed GMM estimation on various country samples for the period between 1970 and 2000. The difference in industrial wages and household income has been measured using the results of the panel, and globalization has been found to increase inequality, especially in the case of OECD countries, while globalization has not had a major effect on inequality in less developed countries.

Bergh and Nilsson (2010) used GMM estimation for 79 countries for the dates the between 1970 and 2005 period. In their study, they emphasized that measures to improve economic mobility have raised inequalities in developed countries. It has also been found to be more necessary for less developed countries to achieve social globalization, with a neutral effect on inequalities from political globalization and monetary legal reforms. Jaumotte et al. (2013) analyzed the influence of trade, financial globalization, and technology on income inequality by applying panel regression analysis on 51 developed and developing countries from 1981 to 2003. While the analysis results support the hypothesis that technological change is an important factor in increasing inequality, it has been revealed that globalization has a relatively smaller effect. In comparison, the argument that the rise in foreign trade in literature leads to an increase in disparity is in contrast with the results. It represents two balance-sheeting implications of globalization. Expanding trade continues

to reduce income disparities, while FDI is increasing income gaps. And also, income inequality has risen in countries with medium and high incomes, in particular, and less in low-income economies. Also, Giri et al. (2021) support the technological progress, trade, and financial globalization positive effects on income inequality for India by using the ARDL method over the period 1982 to 2018.

Asteriou et al. (2014) estimated the econometric model for the exploration of the relationship between globalization and inequality between 1995 and 2009 using relevant panel data techniques for the European Union. According to this analysis, trade openness has a reduced effect on inequality, but the FDI, the openness of capital markets, and the capitalization of the stock market have an increased effect on inequality in all EU Member States. In particular, FDI was found to be the main reason for increasing inequalities in this region. Balan et al. (2015), examined the relationship of globalization and income inequality for G7 countries from 1970 to 2010. According to test results, for Canada, England, and France, globalization has positive effects on reducing income inequality. Globalization has been seen to exacerbate poverty and income disparity, particularly for Canada and the United Kingdom. Lee et al. (2020) analyzed the effect of globalization on revenue inequality for 121 countries with ICRG data using GMM estimation from 1984 to 2014. The findings show that increasingly globalized countries have high levels of inequality. Sethi et al. (2021) investigated the globalization and financial development effect on inequality for India from the 1980 to 2014 period by using the ARDL bounds test and found for both variables a negative effect. For 64 countries in the period 2003 to 2018, Ullah et al. (2021) found the same results by using the GMM method between globalization and income inequality relation. Within the same results were revealed by also using economic growth, e-government development, government expenditure, and inflation variables.

We aim to contribute to the existing literature by examining the effects of trade openness, a basic educated workforce, agricultural employment, information, and communications technology spending, gross domestic product, high-tech exports, stock market capitalization, and R&D expenditure on income inequality. Recently only a few studies have investigated the effect of several factors on inequality, most of them usually investigate singular or dual effects of variables. This paper investigates the effects of factors that may increase or decrease income equality for EU countries by using a new and robust econometric method quantile analysis.

3 Data, methodology and empirical results

3.1 Data

The analysis for the study uses yearly data for 28 EU countries covering the period 1995 to 2018.² As 10 different data are used in the analysis, the availability is the best country group for countries and the timeline for data availability is chosen. The dependent variable Gini was picked because this data displays the income gap in countries more effectively and was obtained from the Standardized World Income Inequality Database (SWIID v.9.1) released (Solt 2020). Furthermore, all data except the Gini are used as proxy components in order to define the association between economic globalization and income inequality.

² Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

Table 1 Data set

Name	Variable	Source
Gini coefficient	GINI	SWIID v.9.1
R&D Expenditure	R&D	WB-WDI
Trade openness	Trade _{opennes}	WB-WDI
Basic educated workforce	Lab _{basic}	WB-WDI
Foreign direct investment	FDI	WB-WDI
Information and communications technology spending	ICT	WITSA-EUROSTAT
Gross domestic product	GDP	WB-WDI
Agricultural employment	Emp _{agr}	WB-WDI
High-tech exports	HTE	WB-WDI
Capitalization of the stock market	SMC	WB-WDI

GINI denotes Gini coefficient, R&D implies Research and development expenditure (% of GDP), GDP is real GDP, FDI shows Foreign direct investment (net inflows), SMC is Stock market capitalization (% of GDP), LAB_{basic} is Labor force (with basic education) % of the total working-age population with basic education), TRADE_{opennes} is Trade openness Ratio of exports and imports to GDP (%), HTE is High-technology exports (% of manufactured exports) and EMP_{agr} is Employment in agriculture (% of total employment)

All used data is derived from EUROSTAT, IMF, WITSA and World Bank WDI databases as seen from Table 1, while all variables are represented in logarithms.

3.2 Methodology

This Quantile methodology offers various advantages over classical regression methods and this approach provides a great advantage since the regression can accomplish conditional quantile estimation and estimate the behavior of each specific point in the conditional distribution (Alharthi et al. 2021). The quantile regression models are employed to define the income diversity survey by the log of the Gini as a function of R&D, GDP, FDI net inflows, HTE, Stock market capitalization, Stok market turnover, Labor, Trade openness, percentage of exports and imports to GDP (%), Employment (agriculture), Capital Account Openness and ICT in a panel quantile specification Firstly, there is an accounting function-built for the fundamental production function:

$$\text{GINI} = f(\text{R\&D}, \text{ICT}, \text{HTE}, \text{EMP}_{\text{agr}}, \text{LAB}_{\text{basic}}, \text{GDP}, \text{TRADE}_{\text{opennes}}, \text{SMC}, \text{FDI}) \quad (1)$$

This model allows us to examine the factors that drive income inequality at various quantitative stages. In areas of inequality-globalization, data also have a sharp peak or thick tail. Compared to the ordinary least squares method, quantile regression does not require strong estimates for error terms, in this case, the quantile regression can supply more robust estimation results (Koenker and Bassett 1978). Quantile regression can be more detailed in explaining the conditional distribution of the variables explained, rather than merely evaluating the conditional expectations of the variables explained. Regression coefficient estimators often vary between quantiles, i.e. the results of explanatory variables on the variables are different between quantiles (Yan et al. 2019).

OLS regression is the minimum variance unbiased estimator. First, if the random disturbance term of the OLS regression has a zero mean and is identically distributed (i.i.d.). Second, if the error term is a normal distribution. Nonetheless, De Silva et al. (2016) stated that these assumptions are not true in real economic life since the data of socioeconomic indicators may have different distributional patterns. The quantile regression estimation technique established by Koenker and Bassett (1978), is a widely used method to overcome the limitations of the ordinary least-square (OLS) approach. The motivation for implementing the quantile regression estimation technique is threefold. First, as argued by Zhu et al. (2016a, b) quantile regression does not make any assumptions about the presence of moment function. Next, the quantile regression supplies direct and robust findings in the existence of outliers and heavy-tailed distributions (Bera et al. 2016). Finally, quantile regression is an analysis method that does not take into account any dispersion assumptions (Koenker 2004; Sherwood and Wang 2016).

The panel linear regression Eq. (1), the matrix notation behind it and the quantitative regression form to be used in our study are as follows:

$$y_{it} = \alpha_i + \beta(q)x'_{it} + u_{it} \tag{2}$$

The number of countries is symbolized with the symbol i and the time dimension with t . The dependent variable in the model, on the other hand, indicates the real GDP, while the vector x represents all independent variables explained in Eq. (1). Here q indicates the quantity of the conditional distribution ($0 < q < 1$) and α indicates the presence of fixed effects. In our model, the effect of variables X is allowed to depend on quantitative q , whereas fixed effects are not α_i . Following Koenker (2004) in the model, the estimation of Eq. (2) is made and in the next step, the equation is obtained by solving the minimization problem simultaneously:

$$\min_{\alpha\beta} \sum_{k=1}^{\tau} \sum_{j=1}^n \sum_{i=1}^{mi} w_k \rho_{qk}(y_{ij} - \alpha_i - \beta(q_k)x_{ij}) \tag{3}$$

The piecewise linear quantile loss function $Pqk = u(q - I(u < 0))$ given by Koenker and Bassett (1978). Weights w_k focuses on the effect of quantiles $\tau (q_1, \dots, q_{\tau})$ on α_i parameters and controls this effect. In empirical studies where the number of divisions is larger than m time dimension (as seen in our globalization and poverty model), then the estimates contain a large number of influences that can significantly overstate the variability of other coefficient estimates. On the other hand, Koenker (2004), on the other hand, thinks of a penalty in his study and allows this inflated individual effect to be regulated or reduced towards a common value. This method, called penalized quantile regression in the literature, transforms into the following model equation by constant effect:

$$\begin{aligned} \min_{\alpha\beta} \sum_{k=1}^{\tau} \sum_{j=1}^n \sum_{i=1}^{mi} w_k \rho_{qk} \{ & \text{GINI}_{i,t} - \alpha_{1\tau} \text{R\&D}_{i,t} - \alpha_{2\tau} \text{ICT}_{i,t} - \alpha_{3\tau} \text{HTE}_{i,t} - \alpha_{4\tau} \text{EMPagr}_{i,t} \\ & - \alpha_{5\tau} \text{LABbasic}_{i,t} - \alpha_{6\tau} \text{GDP}_{i,t} - \alpha_{7\tau} \text{TRADEopennes}_{i,t} - \alpha_{8\tau} \text{SMC}_{i,t} - \alpha_{9\tau} \text{FDI}_{i,t} \} \\ & i = 1, \dots, N, \quad t = 1, \dots, T \end{aligned} \tag{4}$$

where $p_{\alpha} = P(\alpha) = \sum_{j=1}^n |\alpha_j|$ is the penalty considered.

The Dumitrescu and Hurlin (2012) causality test is a method for determining whether two series are causally related. This method is very advantageous, because that it can take

Table 2 Descriptive statistics

Variables	Obs.	Mean	SD	Min	Max
GINI	672	1.1553	0.6034	0	1.6042
R&D	672	0.0564	0.2623	- 0.6963	0.5926
GDP	672	11.26892	0.7027	9.7456	12.5950
FDI	672	8.9538	2.7610	0	11.8650
HTE	672	0.4665	0.5294	0	1.6222
Lab _{basic}	672	1.4428	0.4230	0	1.8393
SMC	672	1.2703	0.6892	- 1.5864	2.3930
Trade _{open}	672	1.9064	0.4464	0	2.6195
Emp _{agr}	672	1.8094	0.0756	1.4581	1.9447
ICT	672	0.3380	0.3516	- 0.0458	1.0531

into account both cross-sectional dependency and heterogeneity among samples that make up the panel, the unbalanced panel data yield successful outcomes and the time dimension can be used where the cross-section dimension is greater (or less). A further aspect of the evaluation is that co-integration relationship results can be implemented regardless. In the DH method, when X and Y entitle two stationary processes pursued during the T period for the N units, the unit helps determine the linear heterogeneous model in Eq. (5) for each unit (i) at time t:

$$Y_{i,t} = \alpha_i + \sum_{k=1}^K \gamma_i^k Y_{i,t-k} + \sum_{k=1}^K \beta_i^k X_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

The null hypothesis of the test is “X does not Granger cause Y” total cross-sections, and K is the ideal lag length. Table 2 offers some descriptive statistics and explains thoroughly all the country samples involved in the analysis.

3.3 Empirical results

After descriptive statistics are given, firstly, the degree of integration of the relevant factors is calculated by a second-generation panel root unit test. In order to remove the cross-sectional dependence, the Pesaran (2007) root unit test requires no estimate of factor loading cross-sectional dependence. The null hypothesis is a unit root for the Pesaran (2007) test. Table 3 reports the findings of this test and confirms the stationary in all panel variables in the first differential stage.

Table 4 outlooks Eq. 1 and the whole study by quantile estimates (low-income inequality between 10 to 25%; middle-income inequality—50%; high-income inequality between 75 to 90%). The effects of GDP, technology, employment, trade, and financial globalization variables on the GINI dependent variable were estimated using quintiles from 10 to 90% (Fig. 2).

The OLS and quantile regression results indicate a statistically significant impact of globalization on income inequality. Results of quantile regression and OLS in Table 4 show that the effect of economic growth on income distribution increases, inequality in all quantiles except the 90th. However, this effect of economic growth diminishes as the level of inequality increases and the GDP has an equalizing effect in the highest inequality countries.

Table 3 CIPS panel unit root tests

H ₀ : contain a unit root		
Variable	Level	First difference
GINI	- 2.828***	- 4.546***
R&D	- 1.066	- 3.476***
GDP	- 0.086	- 2.021***
FDI	- 3.282***	- 4.309***
HTE	- 2.584***	- 2.732***
Lab _{basic}	- 3.223***	- 3.266***
SMC	- 1.652	- 2.798***
Trade _{open}	- 1.800***	- 3.033***
Emp _{agr}	- 1.164	- 3.167***
ICT	- 2.395***	- 3.214***

***1% statistically significance levels

Table 4 Panel quantile regression results

Variable	Quantiles (dependent variable = GINI)					
	Ols	10%	25%	50%	75%	90%
C	- 0.6272*	- 0.5201***	- 0.6376*	- 0.3682***	0.8746***	1.4485***
R&D	- 0.1036	0.1134***	0.3909***	- 0.1388***	- 0.1372***	- 0.1087***
GDP	- 0.0882**	0.0472***	0.0344***	0.0294***	0.0116***	- 0.0082***
FDI	- 0.0114	- 0.0130***	- 0.0141***	- 0.0028***	- 0.0006***	0.0017***
HTE	0.4515***	1.0512***	0.8053***	0.1146***	0.0425***	0.0158***
Lab _{basic}	0.4145***	0.0080*	0.1868***	0.8346***	0.2611***	0.0610***
SMC	0.0684*	- 0.0213***	- 0.0324***	- 0.0074***	0.0133***	- 0.0061***
Trade _{open}	- 0.0684	- 0.0288**	- 0.0535***	- 0.0198**	0.0115***	- 0.0128***
Emp _{agr}	0.04705	0.0278***	- 0.0589***	0.0491***	0.0545***	0.0278***
ICT	0.2108***	- 0.0027	0.1331***	0.0971***	0.0206***	0.0107**

*10%, **5% and ***1% mean statistical significance levels.

Secondly, with implications for technology globalization, the effect of R&D on inequality tends to rise up to 50th, and at middle and high inequality level, R&D expenditures have an equalizing effect. While the effect of High Technology Exports (HTE) to increase inequality is high, this effect decreases as the level of inequality increases. In the 25th–75th ranges, Information and Communications Technology spending (ICT) has a favorable influence on reducing inequality yet while the inequality increases, this effect gradually decreases.

In order to see the impact of globalization on employment, we chose agricultural employment and a basic educated workforce. Because the findings support that the level of employment that is most affected by income inequality, workers in jobs requiring low skills and workers who do not have advanced training. According to the analysis results, the increase in agricultural employment and the increase in the share of the workforce with basic education in employment increase the income inequality.

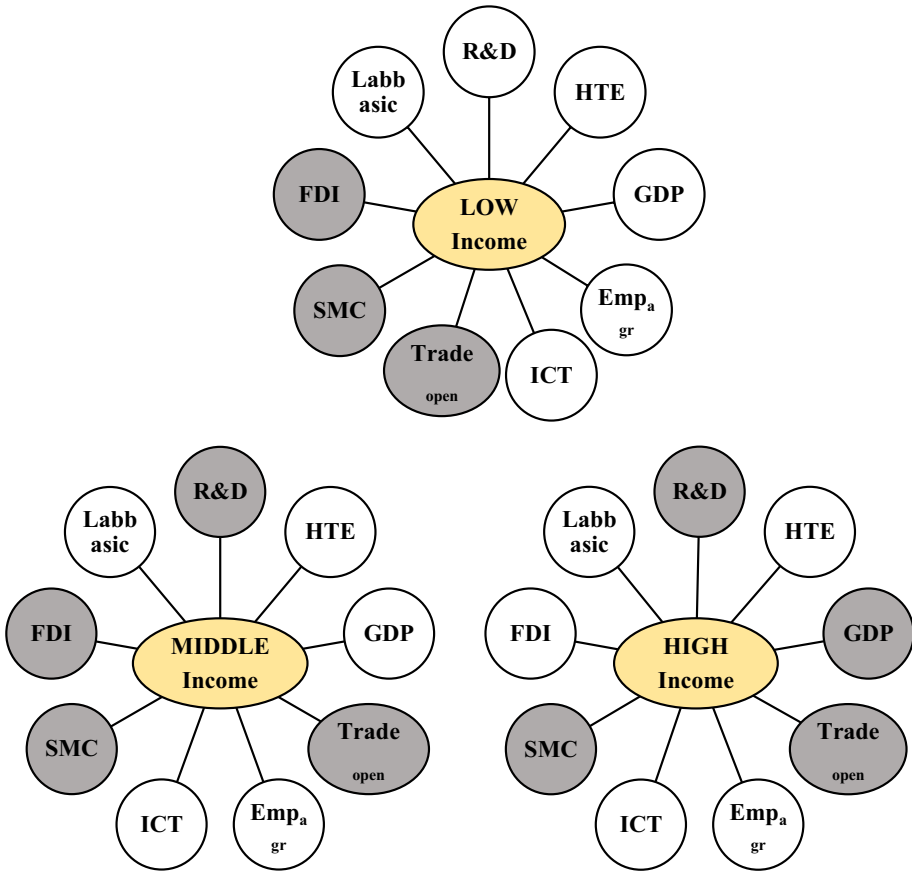


Fig. 2 Graphical expression low, middle and high income inequality level of the relationship between independent variables and Income inequality (The effects of variables included in the model on inequality: Gray colored ones show negative effect and white ones show a positive effect.)

FDI has an effect that increases inequality at a high level of income inequality, while it has an effect that reduces income inequality at low and medium-income inequality. Also, the openness to trade and the capitalization of the stock market as the financial globalization variables have the effect of reducing income inequality at all levels of inequality.

There is no consensus among economists on the direction of economic openness or its integration to the international economic systems effects on income distribution. For example, in analyzing developing countries according to their level of development Meschi and Vivarelli (2009) found that trade only with high-income countries weakens the deployment of earnings through both imports and exports in developing countries. In the literature, Asteriou et al. (2014) and Jaumotte et al. (2013) found that trade openness has the effect of reducing inequality. However, in this study, the trade openness variable has a positive effect at 75% of the inequality level quantile (like in the study by Goldberg and Pavcnik (2007)) and at other quantiles, especially between 25 and 50% seems to tend to reduce inequality. Furthermore, the rise in FDI has a positive influence on inequality, while Adams (2008) has observed a negative effect, as found by Lee

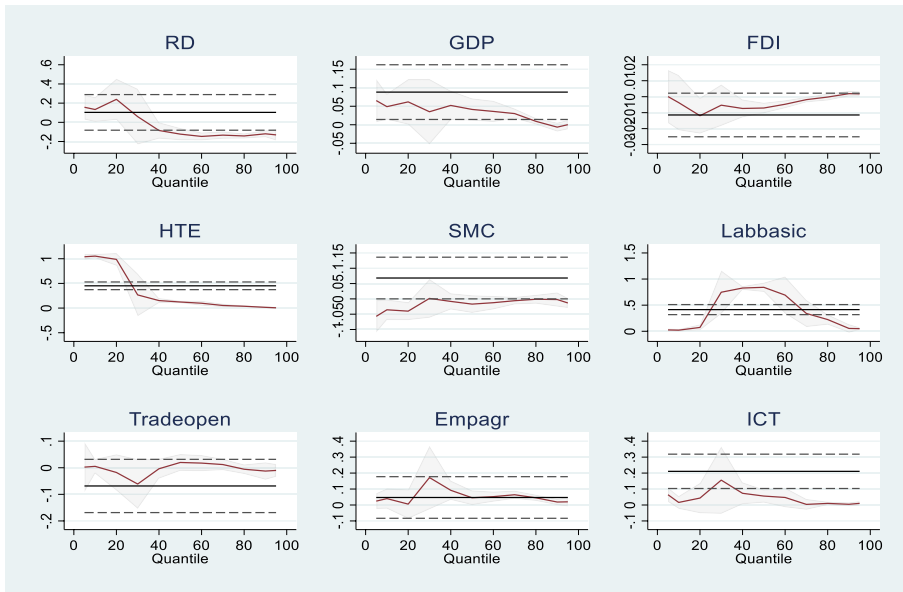


Fig. 3 The impact of influencing factors of the globalization's income inequality. Notes: The red curve demonstrates the impact of influencing factors on income inequality at different quantiles. The blue straight line specifies the results of the least-squares regression. The black dotted line represents the 95% confidence interval of the least-squares regression. The shaded area symbolizes 95% confidence interval for the quantile regression

(2006), Jaumotte et al. (2013), and Asteriou et al. (2014). This analysis indicates that FDI has a positive effect at the highest level of inequality (90%), while it has a negative effect on the other levels of inequality. Although FDI appears wavy at amounts where inequality decreases, it has a good degree of inequality reduction of up to 50 percent.

For the technology globalization-inequality relationship, Jaumotte et al. (2013) found observational evidence that technological improvement plays a major role in rising disparities. On the other hand, in this analysis findings are examined, one of the technology variables R&D expenditure's effect on inequality tends to increase up to a 50th, and as the inequality increases at 50% and above, R&D expenditures have a negative effect on income inequality. HTE has a high effect of increasing income inequality, while this effect decreases as the level of inequality rises, ICT has a positive effect on reducing inequality, especially in the range of 25th -75th, However, as inequality increases, the positive effect decreases (Fig. 3).

The study of long-term relationships between variables has provided valuable results, and it also has explored the possibility of causal interaction between the variables. Table 5 demonstrates the effects of the short-term approximation of the causality of the DH panel, under the conditions of cross-sectional dependence.

The results indicate the importance of independent variables included in the short-term analysis on account of income inequality. Additionally, are supported by statistically valid income inequality coefficient estimates. According to the results of causality, there is bidirectional causality between GINI and GDP, HTE, Trade_{open}, and Emp_{agr}. Also, there is unidirectional causality from R&D to GINI. However, there is no

Table 5 DH causality test results

Hypothesis	GINI → R&D	GINI → GDP	GINI → FDI	GINI → HTE	GINI → SMC	GINI → Lab _{basic}	GINI → Trade _{open}	GINI → Emp _{agr}
Z-bar	0.5001	13.0017***	1.5003	4.0114***	0.2074	0.4036	10.2897***	6.1081***
Decision	No	Yes	No	Yes	No	No	Yes	Yes
Hypothesis	R&D → GINI	GDP → GINI	FDI → GINI	HTE → GINI	SMC → GINI	Lab _{basic} → GINI	Trade _{open} → GINI	Emp _{agr} → GINI
Z-bar	4.9648***	- 1.960**	0.9356	4.6130***	- 0.2259	0.3787	- 2.8970***	- 2.5497**
Decision	Yes	Yes	No	Yes	No	No	Yes	Yes

** and ***5% and 1% statistically significance levels
 Bold indicates that there is no causal relationship

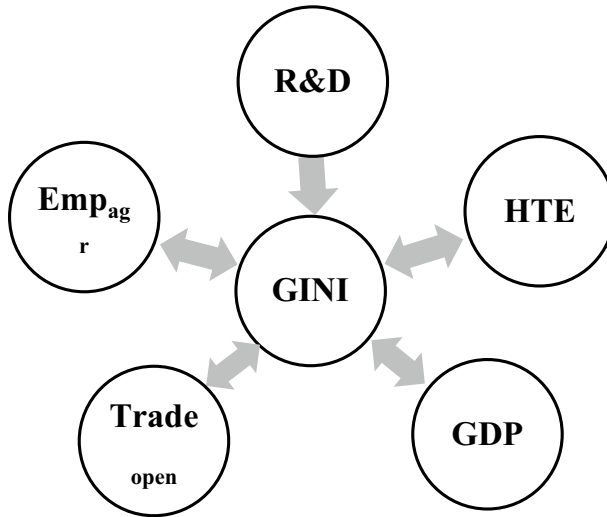


Fig. 4 Graphical expression of the causality between independent variables and Income inequality

relationship between FDI, SMC, Lab_{basic} and income inequality because it will be hope meaningful for the long-run causality (Fig. 4).

4 Conclusions and policy implications

This research analyzed with a new analysis method the relationship between income inequality and globalization for 28 EU countries in the data duration from 1995 to 2018. Whereas the dependent variable, the GINI coefficient is taken into account. In order to explain ever-increasing income inequality in EU countries, basic factors such as technology, finance, education, economic growth, and trade were used to investigate the effects of globalization on inequality with which variables could be explained more meaningfully. In order to explain the roots of inequalities and explore a connection between rising inequality and globalization, numerous literature studies have been undertaken. Many policy guidelines to ensure fair distribution of rising national well-being were also produced on the basis of these studies.

According to this panel quantile analysis and OLS, the effects of variables differ while the level of inequality changes. In the literature, previous studies have inadequate to explain this heterogeneous structure. The empirical findings show that income inequality has been grouped into three basic levels and revealed that the selected variables can have different effects on different levels of inequality. This shows that the effect of economic growth on income distribution increases inequality in all quantiles except the 90th. However, this effect of economic growth diminishes as the level of inequality increases and the GDP has an equalizing effect in the most unequal countries. These empirical results are close to Kuznets' hypothesis of the relationship between development and income distribution. For EU countries that have different levels of development, the GDP has a positive and high effect at low levels of inequality, while this effect tends to decrease as the level of

inequality increases. And GDP has an equalizing effect on the countries with the highest inequality.

For technology variables, the effect of R&D on inequality tends to rise up to 50th, and at middle and high inequality levels, R&D expenditures have an equalizing effect. While the effect of High Technology Exports (HTE) to increase inequality is high, this effect decreases as the level of inequality increases. In the 25th–75th ranges, Information and Communications Technology spending (ICT) has a favorable influence on reducing inequality yet while the inequality increases, this effect gradually decreases. And, the increase in agricultural employment and the increase in the share of the workforce with basic education in employment increase income inequality. In fact, these variables have a direct relation to the FDI and technology variables, since individuals who have a high-level education, easily use new technology, and get high wages in return. In the labor market demand for low-educated and low-skilled individual's decreases and so skill-based wage differentials increase (Acemoglu 2002; Weiss and Garloff 2005; Goldberg and Pavcnik 2007); ;). FDI has an effect that increases inequality at a high level of income inequality, while it has an effect that reduces income inequality at low and medium-income inequality. Also, the openness to trade and the capitalization of the stock market as the financial globalization variables have the effect of reducing income inequality at all levels of inequality. Also, since FDI mostly takes place in technology-intensive and skill-demanding sectors, an increase in Emp_{agr} and Lab_{basic} has an augmentative influence on income inequality.

The rising disparity in most countries has been one of the main threats to both developed and emerging countries in recent decades. It is hard to make a common policy offer for countries that have different development and inequality level within the European Union. However, the present analysis illustrates the value of a policy strategy to counter growing inequalities. In particular, the analysis results show that, contrary to Dreher and Gaston (2008), generally globalization has an effect on the EU that reduces inequality rather than increasing it. Countries that have high-income inequality should pay attention to R&D spending, stock market openness, trade, and a well-designed labor market with high education levels. There is an important link between inequality and human capital. The evidence strongly means that high-level inequality negatively affects the ability of low-income individuals (agricultural Employe and the labor force with basic education) to invest in their human capital, both in terms of high and advanced education. Accordingly, policymakers' education policy should focus on improving access by low-income and low-skilled groups who are more sensitive to increases in inequality. The fact that there are new members joining the Union, the level of inequality and welfare of some countries are very high, shows that country-based work will provide clearer evidence in future studies.

There are many topics that should be addressed in future studies (such as government policies, uncertainty, poverty, etc.) using other measures for income distribution. In addition, forming groups according to the shares taken from the national income in the measurement of income inequality and analyses for these groups can provide more detailed results in future studies.

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